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"QUALITATIVE CHARACTERIZATION OF PRETREATED FRUIT WASTE TO PRODUCE AN EFFECTIVE FERTILIZER BY USING FTIR"

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Abstract-

The production of biowaste increasing day by day, due to the more availability raw material especially from lignocellulosic based material become resistant for their degradation and recovery of valuable material. To overcome this problem several pretreatments, apply on the biomass. The aim of this work was to pretreat the agro-waste with physical, chemical as well as physicochemical pretreatment to produce the bio stimulant for better yield and to investigate the transformation of structure of compounds in organic matter and their relation with stability of organic matter during the pretreatments. Raw material was taken from the field of agriculture. The pretreated biowaste evaluation was monitored by infrared spectroscopic analysis. Through the Flurorier Transformed Infrared Spectroscopic analysis shows the chemical nature of raw as well as pretreated material to determine changes in chemical nature of fruit waste. The qualitative characterization of pretreated fruit waste is beneficial to produce a biofertilizer which is direct food source to the microflora of soil.

***Keywords*: Fruit waste, Pretreatments, Infrared spectroscopy**

Introduction-

Agricultural sector is the backbone of Indian economy. India has a huge area under the cultivation on the comparison of the world but due to some industrial, economic and environmental reasons we lost our good texture of soil. Pollution is also one of the reasons for infertile soil. To improve such quality of soil we supply the micronutrients and macronutrients with the help of biostimulents on the basis of quality of soil.

Biostimulents have various benefits, beside taking nutrients for intake as well as residual. Number of biostimulent's provide the growth promoting factors to crop and some have been totally facilitating the composting and beneficially recycle the huge solid waste generated in to the area of agricultural sectors. Scientific and hygienic waste disposal is serious question in developing countries specially in urban area where the population density is high and availability of land for waste processing and disposal is limited (C.R. Sudharmaidevi et. al. 2016)

Lignocellulosic biowaste like fruit peels are basically made up of cellulose, hemicellulose, pectin and small amount of lignin for production of biostimuents pre-treatment is important tool for conversion of cellulosic biomass pre-treatments are generally efficient processes to reduce the time duration in between biostimulent formulation. The lignocellulose containing biomass do not directly compete with food production. This is waste basically unusable and in huge quantity. And such a production of humates from bio-waste rich in carboxylic acid and (O and N) containing functional group can influence the plant growth directly by complexing with a nutrient cation in the growing medium resulting in enhance uptake of nutrients by plants (H. S. S. Sharma et.al. 2016)

The stage of pre-treatment and stabilisation of the organic matter in selected bio-waste originating from the agriculture sector were detected by number of different technique but the simplest and most useful technique available in literature survey was FTIR (Flurorior transformed infrared spectroscopy) which gives reliable results from the given data provided to the FTIR

Now a day bio stimulant is considered as a good alternative to chemical fertilizer in the field of agriculture sector. The objective of the study is to identify simplified chemical nature of material which is pre-treated by physical, chemical and physicochemical processes. This technique is reliable, fast and capable to identify status of functional group present in the bio-waste material and which gives reliable data of the fertilising ability of pre-treated bio-waste material. (S. A. Bhat et.al. 2017)

The investigation provides us detail about chemical constituent and their behaviour during the pre-treatment processes (Ena smidt et. al. 2005). FTIR gives detail information of chemistry and changes happens in bio-waste material which are physically, chemically and physicochemical pre-treated. Different indicator bands that are referred to number of functional groups shows the components present in pre-treated bio-waste. The rapid analysis of the stage of bio-waste decomposition is beneficial field of application so FTIR therefore it is important tool for processes and quality control for analysis of bio-waste material. Their presence of intensity or their absence shed light on the phase of degradation and stabilization is the basic principle of FTIR (Ena smidt et. al. 2007)

Material and Method.

Materials and methods-

1. **Physical pretreatment**

Physical pretreatment carried out to minimize the particle size that increase the surface area and reduce in degree of polymerisation and crystallinity. The common physical treatments are milling, extrusion, microwave treatment, ultrasonication etc. In which milling and extrusion were done. Milling process is important for the reduction of particle size and increases in surface area of biowaste to treat the biowaste.

Microwave pre-treatment

In this pre-treatment, microwave treatment with water alone is carried out to conversion of feedstock. This treatment was carried out in conical flask containing 10 gm biowaste with 10 ml water alone at microwave for 10 minutes at 100^0 C. (Jian x. et. al. 2015)

Steam explosion pre-treatment

In this pre-treatment, Steam explosion treatment with water alone is carried out to conversion of feedstock. This treatment was carried out in conical flask containing 10 gm biowaste with 10, 20,30,40,50 ml water in each flask respectively at autoclave for 15minutes at 15 PSI pressure at 121^0 C. (Jian x. et. al. 2015)

2. **Chemical pretreatment**

Chemical pre-treatments are carried out to simplify the complexity of bio waste after the physical treatments. The common chemical treatments are use of acids and alkali by the literature survey. Acids like H_2SO_4 and HCl and alkali like NaOH and KOH were used to reduce the cristanality of complex organic matter. Various concentrations of each dilute acids and dilute alkali having normality 0.1N, 0.2N, 0.3N, 0.4N, 0.5N were used to treat the feedstock separately. Likewise, such a number of concentrations of each dilute acids and dilute alkali having normality 0.1N, 0.2N, 0.3N, 0.4N, 0.5N were used to treat the feedstock with 40 probable number of ways with each normality of acid with each and every normality of alkali. From the analysis of different test five samples were checked at Infrared Spectroscopy.

3. **Physicochemical pretreatment-**

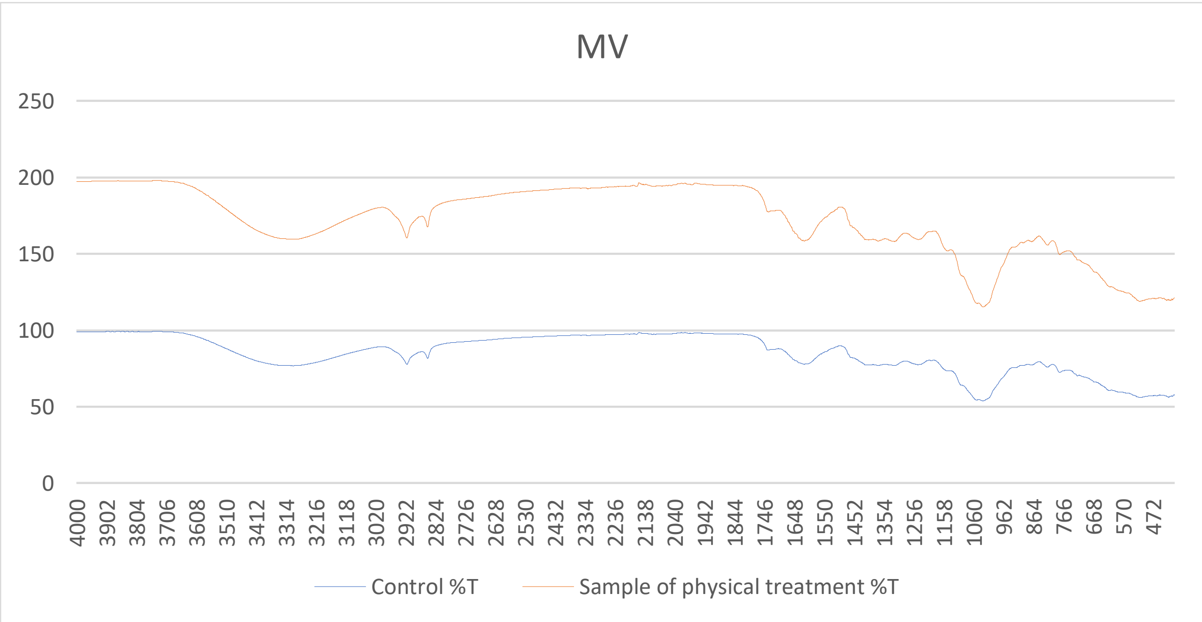
Physicochemical treatments are also carried out on the basis of literature survey. In which same chemicals, Acids like H_2SO_4 and HCl and alkali like NaOH and KOH were used with physical treatments of microwave and steam explosion. Here also Various concentrations of each dilute acids and dilute alkali having normality 0.1N, 0.2N, 0.3N, 0.4N, 0.5N were used to treat the feedstock with 40 probable number of ways with each normality of acid with each and every normality of alkali. From the analysis of different test five samples were checked at Infrared Spectroscopy.

Result & Discussion

1. **Physical pretreatment**

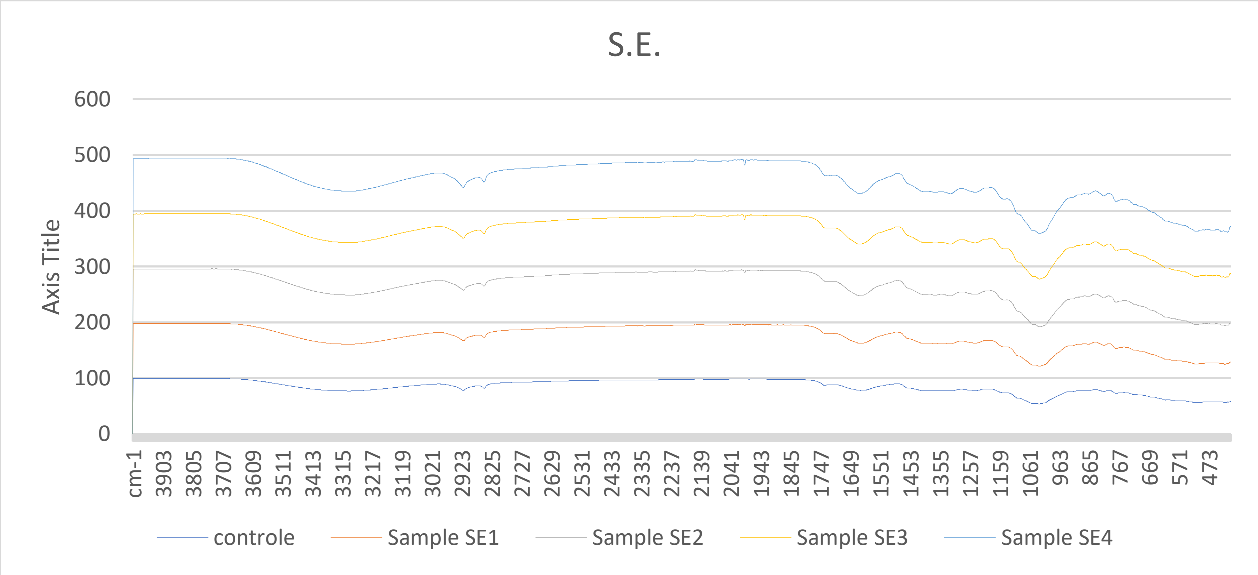
i) **Microwave treatment-**

In physical pretreatment, there is increase in new surface area, generates high porosity as well as bulk density. The FTIR specta were used to determine chenges in structure of cellulose, hemicellulose, lignin and pectin present basically in biowaste selected for the study.



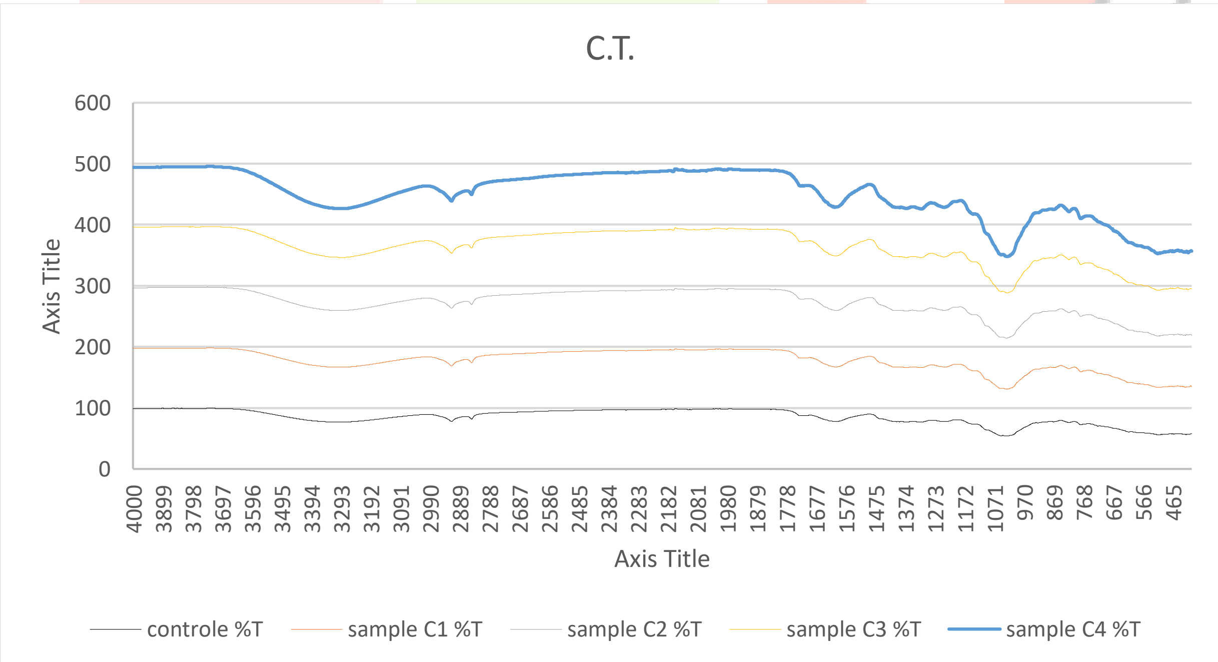
The band at 899.95 cm-1 is the characteristic of B1-4 glyosidic bond of cellulose. The range between 1200-1100 cm-1 is the region of hemicellulose and cellulose, which attained a maximum value around 1060 cm-1 due to C-O stretching. A band around 1452 cm-1 is deformation of lignin CH2 and CH3 and 1648 cm-1 is reported to be stretching of C=C stretching of unconjugated hemicellulose again the peak at 2922 cm-1 is due to asymmetric stretching of CH2 and CH which shows characteristics of cellulose. The region between 3800-3000 cm-1 shows a crystalline structure of cellulose and covers the sum of vibration of valence bond of H of O-H group and intramolecular and intermolecular H bond.

ii) Steam explosion treatment



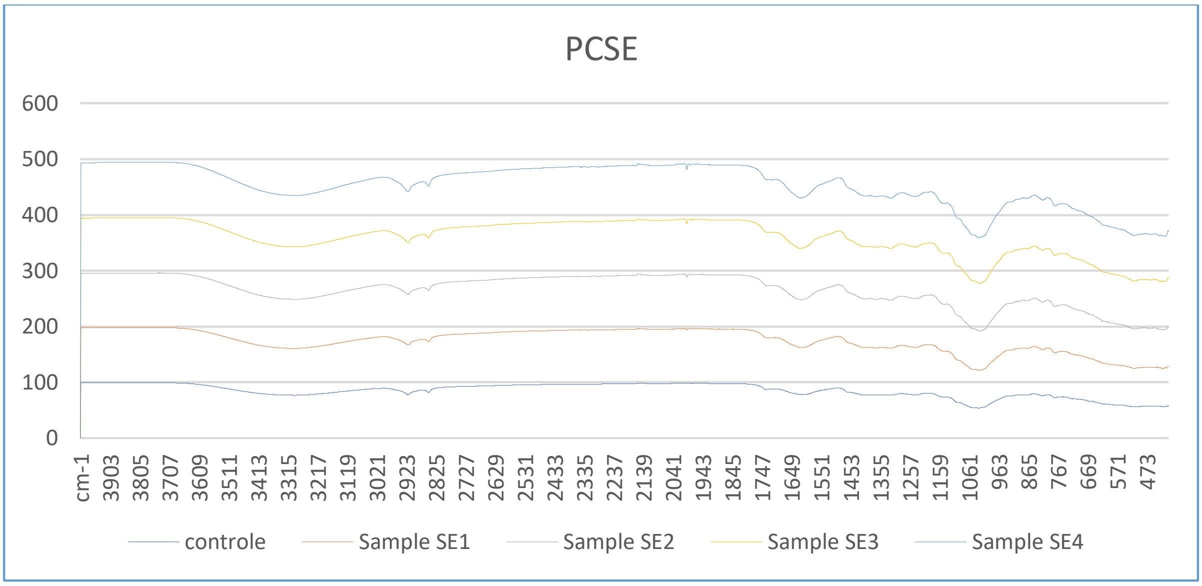
The peak at 865 indicates CH deformation of cellulose. The range between 1200-1100 cm-1 is the region of hemicellulose and cellulose, which attained a maximum value around 1061 cm-1 due to C-O stretching. A band around 1453 cm-1 is deformation of lignin CH2 and CH3 and 1649 cm-1 is reported to be stretching of C=C stretching of unconjugated hemicellulose and peak at 1740-1720 cm-1 indicates the C=O Saturated xylenes present in hemicellulose in which graph shows peak at 1747 cm-1 again, the peak at 2923 cm-1 is due to asymmetric stretching of CH2 and CH which shows characteristics of cellulose. The region between 3800-3000 cm-1 shows a crystalline structure of cellulose and covers the sum of vibration of valence bond of H of O-H group and intramolecular and intermolecular H bond.

2. Chemical pretreatment



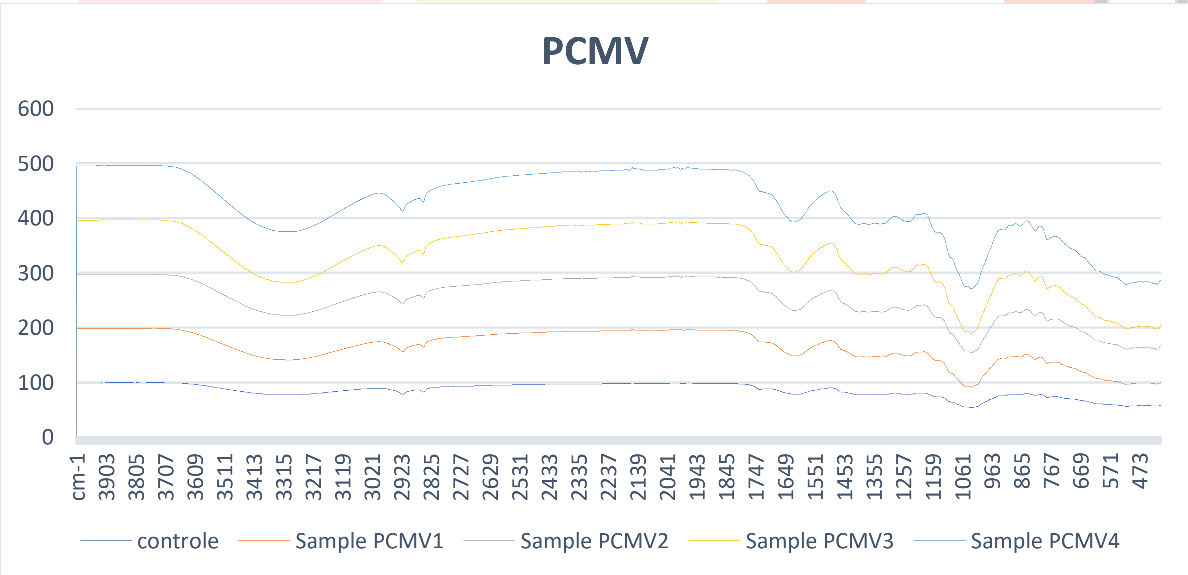
The band at 897 cm-1 is the characteristic of CH deformation of cellulose. The range between 1200-1100 cm-1 is the region of hemicellulose and cellulose, which attained a maximum value around 1060 cm-1 due to C-O stretching. A band around 1452 cm-1 is deformation of lignin CH2 and CH3 and 1647 cm-1 is reported to be stretching of C=C stretching of unconjugated hemicellulose again the peak at 2922 cm-1 and 2824 cm-1 are due to asymmetric stretching of CH2 and CH which shows characteristics of cellulose. The region between 3800-3000 cm-1 shows a crystalline structure of cellulose and covers the sum of vibration of valence bond of H of O-H group and intramolecular and intermolecular H bond.

3. Physicochemical pretreatment-



The range between 1200-1100 cm-1 is the region of hemicellulose and cellulose, which attained a maximum value around 1061 cm-1 due to C-O stretching. A band around 1453 cm-1 is deformation of lignin CH2 and CH3 and 1649 cm-1 is reported to be stretching of C=C stretching of unconjugated hemicellulose and peak at 1740-1720 indicates the C=O Saturated xylenes present in hemicellulose in which graph shows peak at 1747 cm-1. again, the peak at 2923 cm-1 is due to asymmetric stretching of CH2 and CH which shows characteristics of cellulose. The region between 3800-3000 cm-1 shows a crystalline structure of cellulose and covers the sum of vibration of valence bond of H of O-H group and intramolecular and intermolecular H bond

4. Physicochemical Microwave pretreatment-



The band at 897 cm-1 is the characteristic of CH deformation of cellulose. The range between 1200-1100 cm-1 is the region of hemicellulose and cellulose, which attained a maximum value around 1025 cm-1 due to C-O stretching of cellulose and hemicellulose. A band around 1452 cm-1 is deformation of lignin CH2 and CH3 and 1676 cm-1 is reported to be stretching of C=C stretching of unconjugated hemicellulose as well as xylene again the peak at 2978 cm-1 and 2885 cm-1 are due to asymmetric stretching of CH2 and CH which shows characteristics of cellulose. The region between 3800-3000 cm-1 shows a crystalline structure of cellulose and covers the sum of vibration of valence bond of H of O-H group and intramolecular and intermolecular H bond.

Conclusion

- In this study, milling and extrusion were beneficial to reduce a particle size of raw material, which increases surface area and also reduce degree of polymerization.
- The trend of all FTIR spectra of biowaste states that the biowaste taken from field is generally have same in nature in each pretreatment.
- From FTIR spectra, biowaste selected for pre-treatment that is raw material generally have a same trend with physical (MV, SE), chemical (acid + base) and physicochemical treatment (PCMV, PCSE) this indicates that the pre-treatment strategies could not remove the cellulose, hemicellulose and pectin completely during pre-treatment processes.

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