Use of charcoal and wood carbonization by-products in agriculture: learning with "Terra Preta de Índio"

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INTRODUCTION

➢*Brazil is the leading producer of charcoal in the world, being responsible for 38.5% of the world production.*

➢*During the traditional process of carbonization, around 35% of the wood carbon is fixed in the charcoal and the rest is released to the atmosphere in smoke form and by non condensable gases (CO_2, CO, CH_4 etc.).*

➢*Some technologies are utilised in Brazil that can recover up to 50% of lost carbon in the form of condensed gases that are explored commercially for industry (flavouring).*

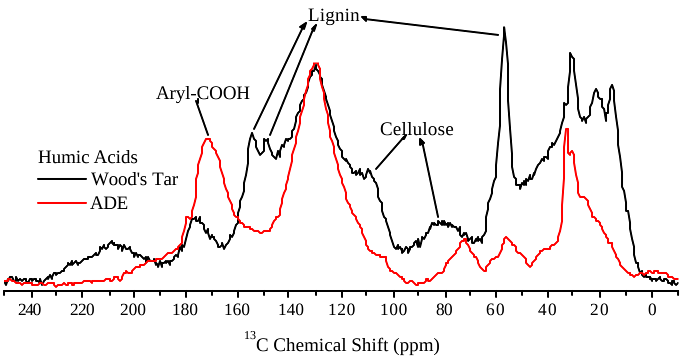
➢*The condensed smoke can be distilled producing a wide range of compounds - wood tar, aromatic oils and pyroligneuos liquor (woods vinegar).*

➢*Another important by-product generated in the process is fine charcoal that, in some cases represents up to 15% of the produced charcoal.*

➢*The development of processes that allow the transformation of charcoal and its by-products into compounds with appropriate characteristics ⇒ similar to humic substances extracted from Anthropogenic Dark Earths (ADE) ("Terra Preta de Índio"), for the use as an organic conditioner, with high reactivity and stability, is highly desirable and strategic for agricultural and forest activities.*

POTENTIAL PRODUCTION OF FERTILIZERS AND SOIL CONDITIONERS FROM CHARCOAL AND ITS BY-PRODUCTS

➢*Humic acids extracted from wood's tar presented the typical pyrogenic aryl C signal (Figure 1), however, compared to ADE humic acids it presents several precursor signals (e.g. lignin and cellulose) and lower carboxylic signals. Additionally this carboxylic groups probably is not attached to aromatic backbones.*



➢***Figure 1*** *– Solid state ^{13}C NMR spectra of wood's tar humic acids compared to ADE humic acids.*

➢*Functionalization of this aryl backbone is possible by chemical (Figure 2) and biological oxidation.*

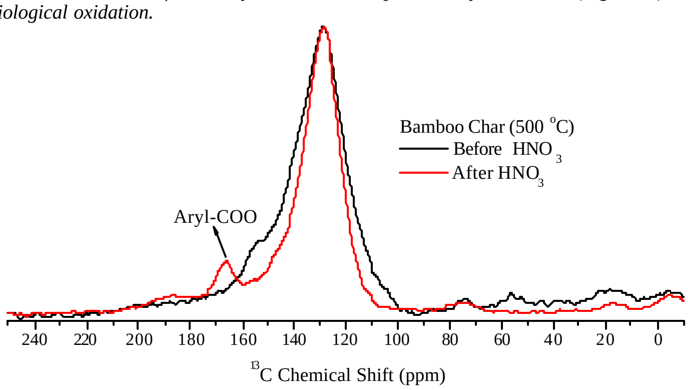


Figure 2 *– Solid state ^{13}C NMR spectra of chemical oxidation product of Bamboo charcoal.*

➢*The mixture of coconut fibre and fine charcoal (1:1) is a adequate substrate to Actinomycetes growing. This substrate presents typical vegetal polymer signals: lignin, cellulose and long chain alkyl acids – lipids (Figure 3).*

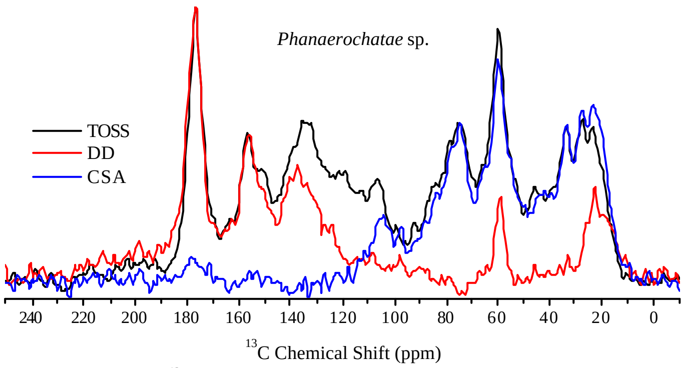


Figure 3 *– Solid state ^{13}C NMR spectra coconut fibre and fine charcoal susbtract.*

➢*Microbiologic oxidation: apparently increases the carboxyl content, however these carboxyl groups are probably not attached to any aromatic ring structures, because its chemical shift is too high, and the PCA showed that the increases in the carboxylic signal corresponds to increases in the alkyl region, indicating that these compounds probably are aliphatic carboxylic acid metabolite from microorganisms entrapped in the charcoal structure.*

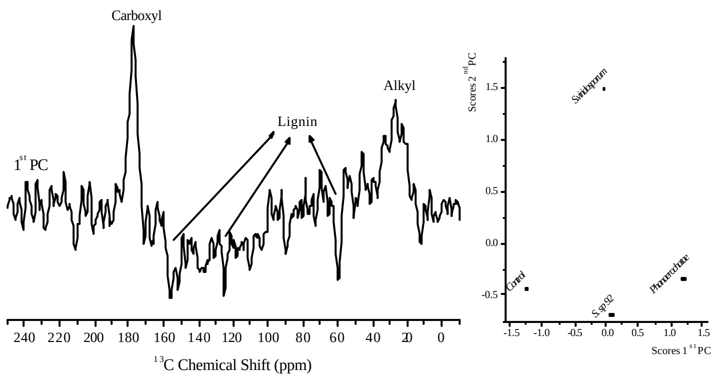


Figure 2 *– PCA results of actinomycetes incubation in coconut fibre and fine charcoal substrate.*

➢*The addition of fine charcoal in compost preparation improves the process by improving: aeration; water retention and probably by providing microorganisms refuge and adsorption of metabolites.*