A comprehensive use of sorghum biomass to produce biofuel, bio-oil, and biochar.

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Among the United Nations seventeen Sustainable Development Goals (SDGs), one ensures access to affordable, reliable, sustainable, and modern energy for all. The use of renewable biomass in products or biofuels as an alternative to fossil fuels meets this goal directly. *Sorghum* is a wide-world cereal crop known due to its wide adaptability to changing climate conditions, especially drought, short life cycle, good adaptation to most regions of Brazil, and multiple uses (human food, animal feed, biofuel, and industrial uses). Moreover, all parts of *Sorghum* can be used as a sustainable feedstock for biofuel production, and our laboratory is investigating different cultivars, hybrids or not, not only to produce biofuels, but also biochemicals. This works aims to report our progress on the conversion of grain *Sorghum* biomass into bio-oil as a fuel additive and biochar for soil amendment. Ground *Sorghum* biomass (*Sorghum bicolor* CMSXS 180) *in nature* and defatted were submitted to slow pyrolysis at 500 ^{o}C to produce bio-oil and biochar. The obtained products were characterized by thermogravimetric analyses (TGA), scanning electronic microscopy(SEM), infrared spectroscopy (IR), ^{1}H NMR, and EDX. Additionally, the antioxidant capacity of bio-oil was evaluated by DPPH radical scavenging assay. The yields of the pyrolysis process were 33% and 36% of biochar and bio-oil, respectively, for the grain *in natura*, and 32% and 28% for the grain defatted. The obtained biochars showed good thermal stability by TGA. The SEM showed irregular particles with some pores on the surface, which contributes to a high surface area of biochars. The FTIR spectra of biochars showed a decrease in bands of the asymmetric and symmetric methylene stretch that are attributed to in aliphatic compounds. The ^{1}H NMR revealed more compounds in extract of the biochar from the defatted sample compared to the in nature, in which acetic acid and formic acid were the main compounds. The EDX detected the presence of K, Ca, and P in the biochars, which were not detected in the sample before the pyrolysis process. This revealed that the biochars concentrate these nutrients and might be useful in soil correction. The bio-oils presented different classes of compounds, which could be observed by IR and ^{1}H NMR. Aldehydes, phenolic compounds, and organic acids could be characterized. The TG showed that the bio-oils lose mass very fast in the range of 34.7 ^{o}C to 165.5 ^{o}C, which is interesting for application as a fuel. The antioxidant assay showed that the bio-oil from sorghum in nature inhibited 77% of the DPPH radical, while the defatted inhibited 76%. These results pointed out the potential of bio-oil to be used as an antioxidant additive.