

## **Alginate/lignin: Antioxidant Activities, Anticancer Activity, Physico-chemistry Characteristics, and Acute Toxicity**

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**Abstract:** Alginate/lignin is a synthetic polymer rich in the biological activity and is of great interest. Alginate is extracted from seaweed and lignin is extracted from corn stalks and leaves. Antioxidant activities of alginate/lignin were evaluated such as total antioxidant activity, reducing power activity, DPPH free radical scavenging activity, and  $\alpha$  – glucosidase inhibition activity. Anticancer activity was evaluated in three cell lines (Hep G2, MCF-7, and NCI H460) and fibroblast. Physico-chemistry characteristics of alginate/lignin were determined through FTIR, DSC, SEM\_EDS, SEM\_EDS mapping, XRD, XRF, and <sup>1</sup>H-NMR. The acute toxicity of alginate/lignin was studied on *Swiss albino* mice. The results demonstrated that alginate/lignin possessed antioxidant activity such as the total antioxidant activity, and reducing power activity, especially, the  $\alpha$  – glucosidase inhibition activity, and had no free radical scavenging activity. Alginate/lignin was not be typical in cancer cell lines. Alginate/lignin existed in a thermally stable and regular spherical shape in the investigated thermal region. Six metals, three non-metals, and nineteen oxides were detected in alginate/lignin. Some specific functional groups of alginate and lignin did not exist in alginate/lignin crystal. Elements such as C, O, Na, and S were popular in the alginate/lignin structure. LD<sub>0</sub> and LD<sub>100</sub> of alginate/lignin in mice were 3.91 g/kg and 9.77 g/kg, respectively. Alginate/lignin has potential for applications in pharmaceutical materials, functional foods, and supporting diabetes treatment.

**Keywords:** antioxidant; anticancer; glucosidase, physic-chemistry characteristics, acute toxicity

Table S1. Mass and atom of elements in alginate/lignin on SEM\_EDS mapping.

Display name		Standard data	Quantification method	Result Type
Map_007_wholespectrum		Standardless	ZAF	Metal

Element	Line	Mass%	Atom%
C	K	22.16±0.08	31.20±0.11
O	K	41.55±0.13	43.91±0.13
Na	K	27.62±0.12	20.32±0.09
S	K	8.66±0.08	4.57±0.04
Total		100.00	100.00
Map_007_wholespectrum		Fitting ratio 0.0210	

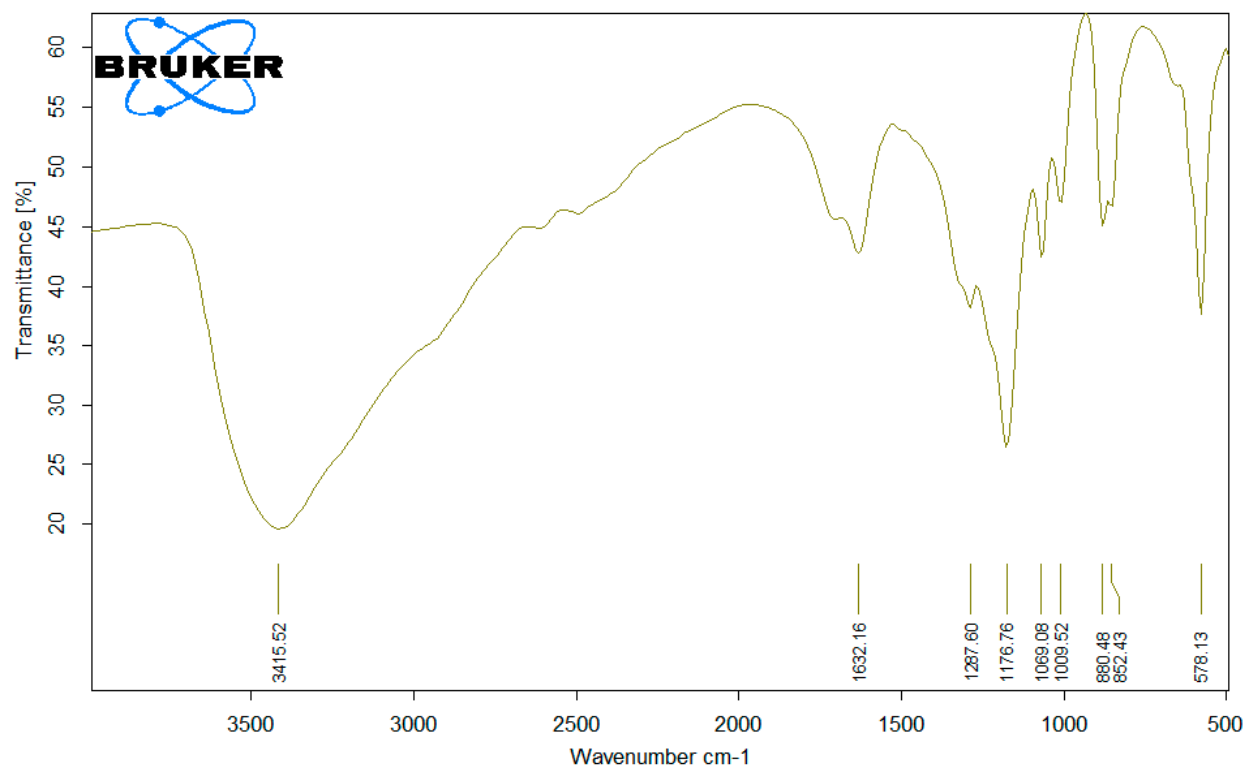


Figure S1. FTIR spectrum of lignin extracting from maize by-products by NaOH solvent.

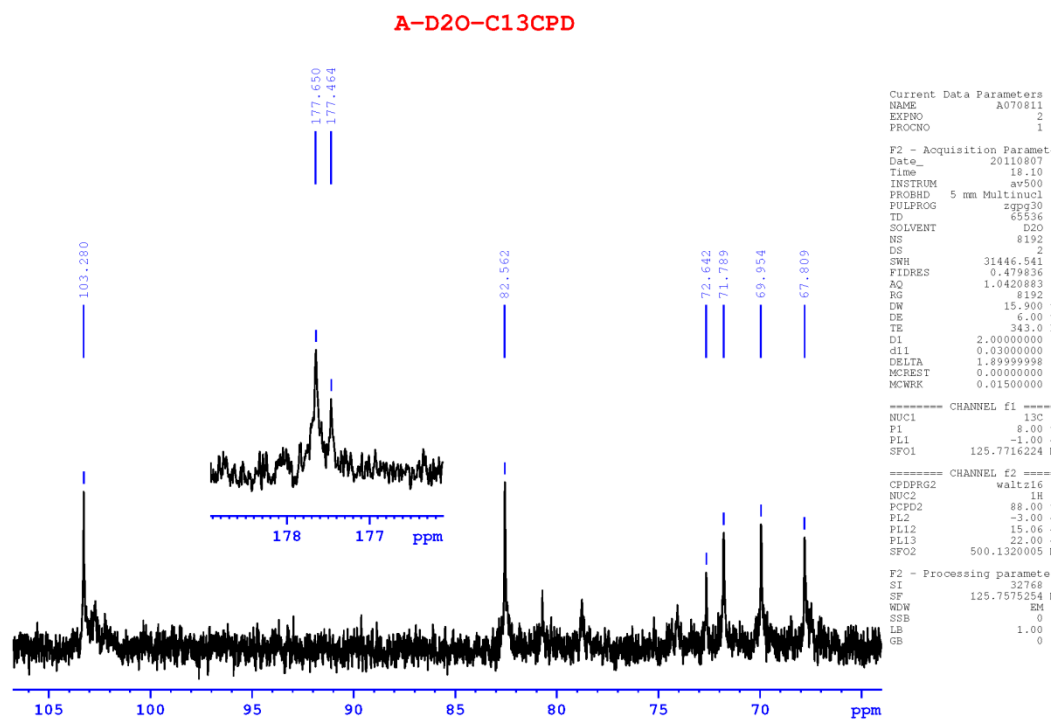


Figure S2.  $^{13}\text{C}$  NMR spectrum of alginate extracted from *Sargassum polycystum* [10]

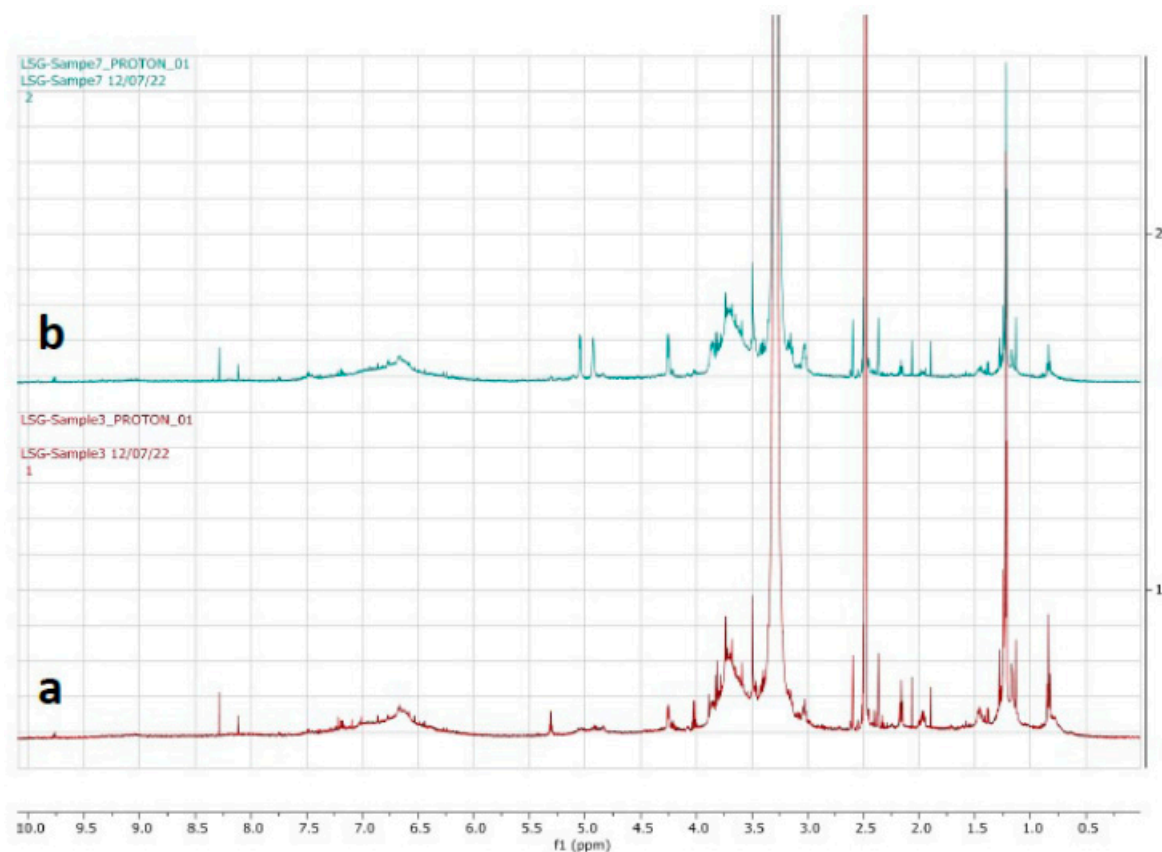


Figure S3.  $^1\text{H}$  NMR spectra (in DMSO) of lignin extracting from: (a) maize stalks; (b) sugarcane bagasse [44]