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Short Communication

The use of maize tassel as an agricultural by-product to ameliorate heavy metals in contaminated groundwater

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The presence of heavy metals in drinking water usually tends to pose some adverse effects to the consumers. It is in the light of this that maize tassel which is usually an agricultural by product was used to remove mercury arsenic, manganese and lead from contaminated water. Maize tassel was milled into fine powder. A laboratory simulated contamination of the above mentioned metals was prepared to a concentration of 2.000 mg/L. Groundwater contaminated samples were also obtained and run through 20.0g of the powdered maize tassel at specific time steps of 0, 15, 30, 45 and 60 minutes respectively. The water that drained out of the tassel was then analyzed for the amount of metals remaining in it using Shimadzu Atomic Absorption Spectrophotometer model AA6300. The concentrations of arsenic, manganese lead and mercury in the laboratory simulated solution after it had passed through the maize tassel for a period of 60 minutes was 0.001 mg/L, 0.005 mg/L, 0.203 mg/L and 0.020 mg/L respectively. The concentrations of arsenic, manganese, lead and mercury in the contaminated groundwater after passing through the tassel was 0.0005 mg/L, 0.0021 mg/L, 0.050 mg/L and 0.025 mg/L respectively.

Maize tassel is the male part of the maize plant. The tassel is a group of stemmy flowers that grow at the apex, or top, of the maize stalk. These tassels are shades of yellow, green and purple. Each maize plant grows these tassels on top after the major growing of the plant is complete and when it is time for the ears of corn to begin growing. The tassel produces pollen which falls off and is blown by the wind to reach the silk of the ears. The silk is the female flower of the maize plant. The tassel as an agricultural by-product has no production value after fertilization. Farmers involved in seed production usually cut them off to ensure maximum utilization of the stored plant food.

A heavy metal is one that has relatively high atomic mass. They include arsenic, lead, manganese and mercury. Contamination of drinking water by heavy metals can produce adverse effects for consumers. These metals are usually generated from industrial settings such as tanneries and mining industries and eventually find their way into the groundwater systems.

Groundwater is a renewable natural resource which when managed properly will ensure a constant supply. Again groundwater is cheaper to maintain when compared to surface water. However, heavy metals in groundwater usually interfere with the normal functioning of the body when consumed.

There are several chemical and physical methods of removing pollutants from contaminated water but these methods usually come with disadvantages such as generating some health effects as well as costing higher than the biological methods. The use of maize tassel which is environmentally friendly and readily available to ameliorate heavy metals in groundwater is reported.

Tassels from maize plants were plucked off the woody parts of the plant, rinsed with deionised water and oven dried for 24 hours at 100 ⁰C. The oven dried maize tassel was milled and sieved into fine powder of 0.2mm.

Arsenic, mercury, lead and manganese solutions were prepared from analytical grade salts of sodium arsenate (for arsenic), lead nitrate (for lead), mercury chloride (for mercury) and manganese sulphate (for manganese) BDH chemicals group of UK. The concentration of the prepared solution was 2mg/L. Borehole water contaminated with arsenic, manganese, lead and mercury to concentrations of 3.937mg/L, 2.405mg/L, 1.096mg/L and 1.137mg/L respectively were obtained from Odumasi a mining community near Obuasi in Ghana.

A one litre empty bottle with the base and lid removed was clamped onto a retort stand. 20g of maize tassel powder was poured into the bottle whose end was blocked with a guaze to prevent the tassel from pouring out. A conical flask was placed beneath the set up to catch any solution that drips from the setup.

Table 1. Results of heavy metal ions removed from 2.000 mg/L laboratory simulated solution using tassels from obatanpa and okomasa maize tassel

Time/ minutes	Laboratory simulated sample-mg/L							
	Okomasa				Obatanpa			
	As	Mn	Pb	Hg	As	Mn	Pb	Hg
0	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000
15	1.057	1.113	1.323	1.060	1.564	1.123	1.010	1.452
30	0.240	0.775	0.765	0.900	0.978	0.340	0.832	1.014
45	0.043	0.535	0.330	0.770	0.340	0.012	0.245	0.248
60	0.002	0.026	0.009	0.570	0.010	0.005	0.203	0.020

Table 2. Results of heavy metal ions removed from contaminated groundwater using tassels from obatanpa and okomasa maize tassels

Time/ minutes	Contaminated groundwater-mg/L							
	Okomasa				Obatanpa			
	As	Mn	Pb	Hg	As	Mn	Pb	Hg
0	3.937	2.405	1.096	1.137	3.937	2.405	1.096	1.137
15	1.920	1.269	0.032	0.424	1.647	1.426	0.307	0.353
30	0.035	0.895	0.015	0.388	0.929	0.477	0.112	0.138
45	0.010	0.274	0.010	0.144	0.113	0.034	0.008	0.038
60	0.001	0.051	0.002	0.035	0.015	0.002	0.002	0.021

The simulated contaminated samples as well as the borehole contaminated ones were gradually poured into the setup from above at specific time steps. The solution after having passed through the maize tassel was then collected by means of the conical flask.

The collected samples were then analyzed in the laboratory for mercury, lead, arsenic and magnesium with a Shimadzu

Atomic Absorption spectrometer model AA6300 linked to a CPU of a computer. Adsorbed amount of each element was taken as the difference between the initial concentration before adsorption and the final concentration of each element after adsorption.

The results obtained indicated that maize tassel had adsorption capabilities for arsenic, manganese, lead and mercury ions. The adsorption of these heavy metals by the maize tassel could be attributed to the presence of functional groups such as -H, -NH_2, - C = O and –COOH on the surface of maize tassel. These functional groups are polar and are capable of binding to heavy metals (Zvinowanda et al, 2009). The rate of adsorption of the heavy metals onto the tassels increased with increasing time. At the end of the 60th minutes, a significant amount of each of the metals had being removed from the solution. The values obtained after adsorption by obatanpa and okomasa maize tassels were within the permissible guideline values for arsenic, manganese, lead and mercury ions in drinking water by World Health Organisation (WHO), United State Environmental Protection Agency (USEPA) and Ghana Environmental Protection Agency (GEPA).

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