



Supplementary Material

Sugar Press Mud as a Proposed Futuristic Aqua-fertilizer – Multi-Elemental Quantitative Characterization by Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES)

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Supplementary Table I.- ICP-OES instrumental operating conditions.

Parameters	Settings
Auxiliary gas flow (Air) rate	0.20 L/min
Nebulizer gas flow (Argon) rate	0.80 L/min
Plasma gas flow rate	15.0 L/min
Sample uptake flow rate	1.50 mL/min
Nebulizer start up	Instant
Plasma view	Axial
View distance	15.0
Plasma condition	Same for all elements
Plasma aerosol type	Wet
Measurement processing mode	Peak area
Background correction	1 or 2 points, selected manually
Warm up time	45 min
First rinse time	15 min
Rinse time between samples	35 sec
Read delay time	60 sec
Number of sample replicates	3
Number of element replicates	3

Supplementary Table II.- Limits of detection for all elements.

Metals	Concentration / detection range (µg L ⁻¹)*	L.D.L. of instrument (µg L ⁻¹)**	Minimum detection range (µg L ⁻¹ ***)
Essential macro-mineral elements			
Ca	17-47 170	0.50	0.30
K	347-14 151	NA	20.00
Mg	34-13 868	NA	0.10
Na	35-47 170	NA	3.50
Essential mineral trace elements			
Co	17-2340	0.25	1.50
Cr	13-1406	0.25	0.50
Cu	8-1887	0.90	0.45
Fe	13-9359	0.20	1.00
Mn	4-1887	0.03	0.10
Ni	17-47 170	0.40	0.75
Zn	7-7076	0.20	0.80
Toxic trace elements			
Al	69-4792	0.90	2.50
Ba	9-377	NA	0.10
Cd	9-1943	0.07	1.00
La	NA	NA	0.80
Li	NA	NA	0.30
Pb	42-4717	1.40	3.00
Sr	NA	NA	0.05

*, established by AOAC; **, established by Perkin Elmer; ***, established by this research; NA, not available.

Supplementary Table III.- Multi-elements parameters.

Standard Stock Solutions	Elements	Wavelength (nm)	Stock standards strengths (mgL ⁻¹)	Working standards for calibration (mgL ⁻¹)					Correction coefficient of calibration	QCS (% recovery)
Standard	Al	396.153	200	25	50	75	100	150	0.999923	99.1
Combined	Na	589.592	200	25	50	75	100	150	0.998409	97.8
Solution-I	K	766.490	400	50	100	150	200	300	0.999615	101.5
	Ca	317.933	1000	75	250	375	500	750	0.999348	100.1
	Cr	267.716	20	0.05	0.1	0.15	0.2	0.25	0.999823	99.9
	Ni	231.604	20	0.05	0.1	0.15	0.2	0.25	0.999273	99.7
Standard	Ba	233.527	100	1.0	2.0	3.0	4.0	5.0	0.997602	91.4
Combined	Fe	238.204	10,000	100	200	300	400	500	0.995743	103.1
Solution-II	Co	238.892	100	0.2	0.4	0.6	0.8	1.0	0.996764	104.6
Standard	Cu	213.597	100	0.2	0.4	0.6	0.8	1.0	0.998023	97.6
Combined	Mn	257.610	10	2	4	6	8	10	0.999849	99.1
Solution-III	Sr	407.771	10	2	4	6	8	10	0.999278	104.7
Standard	Zn	206.200	10	2	4	6	8	10	0.999140	101.0
Combined	Mg	285.213	1000	25	50	75	100	150	0.995198	98.4
Solution-IV	Pb	217.000	50	0.05	0.1	0.15	0.2	0.25	0.999801	100.9
Standard	Cd	214.440	50	0.05	0.1	0.15	0.2	0.25	0.999863	97.5
Solution-VI	La	398.852	10	0.1	0.25	0.5	0.75	1.0	0.999897	98.2
Standard	Li	670.784	10	0.1	0.25	0.5	0.75	1.0	0.996356	96.9
Solution-VII										

Supplementary Table VI.- The overall descriptive statistics of elemental concentration ($\mu\text{g g}^{-1}$ dry weight) in press mud from various Sugar Mills of South Punjab.

Elements	n	Range		Mean	Median	Std. Error	Std. Dev.	Variance	95% confidence interval	
		Min.	Max.						Lower bound	Upper bound
Essential macro-mineral elements										
Ca	15	7761.50	18470.00	10967.5120	9364.00	965.74965	3740.33232	13990085.837	8896.1850	13038.8390
K	15	4250.50	6894.50	5627.0853	5799.00	236.14350	914.57985	836456.295	5120.6079	6133.5628
Na	15	5826.00	8576.50	7023.7100	6735.50	228.97804	886.82815	786464.174	6532.6009	7514.8191
Mg	15	4015.25	5265.00	4670.9400	4860.50	114.90827	445.03782	198058.659	4424.4863	4917.3937
Essential mineral trace elements										
Co	15	18.99	35.60	24.3900	22.75	1.42655	5.52502	30.526	21.3303	27.4497
Cr	15	0.01	9.15	4.4960	5.90	0.99844	3.86693	14.953	2.3546	6.6374
Cu	15	12.25	50.33	28.0093	26.85	3.24709	12.57592	158.154	21.0450	34.9736
Fe	15	2475.30	6725.00	4402.3200	3567.50	438.68621	1699.02438	2886683.829	3461.4317	5343.2083
Mn	15	108.65	283.50	200.8667	196.50	15.21585	58.93072	3472.830	168.2319	233.5014
Ni	15	7.70	35.35	22.8933	26.15	2.83459	10.97830	120.523	16.8138	28.9729
Zn	15	82.50	128.00	109.9147	115.50	4.13941	16.03185	257.020	101.0365	118.7928
Toxic trace elements										
Al	15	182.10	436.10	283.2733	265.15	20.60344	79.79680	6367.529	239.0833	327.4633
Ba	15	27.85	55.55	37.8400	36.15	2.30798	8.93876	79.901	32.8899	42.7901
Cd	15	0.00	1.85	0.6612	0.582	0.17893	0.69300	0.480	0.2774	1.0450
La	15	0.00	5.20	3.2233	3.70	0.45901	1.77773	3.160	2.2389	4.2078
Li	15	12.85	28.60	21.2907	23.50	1.44001	5.57715	31.105	18.2021	24.3792
Pb	15	8.80	74.90	31.5660	27.00	6.17300	23.90793	571.589	18.3262	44.8058
Sr	15	34.25	69.35	45.8393	40.25	3.08945	11.96540	143.171	39.2131	52.4655

Supplementary Table V.- ANOVA results of multi-elements

Elements	df	F	Sig.	Elements	df	F	Sig.
Ca	1,14	308.430	0.000	Ni	1,14	785.969	0.000
K	1,14	356.899	0.000	Zn	1,14	39.427	0.000
Na	1,14	213.404	0.000	Al	1,14	188.395	0.000
Mg	1,14	40.248	0.000	Ba	1,14	181.665	0.000
Co	1,14	100.088	0.000	Cd	1,14	1799.955	0.000
Cr	1,14	715.940	0.000	La	1,14	703.527	0.000
Cu	1,14	793.256	0.000	Li	1,14	145.696	0.000
Fe	1,14	1558.526	0.000	Pb	1,14	1911.278	0.000
Mn	1,14	255.127	0.000	Sr	1,14	190.524	0.000

P value is significant at the 0.0001 level.

Supplementary Table VI.- Correlation results of multi- elements.

	Ca	K	Na	Mg	Co	Cr	Cu	Fe	Mn	Ni	Zn	Al	Ba	Cd	La	Li	Pb	Sr
Ca	1																	
K	.632	1																
Na	-.006**	-.001**	1															
Mg	.069	-.777	-.762	1														
Co	.000**	.865	-.016*	.200	1													
Cr	.023*	.000**	-.000**	.236	.037*	1												
Cu	-.089	.179	.521	-.978	-.000**	-.913	1											
Fe	.001**	.049*	-.003**	.005**	.046*	.000**	.838	1										
Mn	-.650	-.974	.374	.002**	-.713	.636	.270	.259	1									
Ni	-.001**	-.007**	.000**	-.039*	-.027*	-.000**	-.979	-.000**	-.525	1								
Zn	.186	.001**	-.003**	.156	.103	.000**	.991	.003**	.113	-.001**	1							
Al	.672	-.278	.626	-.131	-.421	-.103	.747	-.422	.003**	.370	-.003**	1						
Ba	.000**	.642	-.014*	.005**	.000**	.009**	-.083	.000**	.560	-.000**	.044*	-.489	1					
Cd	-.625	.000**	-.036*	-.554	.531	.009**	-.925	.603	.715	-.228	.002**	-.004**	.988	1				
La	.028*	.002**	-.000**	-.459	.091	.002**	-.655	.051	-.034*	-.005**	.089	.528	.135	.115	1			
Li	.081	.000**	-.000**	.697	.220	.000**	.575	.002**	-.845	-.000**	.001**	-.410	.097	.012*	.000**	1		
Pb	-.009**	-.836	.333	-.084	-.681	-.430	-.341	-.007**	.942	.036*	.949	-.056	-.054	.029*	-.303	-.343	1	
Sr	-.154	.035*	-.332	-.342	.942	.148	-.918	-.667	.552	-.878	.026*	-.002**	-.464	.000**	.585	.178	.001**	1

*, Correlation is significant at the 0.05 level (2-tailed); **, Correlation is significant at the 0.01 level (2-tailed).