Supplementary file

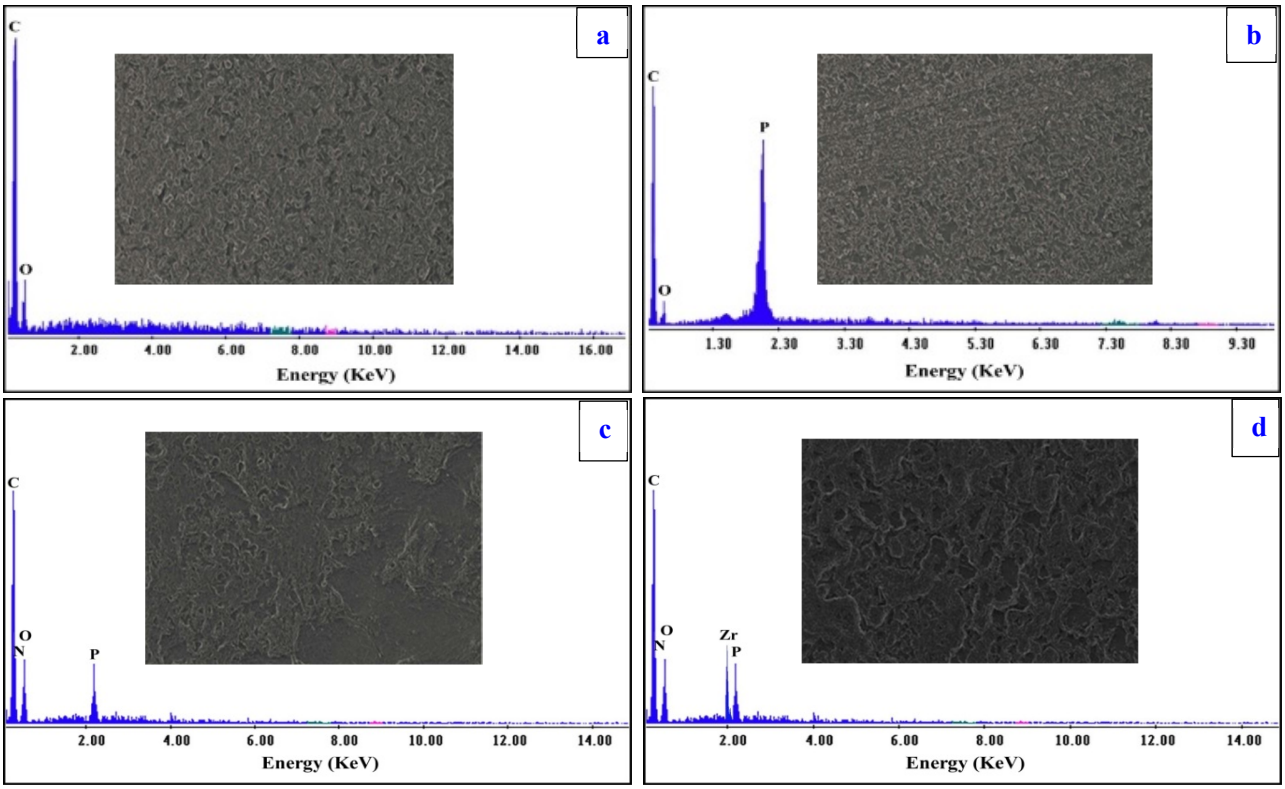

Figure S1: SEM-EDX of **(a)** PVA **(b)** PPVA **(c)** PPVP **(d)** PPVP-Zr after chelation.

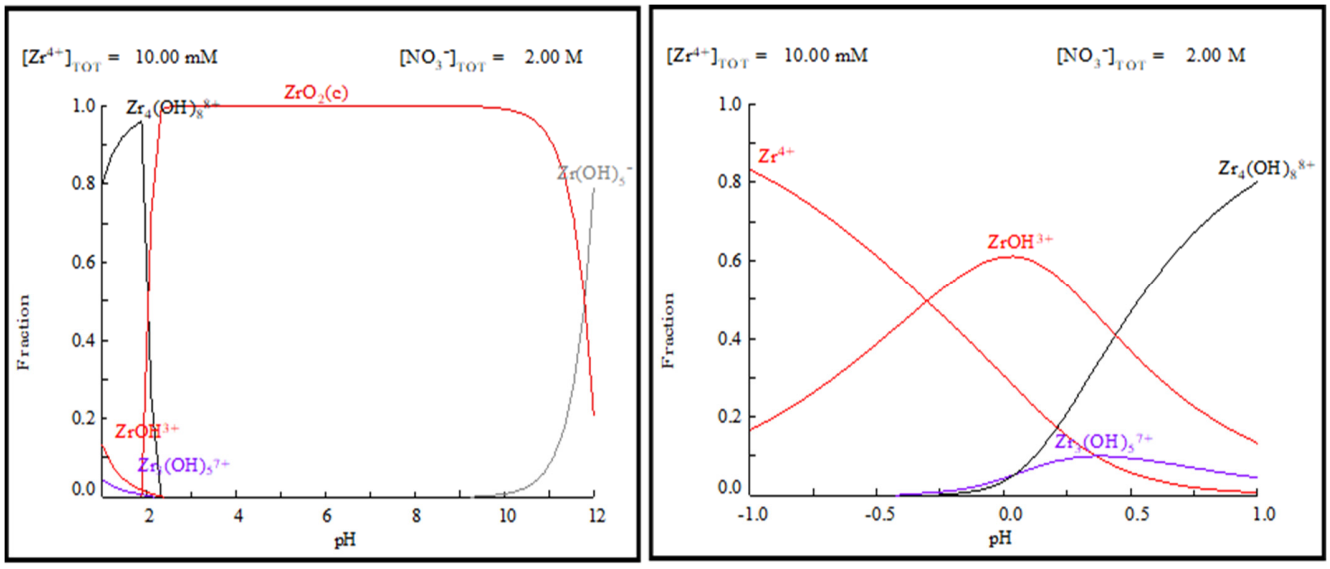

Figure S2. Speciation diagram for zirconium ions in nitrate medium at different pH using HYDRA-MEDUSA software.

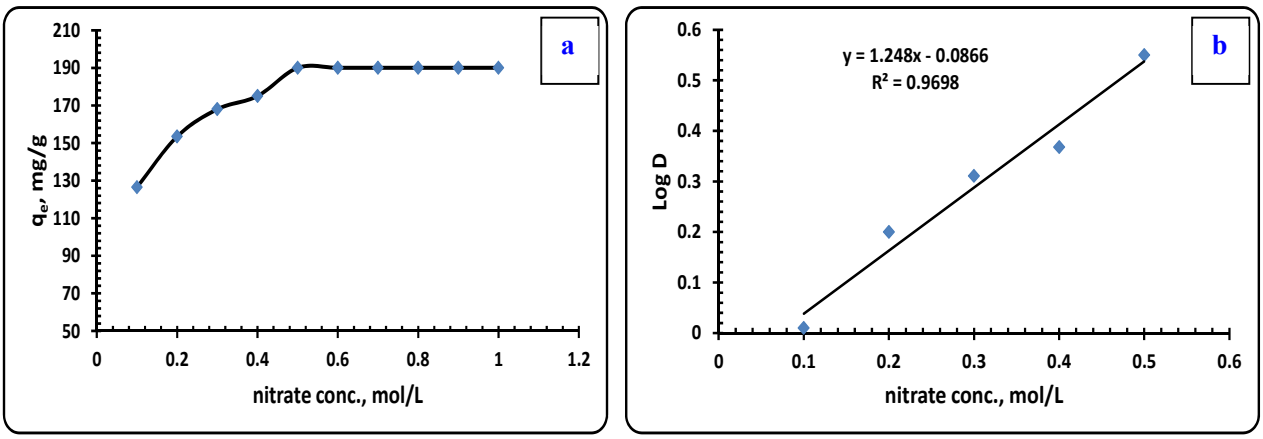

Figure S3. (a) The effect of nitrate ions concentration, on zirconium uptake by PPVP **(b)** The slope regression analysis diagram for zirconium ions uptake by PPVP at different nitrate ions concentration *(conditions: V: 50 mL, Zr concentration: 500 mg/L, m: 0.1 g, T: 25°C, shaking time : 20 min.)*

Table S1. Thermal properties of PVA, PPVA , PPVP and PPVP-Zr samples.

Samples	PVA		PPVA		PPVP		PPVP-Zr	
TGA stages	**temp., °C**	**wt loss, %**	**temp., °C**	**wt loss, %**	**temp., °C**	**wt loss, %**	**temp., °C**	**wt loss, %**
1st	0-105	5	0-105	5	0-105	5	0-105	5
2nd	105-250	10	105-200	15	105-300	35	105-350	20
3rd	250-450	70	200-450	27	300-450	30	350-450	15
4th	450-600	15	450-900	43	450-700	20	450-750	20
Final residue	600-1000	-	900-1000	10	700-1000	10	750-1000	40

Table S2. The thermodynamic indices of zirconium ions extraction upon PPVP.

Parameter	ΔH , kJ/mol	ΔS, kJ/mol.K		ΔG, kJ/mol			
			298 K	**308 K**	**318 K**	**328 K**	**338 K**
Zr^{4+}	-12.22	-0.03	-3.138	-2.948	-2.624	-2.26	-1.941

Table S3. Mineralogical and chemical composition of zircon concentrate after physical separation.

Mineralogical composition		Chemical composition	
Mineral	***Content (%)***	***component***	***Content (%)***
Zircon	90	**ZrO_2**	60.02
Monazite	0.42	**SiO_2**	37
Rutile	0.5	**Fe_2O_3**	0.45
Ilmenite	0.2	**Al_2O_3**	0.4
Garnet	2	**TiO_2**	0.4
Quartz	6	**RE_2O_3**	0.23
Epidote	0.12	**HfO_2**	1.33
Hornblende	0.31		
Feldspar	0.3		

Table S4. ICP-OES characterization of highly pure zirconia concentrate produced by PPVP.

Element	Content, (%)	Element	Content, (%)
Zr	72.77	**Hf**	1.35
Si	0.0021	**Al**	0.0031
Na	0.0023	**K**	0.0005
Fe	0.0011	**Ti**	0.0017
Ca	0.0033	**Mg**	0.0022
REEs	0.0027		