

Adsorption of tetracycline and sulfadiazine onto three different bioadsorbents in binary competitive systems

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Characterization of the bioadsorbent materials

The following parameters were determined in pine bark, oak ash, and mussel shell: pH in water and in 0.1M KCl (ratio solid:solution 1:2.5); total C and N by elemental analysis (CHNS Truspec, Leco, USA); exchangeable cations (Ca, Mg, Na, K and Al), displaced with NH₄Cl 1 M and determined by atomic emission (Na and K) and atomic absorption spectrophotometry (Ca, Mg and Al) (Perkin Elmer AAnalyst 200, USA); effective cationic exchange capacity (eCEC) as the sum of those cations; non-crystalline Al and Fe (Al_o, Fe_o), by extraction with ammonium oxalate solution acidified to pH 3, with subsequent quantification of both elements using atomic absorption spectroscopy (Perkin Elmer AAnalyst 200, USA).

The determination of BET surface areas was performed using ASAP 200 (MICROMERITICS) equipment (by nitrogen adsorption-desorption isotherms measured in Micromeritics ASAP 200). Replicate determinations were carried out (n=3), and coefficients of variation were always lower than 5%.

Standard calibration and measurement conditions were used to assure the quality/assurance of the results.

Table S1. Main characteristics of the three bioadsorbents studied. Average values (n=3), with coefficients of variation always <5%.

| | Mussel shell | Oak Ash | Pine bark |
|---|--------------|---------|-----------|
| pH _{H2O} | 9.39 | 11.31 | 3.99 |
| pH _{KCl} | 9.04 | 13.48 | 3.42 |
| C (%) | 11.43 | 13.23 | 48.70 |
| N (%) | 0.21 | 0.22 | 0.08 |
| C _{ac} (cmolc kg ⁻¹) | 24.75 | 95.00 | 5.38 |
| Mg _c (cmolc kg ⁻¹) | 0.72 | 3.26 | 2.70 |
| Na _c (cmolc kg ⁻¹) | 4.37 | 12.17 | 0.46 |
| K _c (cmolc kg ⁻¹) | 0.38 | 250.65 | 4.60 |
| Al _c (cmolc kg ⁻¹) | 0.03 | 0.07 | 1.78 |
| eCEC (cmolc kg ⁻¹) | 30.25 | 361.17 | 14.92 |
| Al _o mg kg ⁻¹ | 178.33 | 8323.00 | 315.00 |
| Fe _o mg kg ⁻¹ | 171.00 | 4233.00 | 74.00 |
| BET-SA (m ² g ⁻¹) | 1.1318 | 1.3336 | 0.3320 |

Xc: Exchangeable elements; Al_o, Fe_o: Al and Fe extracted with ammonium oxalate; BET-SA: BET surface area

Table S2. Data corresponding to the BET surface area results for the three bioadsorbent materials studied. Mean values (n=3) with coefficients of variation always <5%.

| | Oak ash | Pine bark | Mussel shell |
|---------------------------------------|---------|-----------|--------------|
| Amount of sample (g) | 1.9959 | 1.7630 | 2.9101 |
| COLD (cm ³) | 49.3853 | 45.6137 | 45.6374 |
| WARM (cm ³) | 15.6920 | 15.3332 | 15.3671 |
| C/W | 3 | 3 | 3 |
| BET (m ² g ⁻¹) | 1.3336 | 0.3320 | 1.1318 |