Biosorption of Metals Contaminating Raw Drinking Water Using *Saccharomyces cerevisiae*, the Baker's Yeast

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The main aim of the present study was to investigate capability of *Saccharomyces cerevisiae*, the Baker's yeast for biosorption of some metal ions {Ni (II), Cu (II) and Al (III)} from raw drinking water. It also aimed to study the influence of adsorptive conditions (contact time, pH, metal concentration and bio sorbent dose) on the uptake of metal ions and their removal efficiency. The use of baker's yeast as coagulant aid with Alum (aluminium sulphate), the primary coagulant, for the treatment of raw drinking water was investigated to enhance the coagulant activity towards turbidity and total coliform reduction. Jar test was used and the optimum concentration *Saccharomyces cerevisiae* was determined. Optimization of metal biosorption (at 50 mg/L initial metal ion concentration) using dried Baker's yeast was performed using different pH (1-7), bio-sorbent (yeast) dosage (0.02 g to 2.0 g) and contact time (5.0 – 90 min). The ability of the yeast to remove Al, Cu and Ni ions from aqueous solutions was strongly affected and proportionally increased with pH from 1 to 7. The highest the removal efficiencies (REs) of Al, Cu and Ni recorded 98.8, 100 and 84.09% respectively at pH 7. Results also revealed high selectivity of the tested yeast towards the removal and extraction of Cu (II) compared to Al (III) and Ni (II) ions. There was a clear general trend of increasing RE % of the selected metals with increasing bio-sorbent dosage from 0.02 g to 2.0 g till equilibrium. The highest biosorption of the tested metals reached 98.65, 98.37 and 86.97% for Al, Cu and Ni at 0.75, 0.5 and 0.75 g yeast dosage respectively. Similarly, a general regular trend was shown as increases in the metal's uptake with increasing contact time (5.0 – 90 min) reaching their highest removals (98.81, 97.17 and 88.03%) for Cu, Al and Ni after 60 min. Biosorption efficiency was a function of the initial metal's concentrations (10-80 mg/L) at dried baker's yeast of 0.15 g, 25°C, pH 7- and 30- min contact time. Increasing metal concentrations increased metal removals until certain limit. The highest metals removals (96.73, 98.04 and 85.07 %) were achieved for Al, Cu and Ni at 40, 50 and 50 mg/L respectively after which increasing metals concentrations from 60 to 80 mg/L decreases the removal efficiency. Therefore pH 7, 0.5 g yeast dosage, 30 min contact time and 50 mg/L initial metal concentration are considered as the optimum conditions for optimum metals removal from raw drinking water. Although the highest removals of the tested metals were achieved after 60 min, 30 min considered the optimum contact time where the bulk removals were occurred after which metals uptake was insignificant especially with Al and Cu.

Baker's yeast as was also investigated as coagulant aid with alum to improve turbidity and total coliform reduction during the treatment of raw drinking water. Results revealed that turbidity reduction increased with increasing Alum dose till 24 mg/L after which removal was regularly decreased. The highest turbidity removal (90%) was achieved at 24 mg/L reaching residual turbidity of 1.72 NTU. Therefore, 24 mg/l considered optimum Alum dose. Addition of 1.5 mg/L baker's yeast to the optimum

dose of Alum enhanced turbidity removal reaching 95.43% compared to 90% achieved when Alum was used alone. Therefore, it is recommended to use baker's yeast as coagulant aid with Alum as primary coagulant. Moreover, baker's yeast with Alum for the efficiently help to reduce of total coliform (TC) that recorded 280 CFU/100 mL in the raw water. Treatment with 24 mg/l Alum without yeast produced the lowest TC removal efficiency (67.86%), while with yeast the removal was clearly enhanced reaching the highest RE of 92.86% at 1.0 mg/L, which was considered the optimum yeast dose as a coagulant aid for TC removal.

Results of the present study confirmed the important role of the baker's yeast for the removal of heavy metals associated with the raw drinking water at the tested area. Moreover, results exhibited high efficiency of baker's yeast as a coagulant aid in the improvement of the drinking water treatment process performance.