Use of *Opuntia* sp. mucilage as an alternative for the treatment of wastewater from hemodialysis and dialysis

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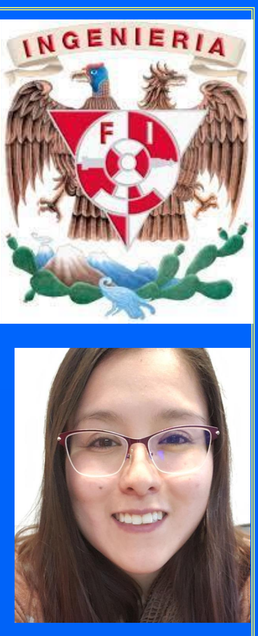

Introduction

Hospital waste may contain dangerous substances as pharmaceutical waste, chemicals, toxins and pathogens; these substances may represent a chemical, biological and physical risk to public and environmental health. The wastewater generated by hemodialysis and dialysis is discharged to the drainage with levels higher than those allowed by Mexican regulations (Chaguay, 2017; Machado et al., 2014; Carraro et al., 2016). It is well known that renal diseases affects 10% of the world's population (OPS, 2015), It is estimated that, in 2025, this disease will affect approximately 4 million of patients. The annual consumption of drinking water for a healthy person is 1,000 liters per year, while a patient with a hemodialysis treatment consumes 37,334 liters and a dialysis patient comes to require 78,000 liters, so the amount of water consumed for these treatments is greater than that required by a healthy person. One of the alternatives for the treatment of the aforementioned effluents is the cactus mucilage Opuntia sp., which is a polysaccharide with high coagulation capacity and is a residue in mexican agricultural practice, aditionaly sludge is highly biodegradable and the sludge generation is low (Urzu et al., 2006; Aliaga, Aceituno & Sa, 2007; Yin, 2010; Rodríguez et al., 2011; Ahuja, 2013; Elena & Gazabón, 2013; Buttice, Alcantar & Florida, 2014; Nawel et al., 2015; Nharingo & Moyo, 2016; Oladoja, 2016).

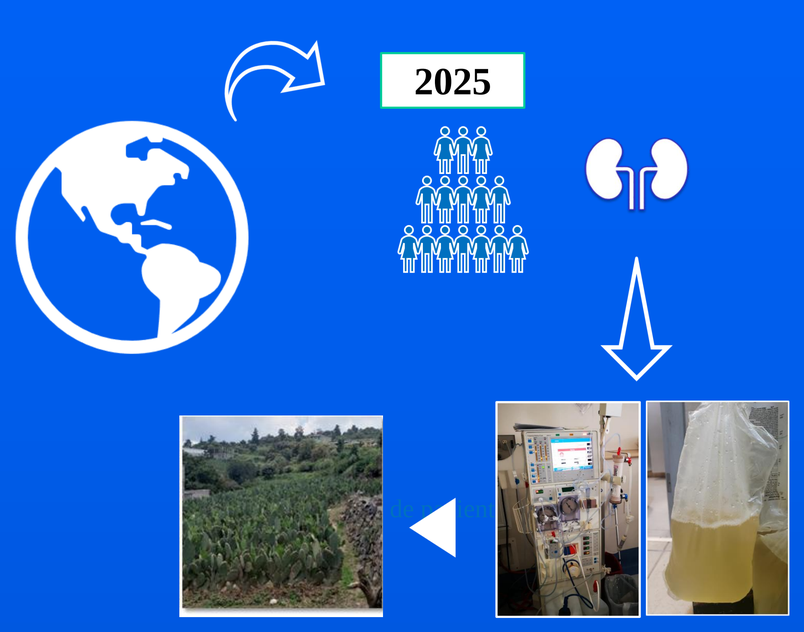

Figure 1: Use de mucilage of *Opuntia* sp.

Results & Discussion

The samples of dialysis and hemodialysis effluents come from two different hospitals located in Mexico City, they were stored at 4 ° C for study. Table 1 shows the characterization of the effluents used..

Parameter	Units	Hemodyalisis	Dyalisis
Turbity	NTU	76.9	34.6
Chemical Oxygen Demand (COD)	mg/L	1824	6790
pH	-	7.65	7.45
Temperature	°C	26.5	26.4
Dissolved solids	mg/L	7.85	7
Electric conductivity	µS/cm	15.73	14.02
N ammonia	mg/L	113.98	541

Table 1: Use de mucilage of *Opuntia* sp.

The mucilage was obtained from the Institute of Applied Sciences and Technology of the National Autonomous University of Mexico, located in Ciudad Universitaria.

Coagulation-flocculation experiments were performed using the Phipps & Bird BP-700 Jar Test Kit. The dose of Opuntia sp mucilage was varied to the hemodialysis effluent samples. and the pH until reaching the optimum values. The pH of the solutions was measured with the HACH Combo Waterproof multiparametric equipment and Ca (OH) 2 was used for pH adjustment.

The samples were shaken at 120 rpm for 1 minute and mixed at 40 rpm for 20 minutes, followed by a 15 minute sedimentation. The effectiveness of Opuntia sp. Was evaluated by measuring the decrease in turbidity at various pH doses, in both dialysis and hemodialysis effluents. The turbidity of the samples was determined with the HACH 2100 equipment. The tests were carried out in triplicate and the mean values are reported.

The extraction method that was used was the one reported by Reyes-Ocampo et al., 2019, called “simple filtration” that mainly consists of emptying the pruning nopal concentrate with a series of filters from larger to smaller size, until obtaining a clarified liquid for subsequent drying.

For the dialysis effluent, the optimal dose of *Opuntia* sp. Mucilage is 25 mg / L and the optimum pH is 10, obtaining a turbidity removal of 53.02%. Figure 2 shows the graph of the percentage of turbidity removal and optimal dose for the dialysis effluent.

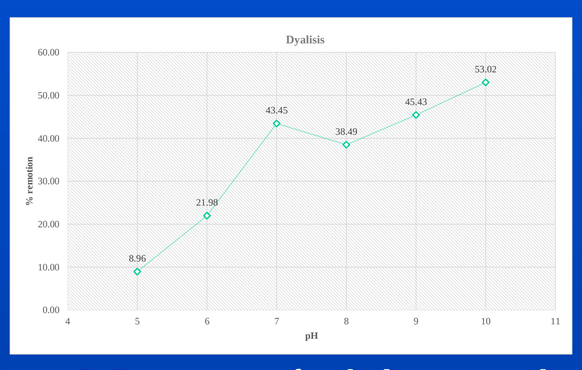

Figure 2: Percentage of turbidity removal

In the case of hemodialysis effluent, the optimal dose of *Opuntia* sp. is 15 mg / L, and the best pH value is 9, achieving a removal of 31.99%.

Figure 3 shows the graph of the percentage of turbidity removal and optimal dose for the hemodialysis effluent.

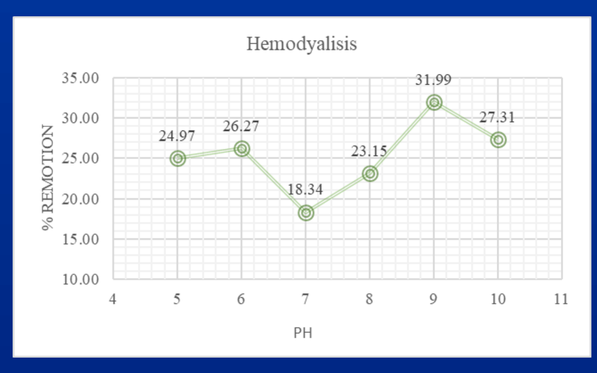

Figure 3: Percentage of turbidity removal

Conclusions

Pruning nopal mucilage Opuntia sp. Due to its abundance, location, rapid growth, low cost and its high coagulation capacity, it was useful as a coagulant in the treatment of hospital effluents since it allowed to treat biological-infectious waste, very little amount of sludge was generated (what which constitutes a disadvantage of physicochemical treatments), in addition to their plant origin, they are highly biodegradable, the most important thing is that good removals were obtained, a low-cost flocculant such as calcium hydroxide was used and the conditions of discharge to the sewer system in accordance with Mexican regulations.

Finally, from the evaluation of the use of nopal mucilage for the treatment of hospital effluents, it can be concluded that it is a good alternative for the treatment not only of wastewater as previously treated, but also for hemodialysis and dialysis effluents.
It is important to mention that you are using nopal waste that can be revalued, instead of discarding it and not giving it any application. In addition, chemical coagulants can have a negative impact due to the abundant formation of toxic sludge than can be substituted.