

The opinion on the doctoral dissertation titled
“Removal of Pharmaceutical Residue from Water and Real Wastewater
Using Activated Carbon Derived from Agro-Industrial Wastes”

by Osamah Jaber Oudah Al-Sareji

The dissertation's theme is very much up to date, because the removal of pharmaceutical pollutants from water is gaining great importance especially since that the endocrine disruptors increasing importance. For that purpose, the author is investigating the effect of activated carbon made from agricultural residues. His goal is to develop sustainable, cost-effective and environmentally friendly adsorbents from agro-industrial wastes to remove pharmaceutical compounds from Milli-Q water and lake water as well as wastewater.

The activated carbon made from oil-stone waste, banana peel, and from pine wood were investigated and partially produced.

The effectiveness of those products was investigated to remove diclofenac, ciprofoaxacin, amoxicilin, and carbamazepine. Each type of activated carbon was combined with different chemicals in order to enhance the efficacy of the removal.

The usage of agro-industrial wastes in active carbon production is a very good idea, because the cost of active carbon is rather high, so it is merit full in decreasing the costs of their production.

The production costs for the processes investigated set the price between \$3.77/kg and \$4.27/kg due to high chemical input during activation benefits from reduced chemical use, improving scalability, environmental impact, and procurement ease.

Compared to commercial activated carbon priced at \$135/kg, the synthesized ACs are 10 to 36 times more cost-effective, offering a highly economical alternative. The results of this study highlight the potential use of agro-industrial waste in eliminating organic micropollutants from different types of water.

The dissertation consists of 6 chapters, and the references, and uses 130 pages including acknowledgement

The first chapter is Introduction, which is also the literature study, containing 36 pages, and 6 subchapters. The reviewer's opinion is that the Introduction is too long, it should be a few pages long, and the other pages could get another title. This chapter describes all of the work of the literature, from the properties of the pharmaceuticals selected for experimental investigations through of the methods for the removal of them, and through of the agro-industrial wastes, as well as the modification techniques for adsorbents. The reader can find the scope of the work either. This chapter is very well written and detailed enough.

The dissertation refers to 221 pieces of literature, which is a huge number, and most of them are quoted properly, sometimes in packages of a lot of papers. The level of the literature study is outstandingly good, clear, and detailed up to the optimal level.

The literature is analyzed deeply detailed with the necessary criticism.

The goals for the research seemed to be based on literature study and the previous research made by the research group and the applicant.

The experimental methods selected by the researcher are adequate and full. The methods are completely applicable to accomplish the goals targeted.

The methods used during the research are generally speaking, up to date for the themes.

The levels of the processing of research results are quite high, using all of the necessary mathematical problem solutions applicable here, including mathematical statistics methods. This is very important, because the dissertation is based on a lot of experimental work and results.

The consequences and conclusions made by the applicant are valid containing strong mathematical and chemical evidence. Those conclusions are good to continue of the development work in the real world although the samples of the materials investigated are rather small. the possibilities of the god practical result are quite high.

The applicant made some comparison between his own results and the literature.

The new scientific results are given in 4 major points.

All are acceptable, and supported properly by experimental results, and with the author's own papers.

The dissertation consists of 6 major chapters and a References

The construction of the dissertation is clear and easy to read. The figures and graphs are having extraordinarily good quality. The literature is referred to very well and in order, clearly and informatively.

The style of the dissertation is outstanding good and following the rules precisely.

Questions:

1. How much banana peel can be collected, and what kind of shops can provide that? It can be a sustainable active carbon source? Do you have some intention to utilize common plants, weeds for that purpose?
2. In removal of pharmaceuticals what is characteristic the active charcoal is showing catalytical like behaviour, and can be used many times, or it could be used only ones? Do you have some experimental results on it?

Dunaújváros, May 15, 2025.

Endre Kiss