Supporting Materials

The removal of tetracycline from aqueous solutions using peanut shell biochars prepared at different pyrolysis temperatures

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Table S1 Comparison of the adsorption capacity of TC on other pristine biochars

Feedstocks	Temperature (°C)	Adsorption capacity (mgg^{-1})	References
Peanue shell	400 and 700	26.4185 and 33.4346	This study
Auricularia auricula dregs	300, 500, and 700	7.22, 9.90, 11.90	[1]
Sludge	600	126.14	[2]
Cow manure	300, 500, and 700	26.727, 15.061, and 22.553	[3]
Spirulina sp. (microalgae)	750	147.9	[4]
Peanut shell	700	51.75	[5]
Peanut shell	300 and 700	12 and 32	[6]
Tea waste	700	10.88	[7]
wheat stalk	300, 450, 600	17.19, 21.19, 21.29	[8]
hay	500	372.31 and 44.24	[9]
Rice straw	700	29	[10]

References

1. Dai, Y.; Li, J.; Shan, D., Adsorption of tetracycline in aqueous solution by biochar derived from waste Auricularia auricula dregs. *Chemosphere* **2020,** 238, 124432.
2. Liu, H.; Xu, G.; Li, G., The characteristics of pharmaceutical sludge-derived biochar and its application for the adsorption of tetracycline. Sci. Total Environ. **2020**, 747, 141492.
3. Zhang, P.; Li, Y.; Cao, Y.; Han, L., Characteristics of tetracycline adsorption by cow manure biochar prepared at different pyrolysis temperatures. *Bioresour. Technol.* **2019,** 285, 121348.
4. Choi, Y.-K.; Choi, T.-R.; Gurav, R.; Bhatia, S. K.; Park, Y.-L.; Kim, H. J.; Kan, E.; Yang, Y.-H., Adsorption behavior of tetracycline onto Spirulina sp. (microalgae)-derived biochars produced at different temperatures. *Sci. Total Environ.* **2020,** 710, 136282.
5. Zhang, Y.; Xu, J.; Li, B.; Xie, Z. X.; Li, X. D.; Tang, J.; Fan, S. S., Enhanced adsorption performance of tetracycline in aqueous solutions by KOH-modified peanut shell-derived biochar. *Biomass Convers. Biorefin.* **2021**.
6. Ahmad, M.; Lee, S. S.; Dou, X. M.; Mohan, D.; Sung, J. K.; Yang, J. E.; Ok, Y. S., Effects of pyrolysis temperature on soybean stover- and peanut shell-derived biochar properties and TCE adsorption in water. Bioresour. Technol. 2012, 118, 536-544.
7. Li, B.; Zhang, Y.; Xu, J.; Mei, Y.; Fan, S.; Xu, H., Effect of carbonization methods on the properties of tea waste biochars and their application in tetracycline removal from aqueous solutions. *Chemosphere* **2021,** 267, 129283.
8. Xiang, W.; Wan, Y.; Zhang, X.; Tan, Z.; Xia, T.; Zheng, Y.; Gao, B., Adsorption of tetracycline hydrochloride onto ball-milled biochar: Governing factors and mechanisms. *Chemosphere* **2020,** 255, 127057.
9. Jang, H. M.; Kan, E., A novel hay-derived biochar for removal of tetracyclines in water. *Bioresour. Technol.* **2019,** 274, 162-172.

10. Mei, Y.; Xu, J.; Zhang, Y.; Li, B.; Fan, S.; Xu, H., Effect of Fe–N modification on the properties of biochars and their adsorption behavior on tetracycline removal from aqueous solution. *Bioresour. Technol.* **2021,** 325, 124732.

Table S2 Comparison of the adsorption capacity of TC on other modified biochars

Feedstocks	**Modification**	**Temperature (°C)**	**Adsorption capacity (mgg^{-1})**	**References**
Peanue shell	No modification	400 and 700	26.4185 and 33.4346	This study
Peanut shell	KOH	700	272.2	[1]
Tea waste	$KHCO_3$+$FeCl_3$	800	333.22	[2]
Pinus taeda	NaOH	800	274.81	[3]
Wheat straw	KOH+$KMnO_4$	700	584.19	[4]
Sludge	hydrothermal pretreatment	600	168.3	[5]
Tea waste	hydrothermal treatment with $KHCO_3$ activation	700	451.45	[6]
wheat stalk	Ball-milling treatment	300, 450, 600	51.04, 96.69, 75.95	[7]
Sludge	$ZnCl_2$+$FeCl_3$	600	145	[8]
Rice husk	KOH	500	58.82	[9]
Eucommia ulmoides	K_2SO_3	700	1163	[10]
Rice straw	Urea+$FeCl_3$	700	156	[11]

References

1. Zhang, Y.; Xu, J.; Li, B.; Xie, Z. X.; Li, X. D.; Tang, J.; Fan, S. S., Enhanced adsorption performance of tetracycline in aqueous solutions by KOH-modified peanut shell-derived biochar. *Biomass Convers. Biorefin.* **2021**.
2. Li, B.; Zhang, Y.; Xu, J.; Fan, S.; Xu, H., Facile preparation of magnetic porous biochars from tea waste for the removal of tetracycline from aqueous solutions: Effect of pyrolysis temperature. *Chemosphere* **2022,** 291, 132713.
3. Jang, H. M.; Yoo, S.; Choi, Y.-K.; Park, S.; Kan, E., Adsorption isotherm, kinetic modeling and mechanism of tetracycline on Pinus taeda-derived activated biochar. Bioresour. Technol. 2018, 259, 24-31.
4. Xu, J.; Zhang, Y.; Li, B.; Fan, S.; Xu, H.; Guan, D.-X., Improved adsorption properties of tetracycline

on KOH/KMnO4 modified biochar derived from wheat straw. *Chemosphere* **2022,** 296, 133981.

5. Chen, W.; Zhao, B.; Guo, Y.; Guo, Y.; Zheng, Z.; Pak, T.; Li, G., Effect of hydrothermal pretreatment on pyrolyzed sludge biochars for tetracycline adsorption. J. Environ. Chem. Eng. 2021, 9, (6), 106557.
6. Li, B.; Zhang, Y.; Xu, J.; Mei, Y.; Fan, S.; Xu, H., Effect of carbonization methods on the properties of tea waste biochars and their application in tetracycline removal from aqueous solutions. *Chemosphere* **2021,** 267, 129283.
7. Xiang, W.; Wan, Y.; Zhang, X.; Tan, Z.; Xia, T.; Zheng, Y.; Gao, B., Adsorption of tetracycline hydrochloride onto ball-milled biochar: Governing factors and mechanisms. *Chemosphere* **2020,** 255, 127057.
8. Ma, Y.; Li, M.; Li, P.; Yang, L.; Wu, L.; Gao, F.; Qi, X.; Zhang, Z., Hydrothermal synthesis of magnetic sludge biochar for tetracycline and ciprofloxacin adsorptive removal. Bioresour. Technol. 2021, 319, 124199.
9. Liu, P.; Liu, W.-J.; Jiang, H.; Chen, J.-J.; Li, W.-W.; Yu, H.-Q., Modification of bio-char derived from fast pyrolysis of biomass and its application in removal of tetracycline from aqueous solution. *Bioresour. Technol.* **2012,** 121, 235-240.
10. Chen, Y.; Liu, J.; Zeng, Q.; Liang, Z.; Ye, X.; Lv, Y.; Liu, M., Preparation of Eucommia ulmoides lignin-based high-performance biochar containing sulfonic group: Synergistic pyrolysis mechanism and tetracycline hydrochloride adsorption. *Bioresour. Technol.* **2021,** 329, 124856.
11. Mei, Y.; Xu, J.; Zhang, Y.; Li, B.; Fan, S.; Xu, H., Effect of Fe–N modification on the properties of biochars and their adsorption behavior on tetracycline removal from aqueous solution. *Bioresour. Technol.* **2021,** 325, 124732.