Extraction of fulvic acid from Mae Moh humic acid using hydrogen peroxide oxidation

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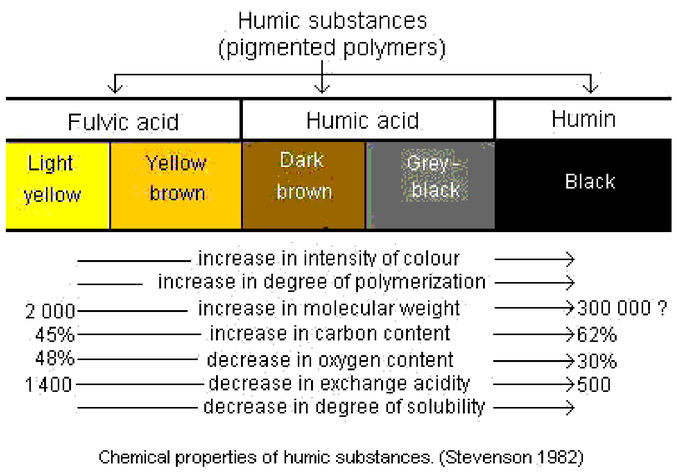
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Abstract

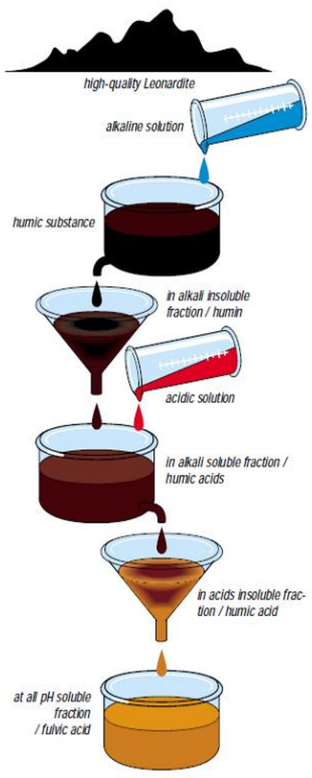
This study aimed to extract fulvic acid from humic acid obtained from Mae Moh mine samples using hydrogen peroxide as an oxidizing agent to enhance extraction efficiency. Fulvic acid is an important organic compound with potential applications in environmental and industrial fields. In this work, hydrogen peroxide was used to oxidize humic acid to improve the release and extraction of fulvic acid. The effects of key parameters, including pH, hydrogen peroxide volume, and reaction time, were investigated to determine the optimal conditions for extraction. The results showed that the use of hydrogen peroxide significantly improved extraction efficiency compared to the method without hydrogen peroxide. The optimal conditions were 10 mL of hydrogen peroxide at pH 2, temperature of 40 ºC, and reaction time of 7 hours, which provided the highest yield of 32.33% with acceptable precision. Compared to the method without hydrogen peroxide, the yield increased by approximately 1.5 times. These results demonstrate that hydrogen peroxide is an effective oxidizing agent for fulvic acid extraction and that this method has strong potential for further applications in environmental and industrial processes.

Introduction

Fulvic acid is the smallest molecular fraction of humic substances, formed through the biodegradation of organic matter. It is water-soluble at all pH ranges and has potential for value-added applications, such as in cosmetic and dietary supplement products. However, conventional extraction methods often result in low yields.



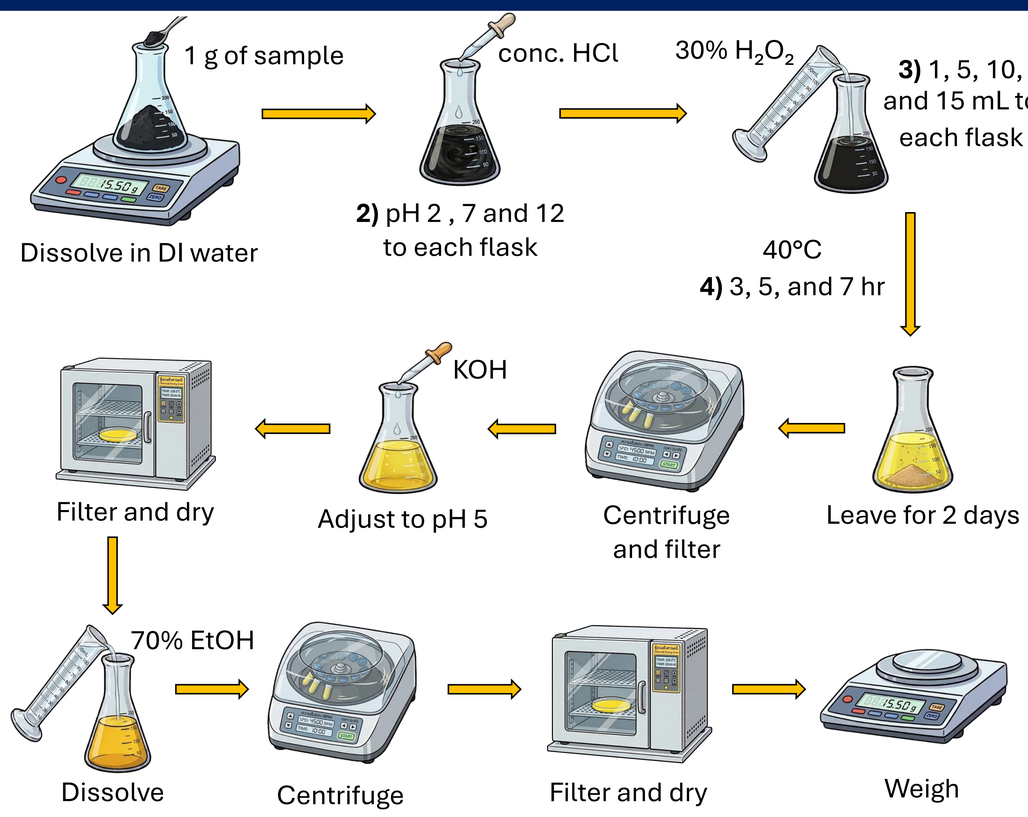
Chemical properties of humic substances. (Stevenson 1982)



conventional extraction

This study investigates the use of hydrogen peroxide as an oxidizing agent to enhance the extraction efficiency of fulvic acid from humic acid obtained from the Mae Moh mine. Key variables affecting the extraction process were evaluated to determine optimal conditions that maximize %yield with accuracy, efficiency, and potential for future application.

Methodology



Conclusion

This study aimed to enhance the extraction efficiency of fulvic acid from Mae Moh humic acid using hydrogen peroxide oxidation. The conventional method without H_2O_2 produced an average %yield of 21.93% (%RSD = 1.81%). Under oxidative conditions, acidic pH (pH 2) gave the highest yield of 31.30% (%RSD = 1.73%). Optimization of H_2O_2 volume showed that 10 mL provided the highest average %yield of 32.65% with the lowest %RSD (0.22%). Further investigation of extraction time at 40 °C revealed that 7 hours achieved the highest yield (32.33%) while reducing the reaction time from 2 days to 7 hours. Overall, hydrogen peroxide oxidation significantly improved both extraction yield and precision compared to the non-oxidative method, demonstrating superior efficiency and reproducibility.

References

[1] Jomhataikool, B., et al. (2017). Effect of humic acid extracted from Thailand's leonardite on rice growth. Journal of Applied Science and Industrial Technology
[2] Humintech. (2020). What are humic acids? German Technology Humic Substances Based Products. https://www.humintech.com/agriculture/information/what-are-humic-acids

Results & Discussion

Table 1 Extraction of Fulvic Acid from Mae Moh Humic Acid without Hydrogen Peroxide Oxidation

Replicate	Weight of precipitate (g)	% yield
1	0.2183	21.70
2	0.2253	22.35
3	0.2185	21.74
Mean	0.2207	**21.93**
SD	0.00399	
%RSD	1.81	
Acceptance %RSD ≤ 5	**Accept**	

From the table 1, the average %yield of fulvic acid extraction from humic acid without the use of hydrogen peroxide was 21.93%. The precision of the method, expressed as %RSD, was 1.81%, which is within the acceptable range.

Table 2 Results of Fulvic Acid Extraction from Mae Moh Humic Acid via Hydrogen Peroxide Oxidation under Acidic, Neutral, and Alkaline Conditions

pH	Weight of precipitate avg (g)	% yield avg.	SD	%RSD	Acceptance %RSD ≤ 5
2	0.3140	**31.30**	0.00544	1.73%	**Accept**
7	0.2899	28.75	0.00559	1.93%	**Accept**
12	0.1725	17.14	0.00219	1.27%	**Accept**

From the table 2, in the extraction of fulvic acid from humic acid was performed at different pH conditions (pH 2, 7, and 12). The highest average %yield was obtained at pH 2, with a value of 31.30%. The precision of the method, expressed as %RSD, was 1.73%, which is within the acceptable range.

Table 3 Results of Fulvic Acid Extraction from Mae Moh Humic Acid via Hydrogen Peroxide Oxidation under Acidic Conditions Using 1, 5, 10, and 15 mL of H_2O_2

Volume H_2O_2 (mL)	Weight of precipitate avg (g)	% yield avg.	SD	%RSD	Acceptance %RSD ≤ 5
1	0.3054	30.48	0.00495	1.62%	**Accept**
5	0.2710	26.49	0.00106	0.39%	**Accept**
10	0.3270	**32.65**	0.00071	0.22%	**Accept**
15	0.3274	32.63	0.00219	0.67%	**Accept**

From the table 3 , in the extraction of fulvic acid from humic acid using hydrogen peroxide, a volume of 10 mL H_2O_2 yielded the highest average %yield of 32.65%. The precision of the method, expressed as %RSD, was 0.22%, which is within the acceptable range.

Table 4 Results of Fulvic Acid Extraction from Mae Moh Humic Acid via Hydrogen Peroxide Oxidation under Acidic Conditions Using 10 mL of H_2O_2 at 40 °C with Reaction Times of 3, 5, and 7 Hours

Time (hour)	Weight of precipitate avg (g)	% yield avg.	SD	%RSD	Acceptance %RSD ≤ 5
3	0.2846	28.35	0.00085	0.30%	**Accept**
5	0.2949	29.28	0.00509	1.73%	**Accept**
7	0.3250	**32.33**	0.00467	1.44%	**Accept**

From the table 4, the extraction conducted for 7 hours gave the highest average %yield of 32.33%. The precision of the method, expressed as %RSD, was 1.44%, which is within the acceptable range.

Acknowledgment

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