Removal of methylene blue using a dried mangosteen peel composite starch cryogel

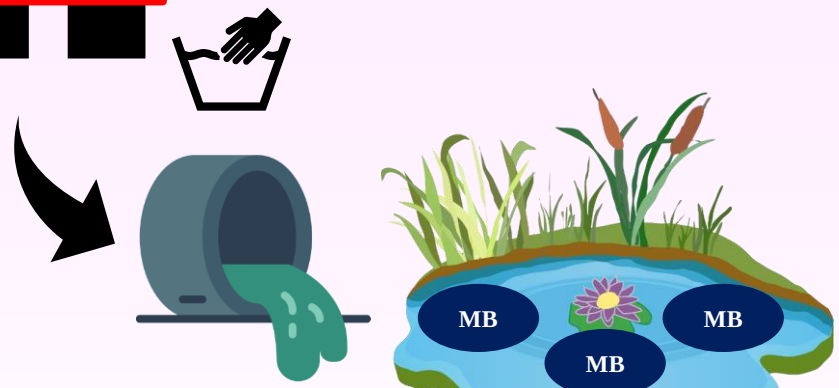
Presented by
Miss Kharittha Phatthanawiwat

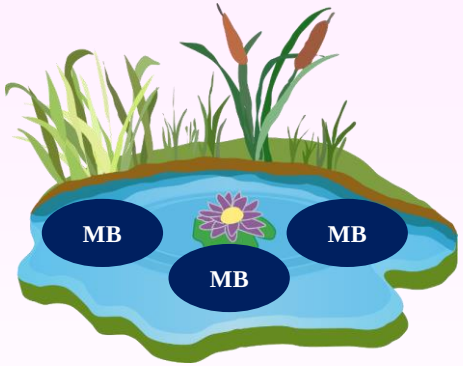
Advisor
Assoc. Prof. Dr.Aree Choodum

Background research

Batik

Phuket





Background research

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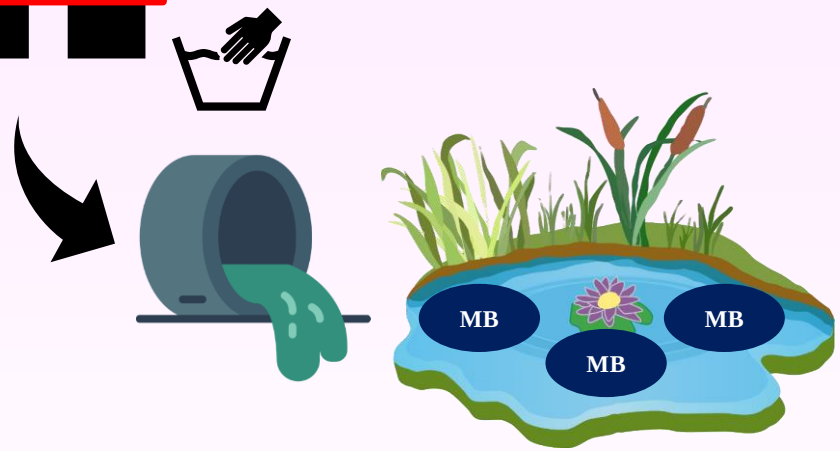
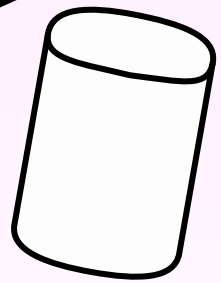


Mangosteen

Mangosteen peel

Dried Mangosteen Peel (DMP)

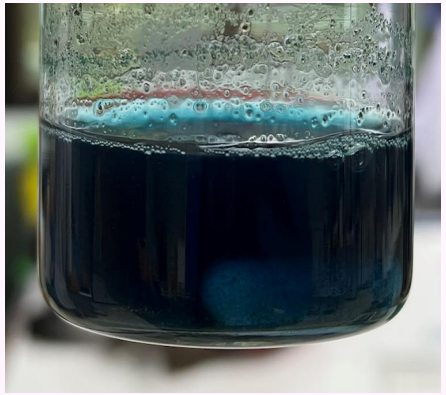
Remove

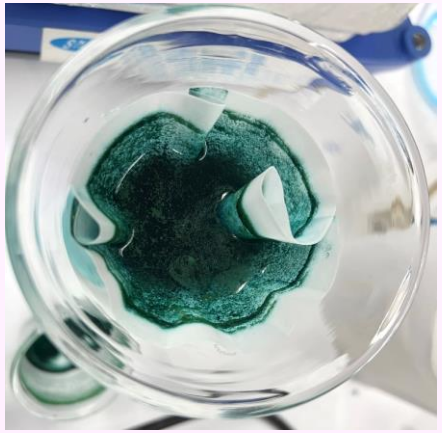


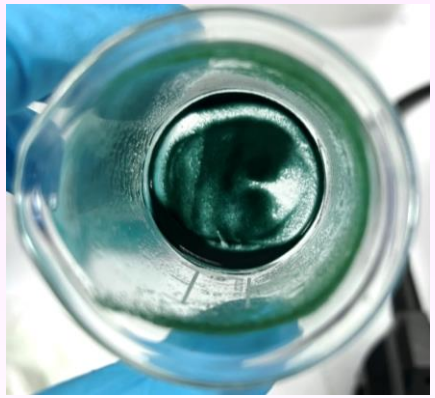
Starch cryogel

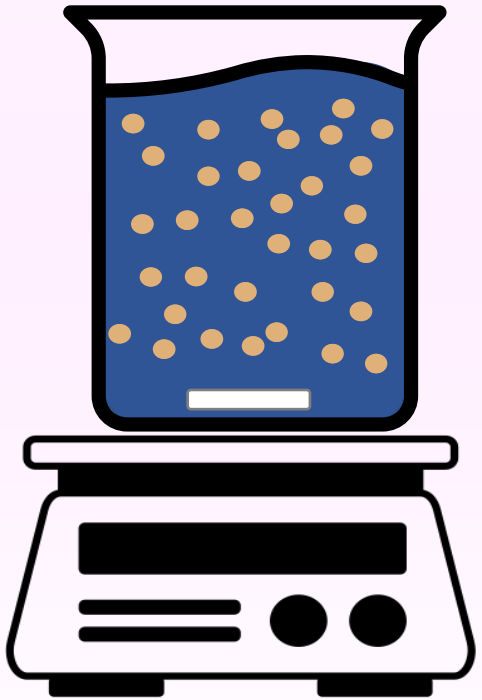
Background research

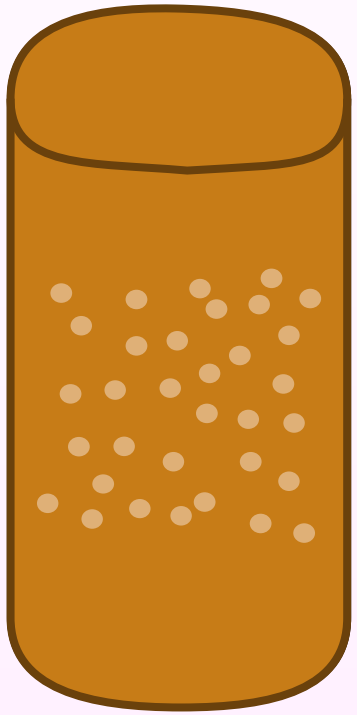
Dried Mangosteen Peel (DMP)



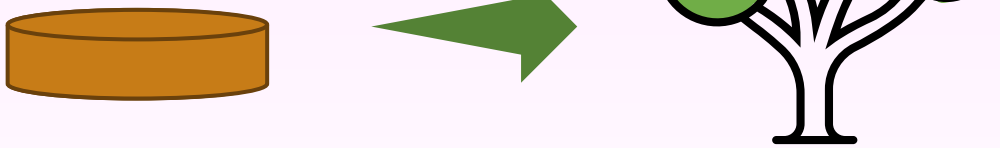






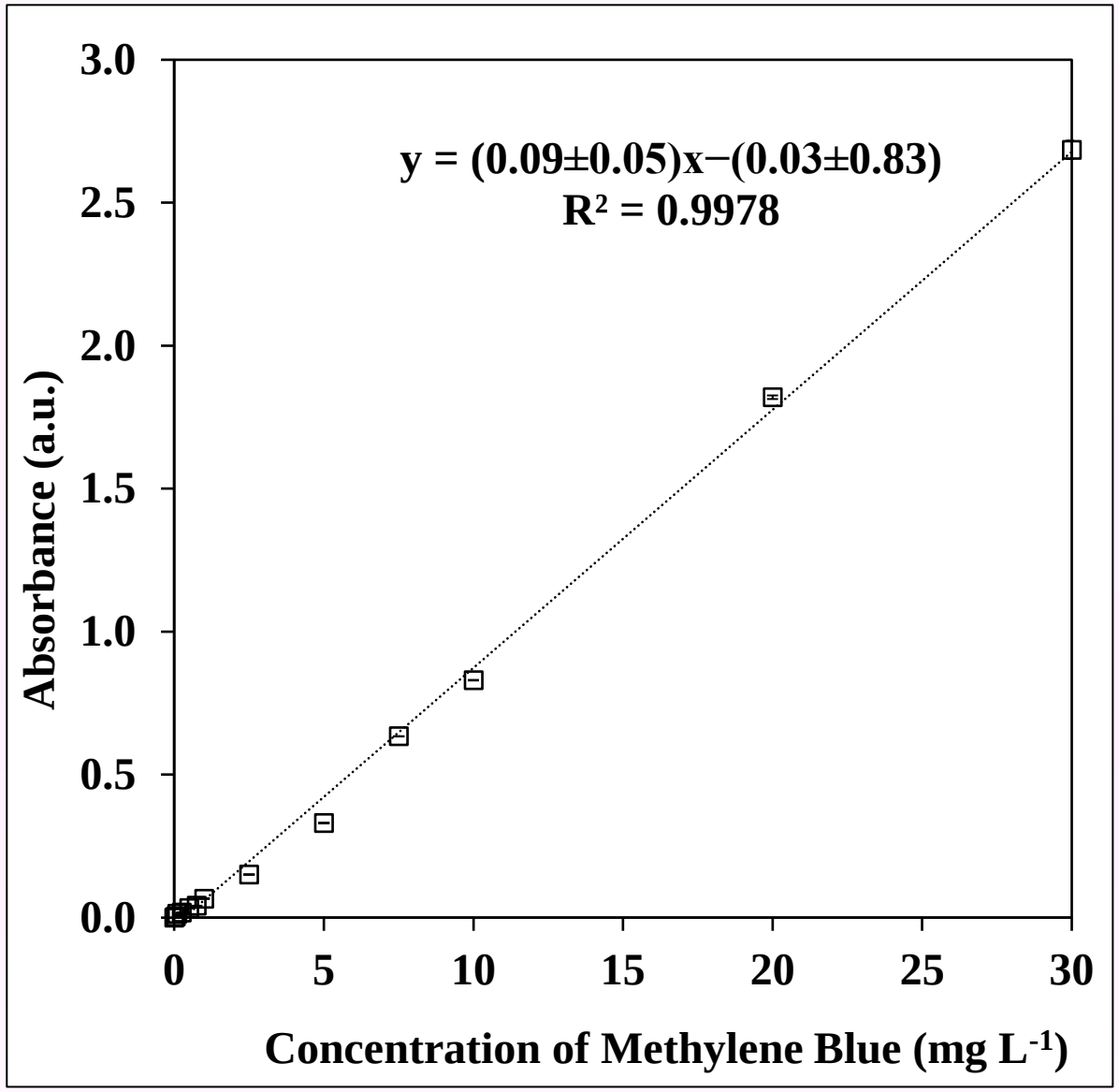


Starch cryogel

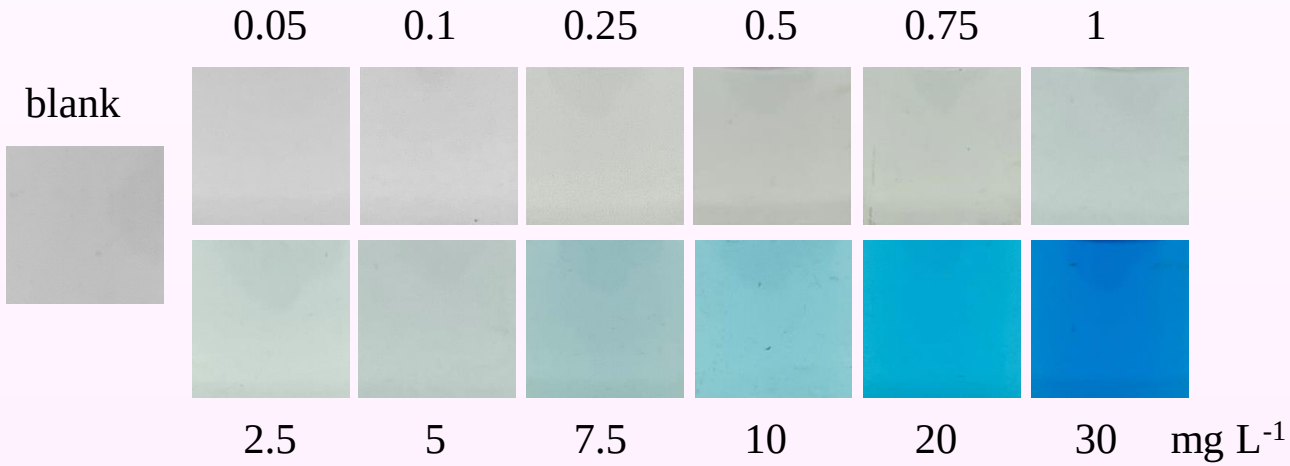


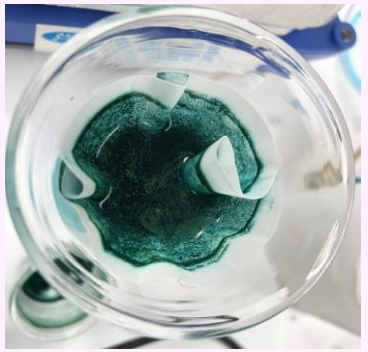
Batch system study

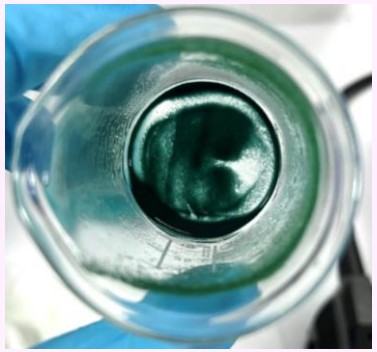
Linear range of Methylene blue (MB)



MB standard solution (0-30 mg L^{-1}) (filtrated*)



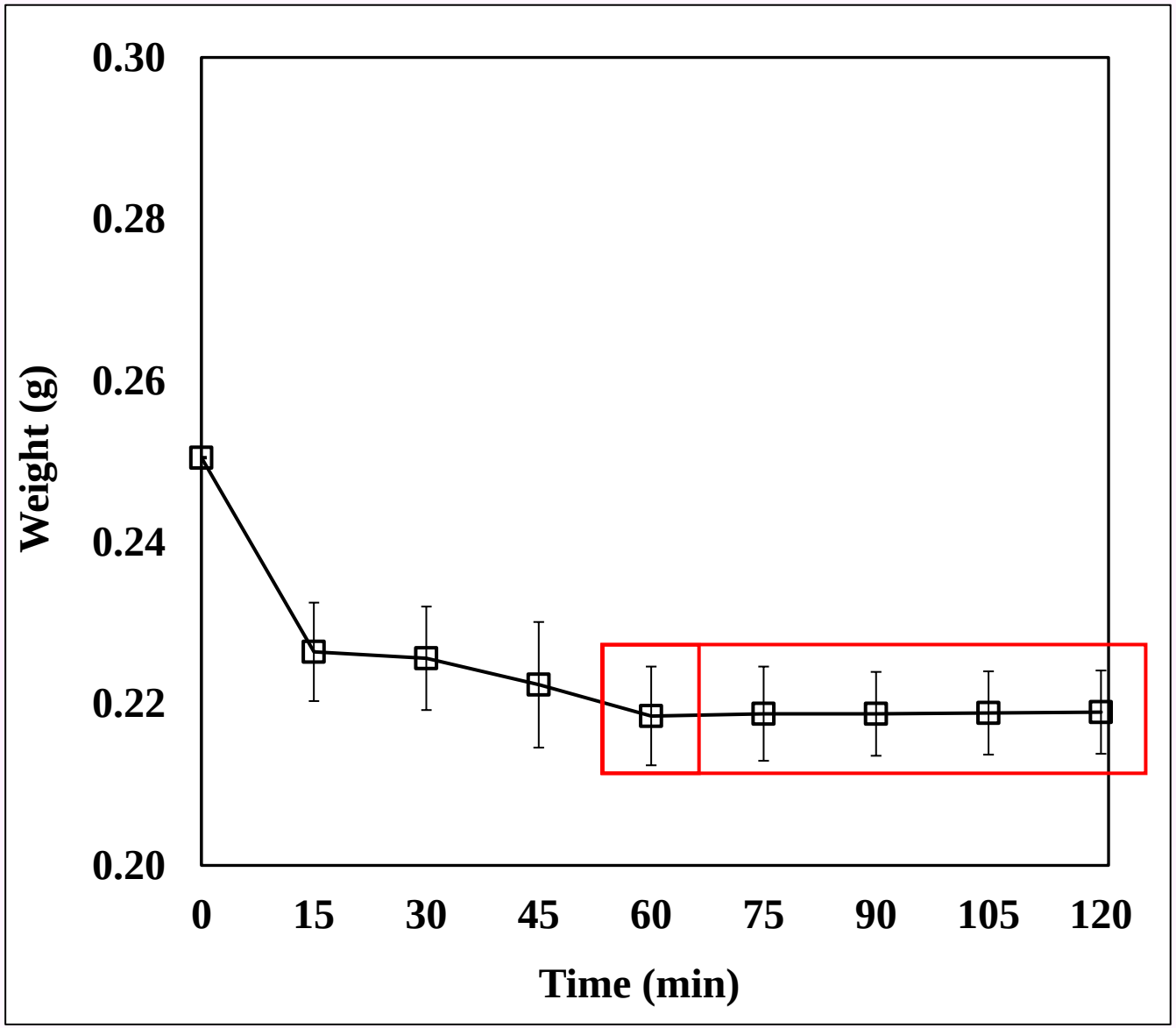




*In this study, I need to filtrate MB to remove the floating sediment of DMP before measuring with a UV-Vis spectrophotometer.

Reference: The efficiency of mangosteen peel for dye removal (2021), https://doi.org/10.1088/1742-6596/1719/1/012061.

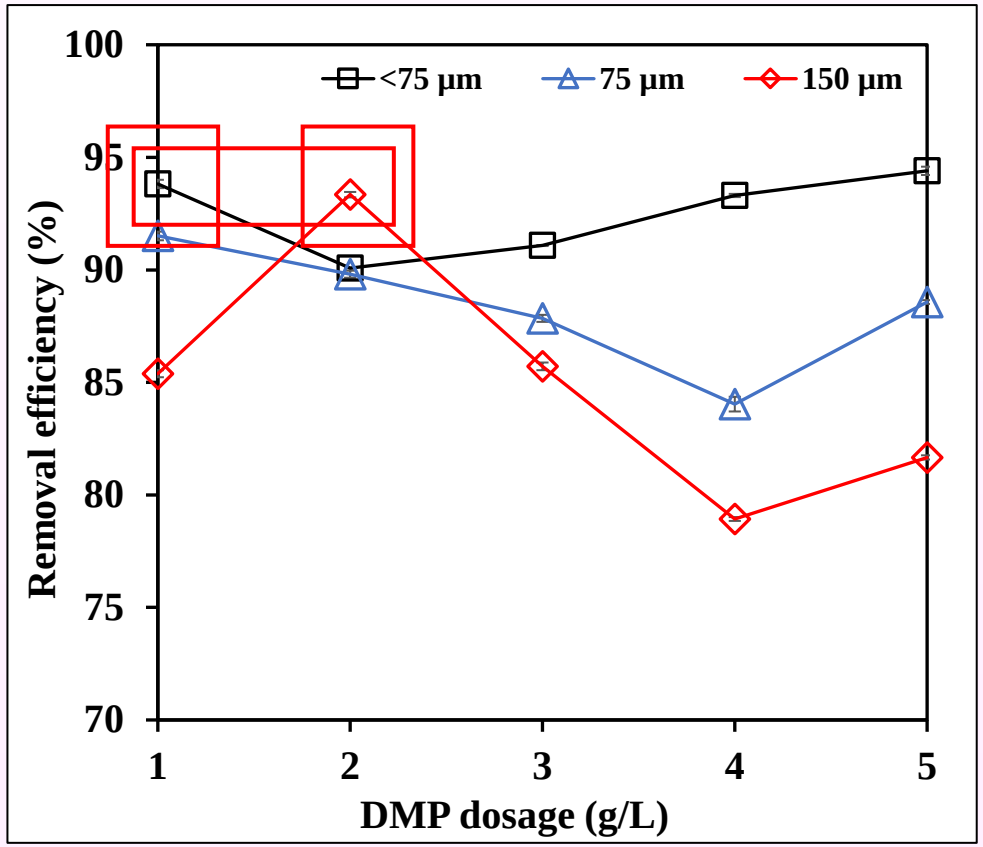
Preparation of Dried Mangosteen Peel (DMP)

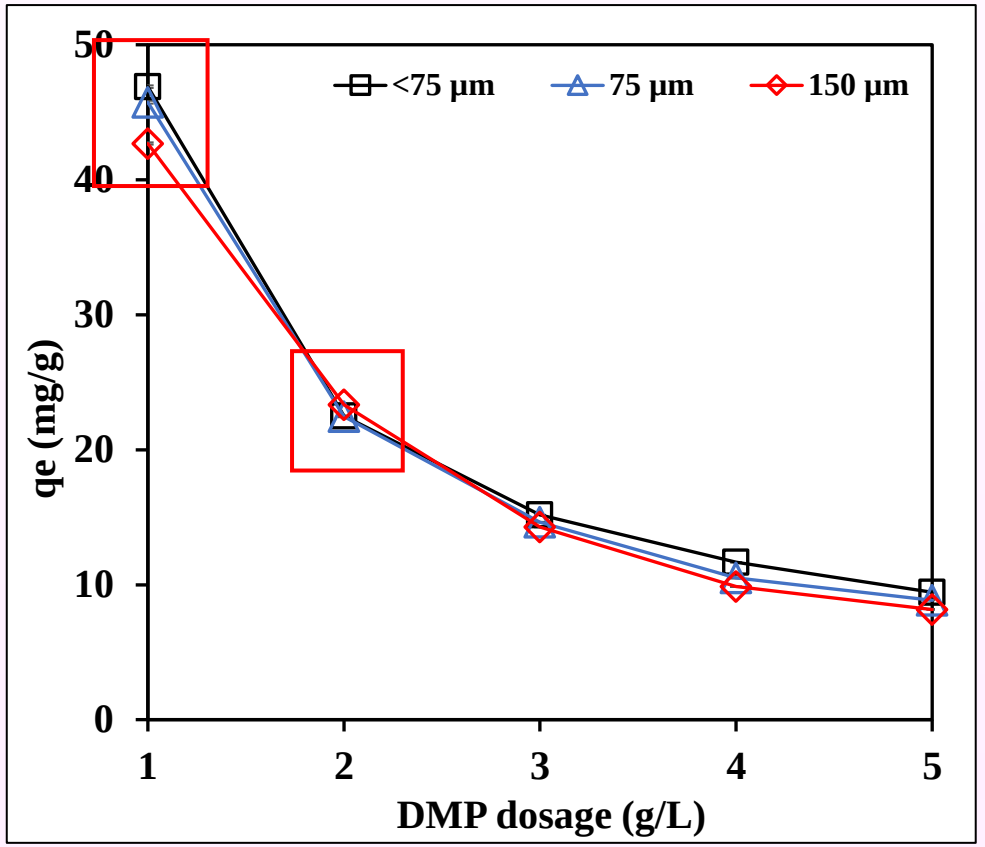


A study of the drying time of ground mangosteen peel (MP) with temperature at 105°C showed weight of MP was equilibrium after 60 min.

(Temperature was fixed at 105°C followed the previous research: The efficiency of mangosteen peel for dye removal (2021), https://doi.org/10.1088/1742-6596/1719/1/012061.)

Effect of DMP dosage and particle size on MB adsorption



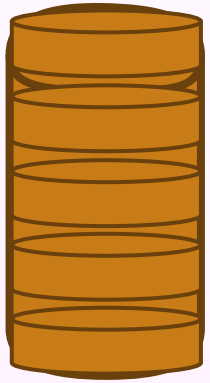


The particle sizes of DMP were divided into 3 sizes: <75-micron, 75-micron, and 150-micron, all of these were used to study the removal efficiency of MB with the ratios of DMP dosage at 1:1, 2:1, 3:1, 4:1, and 5:1 g/L

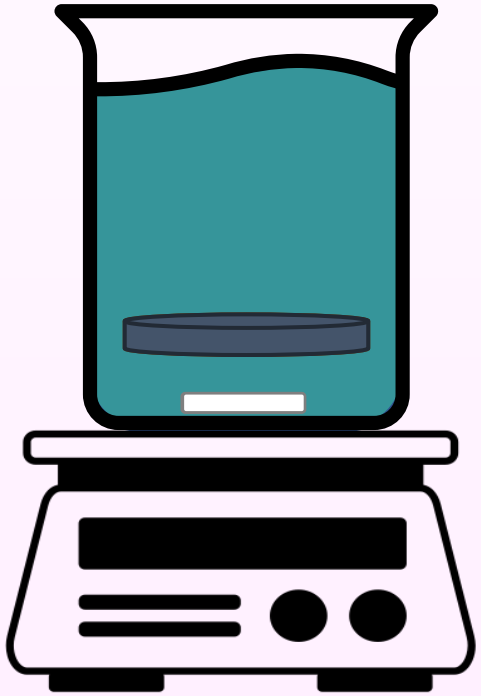
(concentration of MB and contact time were fixed at 50 mg L^{-1} and 1 h, respectively followed the previous research: The efficiency of mangosteen peel for dye removal (2021), https://doi.org/10.1088/1742-6596/1719/1/012061.)

Fabrication of Cry-DMP

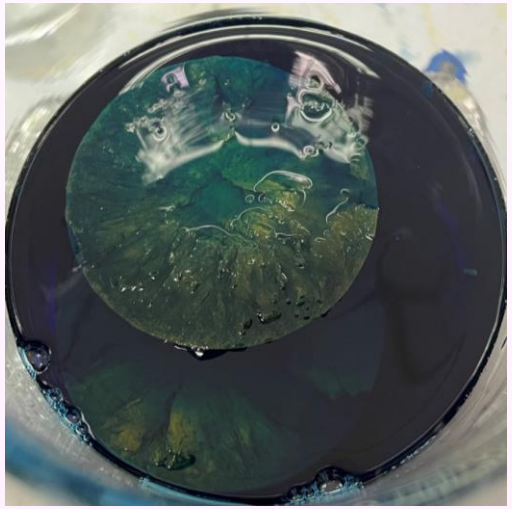
Cryogel (Cry) ratio : rice flour 62.5 g + tapioca starch 18.75 g + lime water ($Ca(OH)_2$) 500 mL + DMP **x** g



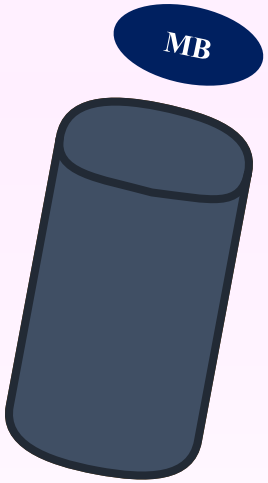
Cry-DMP
(monolithic material)



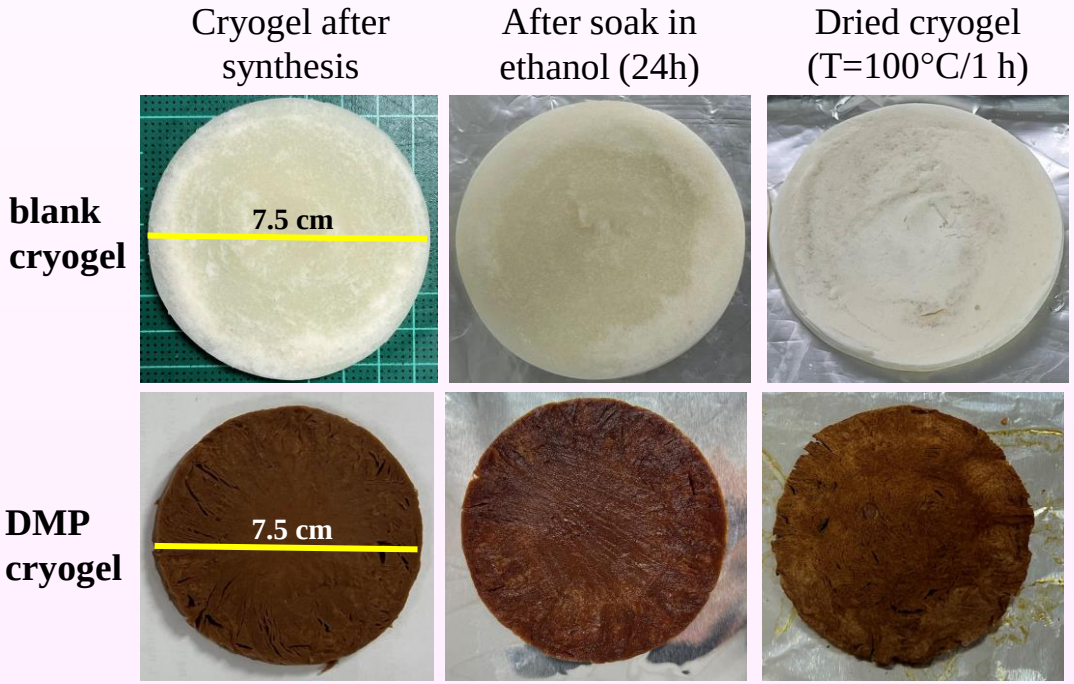
Batch system

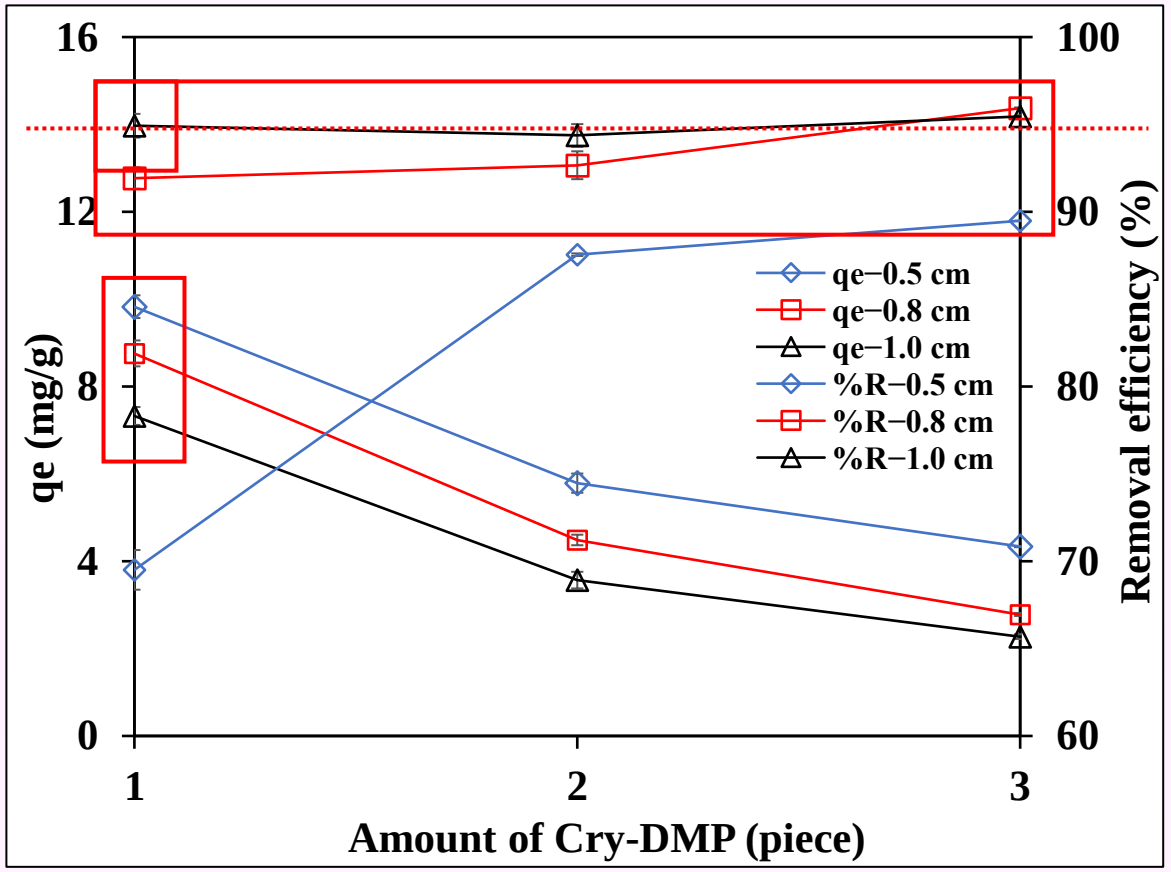


Continuous flow system



Fabrication of Cry-DMP and effect of Cry-DMP dosage





Cry-DMP was fabricated at the thickness of 0.5, 0.8, and 1.0 centimeters with the amount of DMP at 20, 12.5, and 10 g, respectively. To study the removal efficiency of MB, the amounts of all thickness Cry-DMP at 1, 2, and 3 pieces were used.

(concentration of MB and contact time were fixed at 50 mg L^{-1} and 1 h, respectively followed the previous research: The efficiency of mangosteen peel for dye removal (2021), https://doi.org/10.1088/1742-6596/1719/1/012061.)

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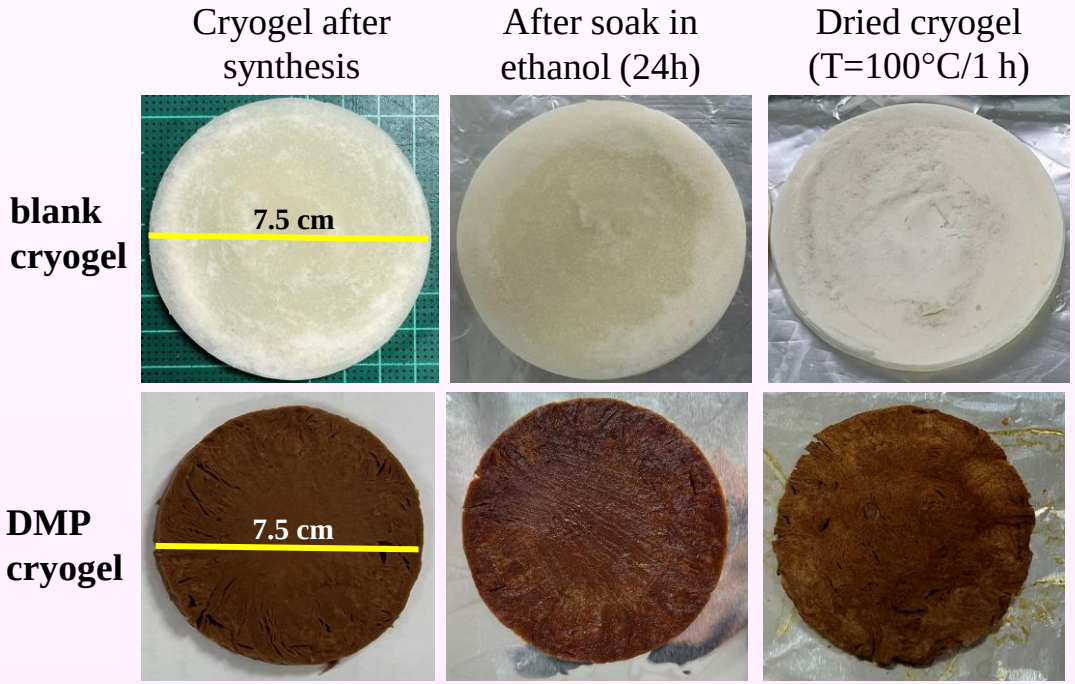

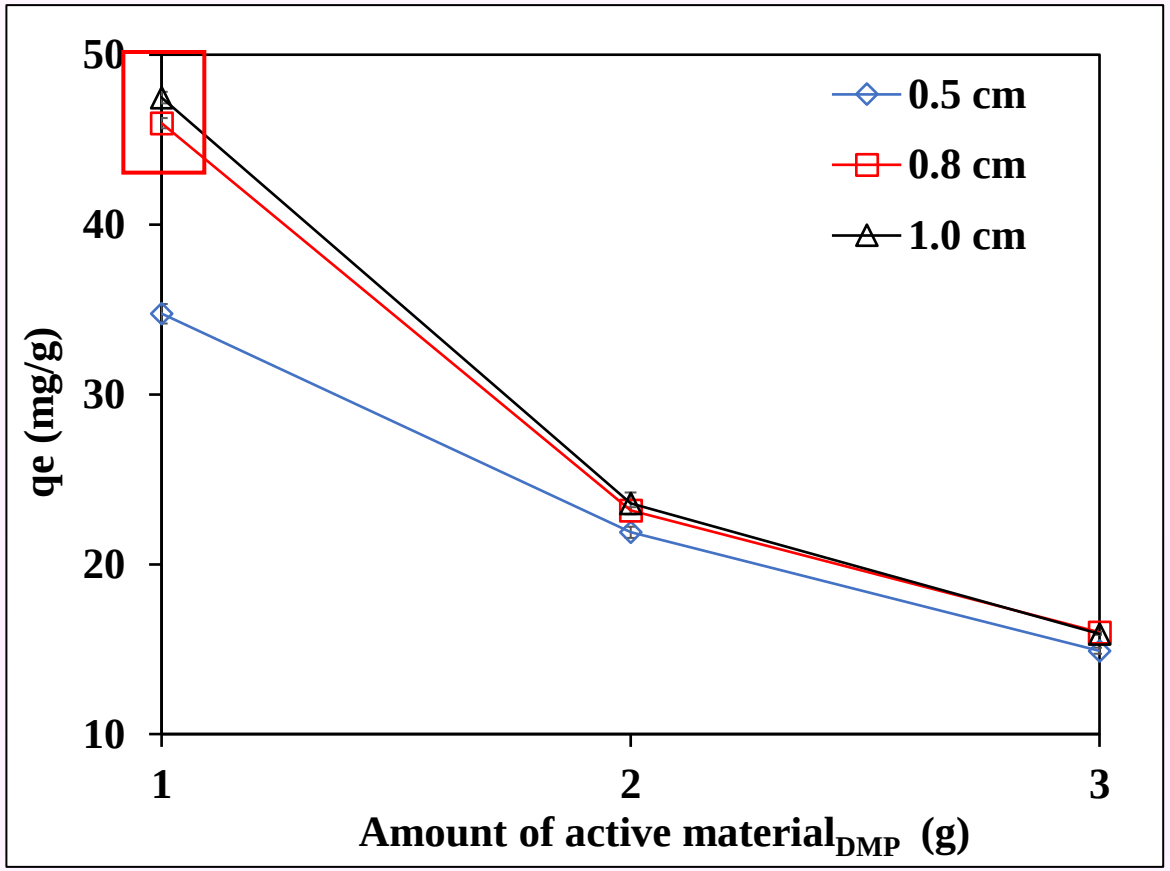

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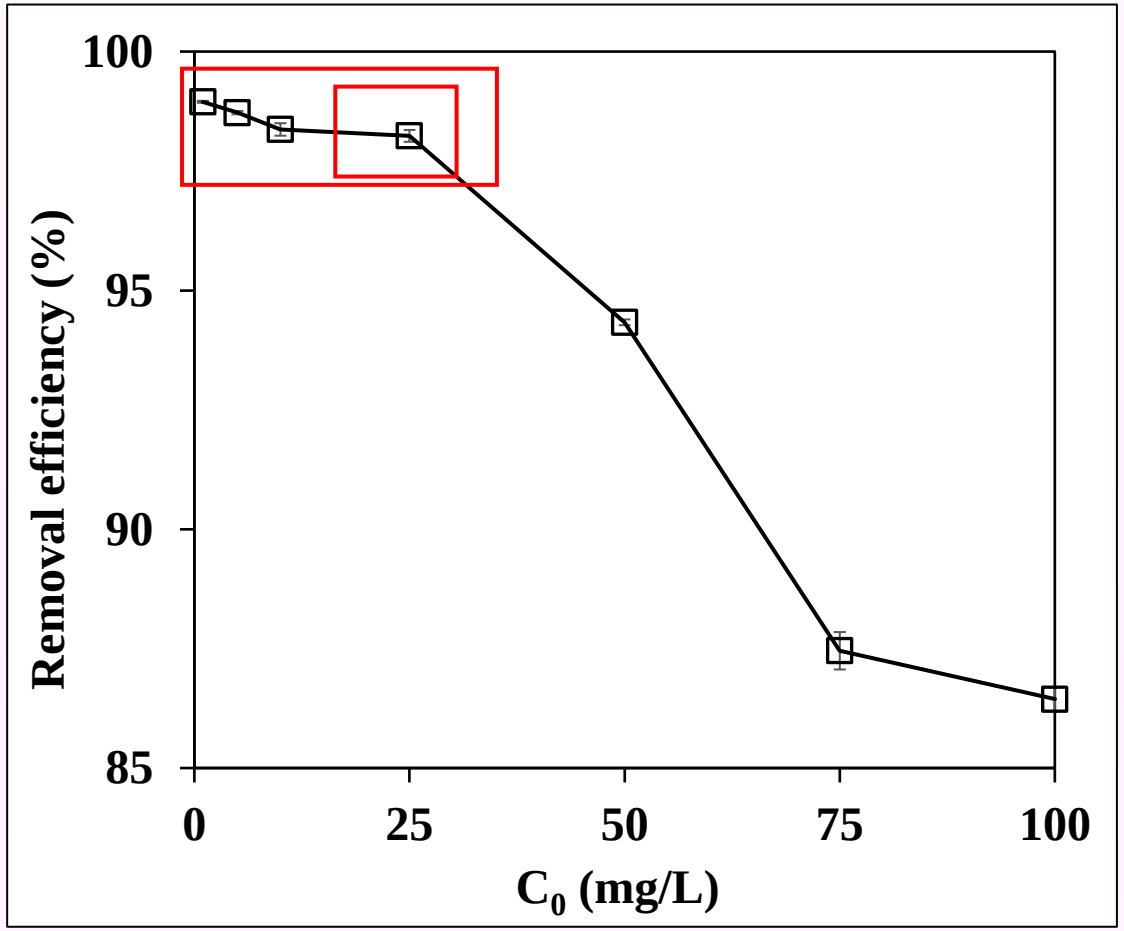
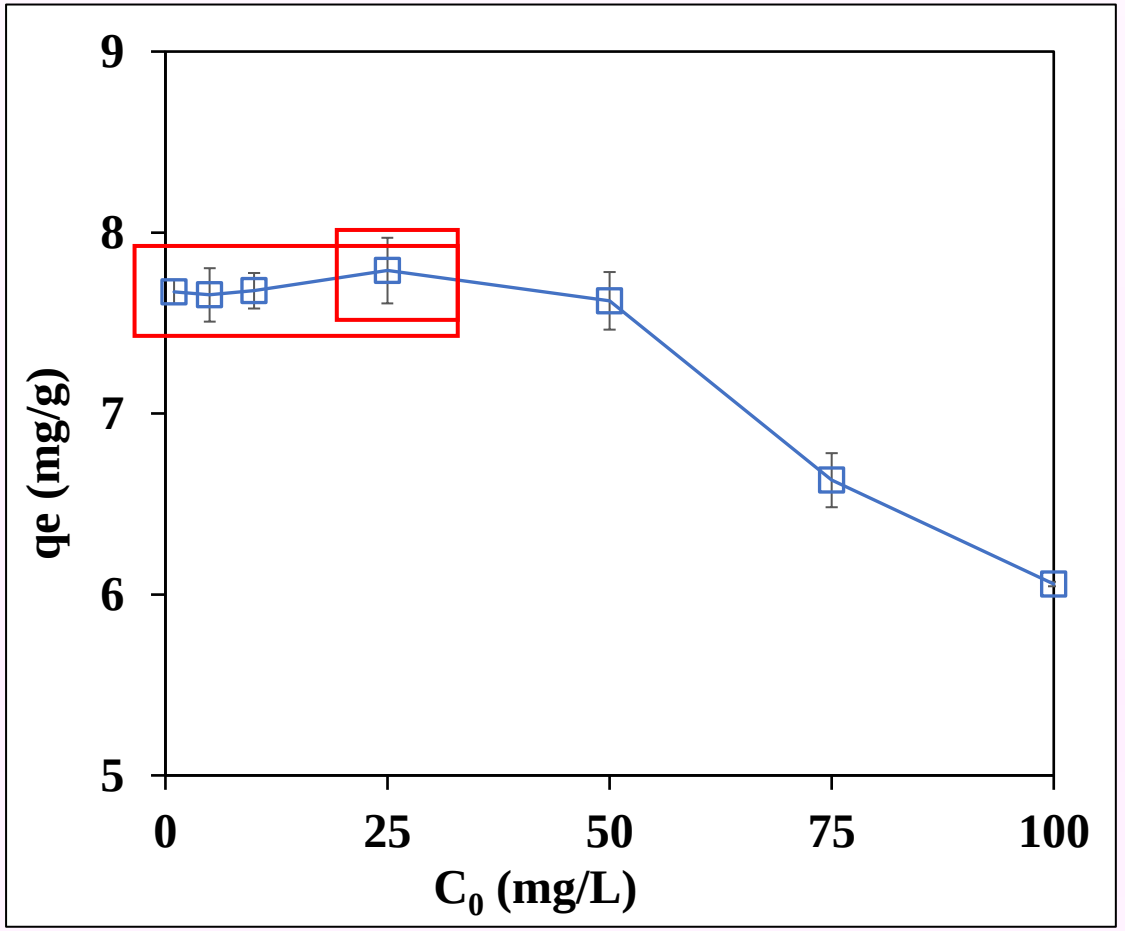
Effect of initial concentration

Removal efficiency of MB in the concentration range of 0 to 100 mg/L

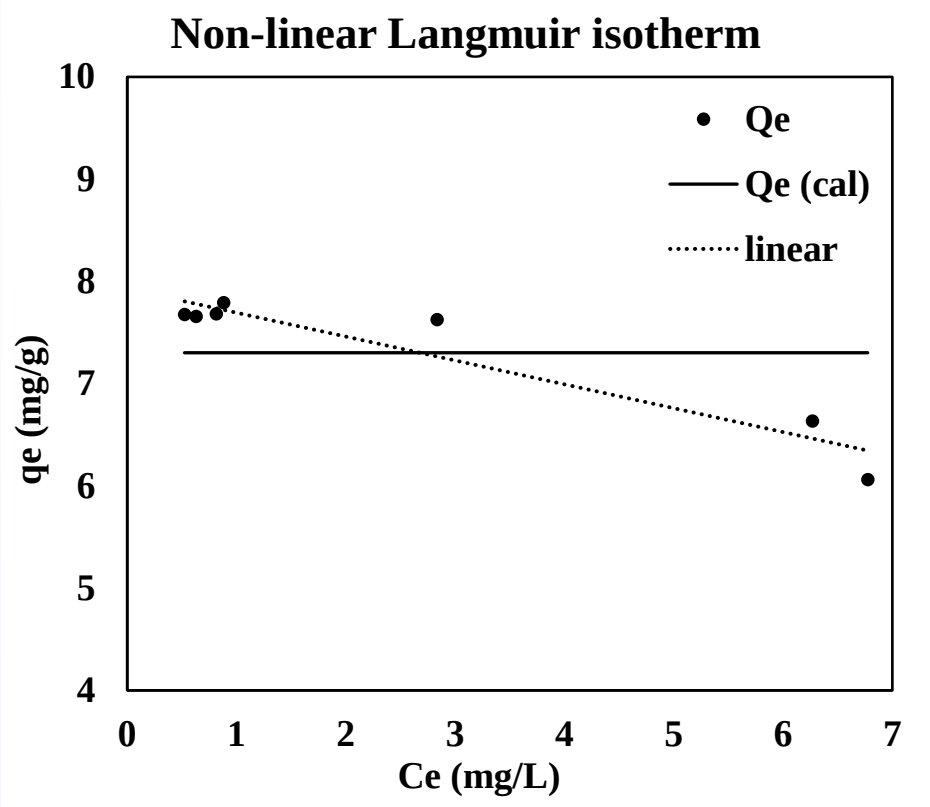


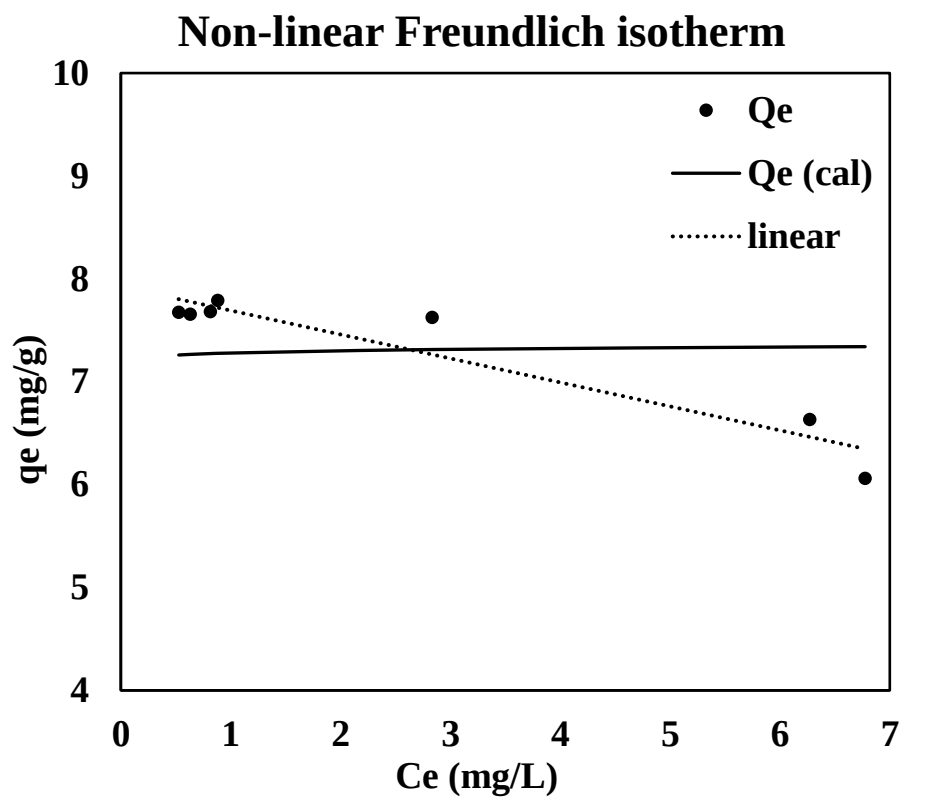


(contact time was fixed at 1 h followed the previous research: The efficiency of mangosteen peel for dye removal (2021), https://doi.org/10.1088/1742-6596/1719/1/012061.)

Adsorption isotherms

Non-linear isotherm



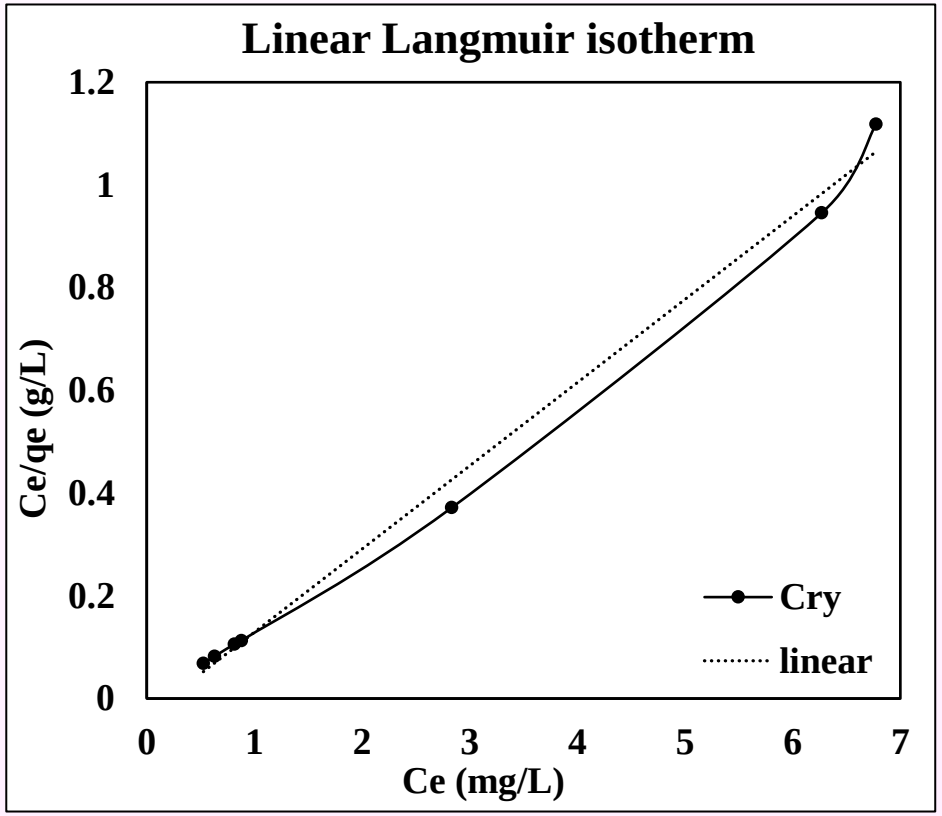


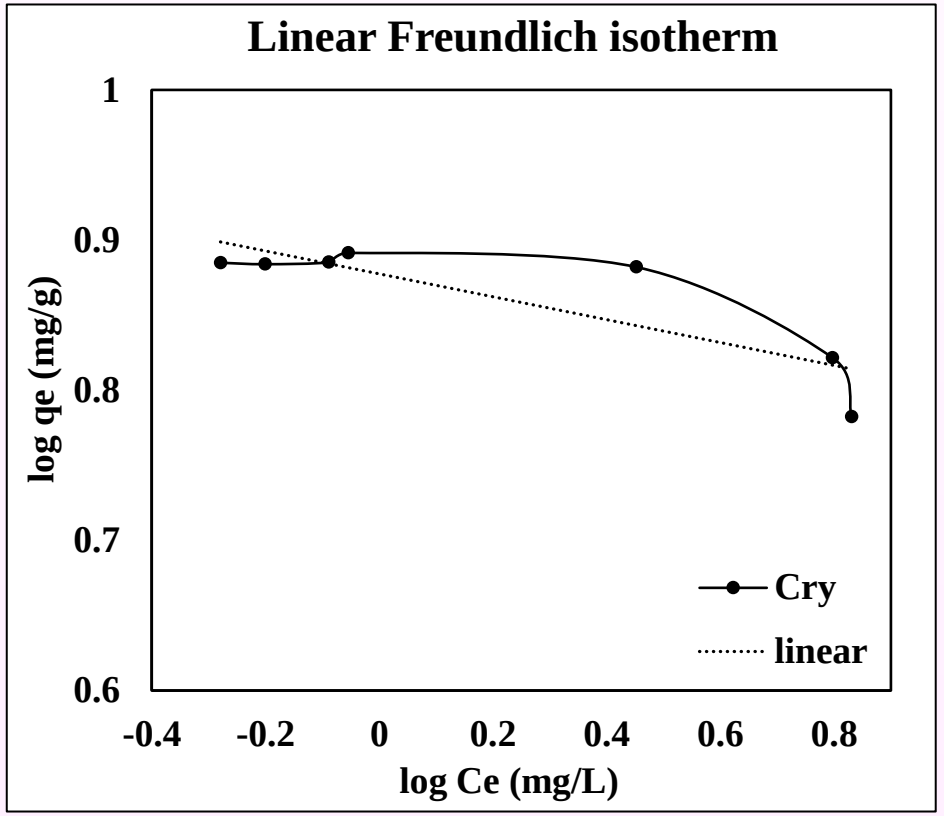
Langmuir	q_m (mg/g)	K_L (L/mg)	R^2	SD	SSE
Cry	7.3013	1.49×10^{9}	0.9445	0.1043	0.2581
Active material$_{DMP}$	47.3226	1.92×10^{9}	0.9774	0.4236	1.0484

Freundlich	1/n	K_F (mg^{1-n} L^n/g)	R^2	SD	SSE
Cry	0.0043	1.00×10^{200}	0.9395	0.0056	0.0139
Active material$_{DMP}$	0.0084	1.00×10^{200}	0.9699	0.0109	0.0270

Absorption isotherms

Linear isotherm



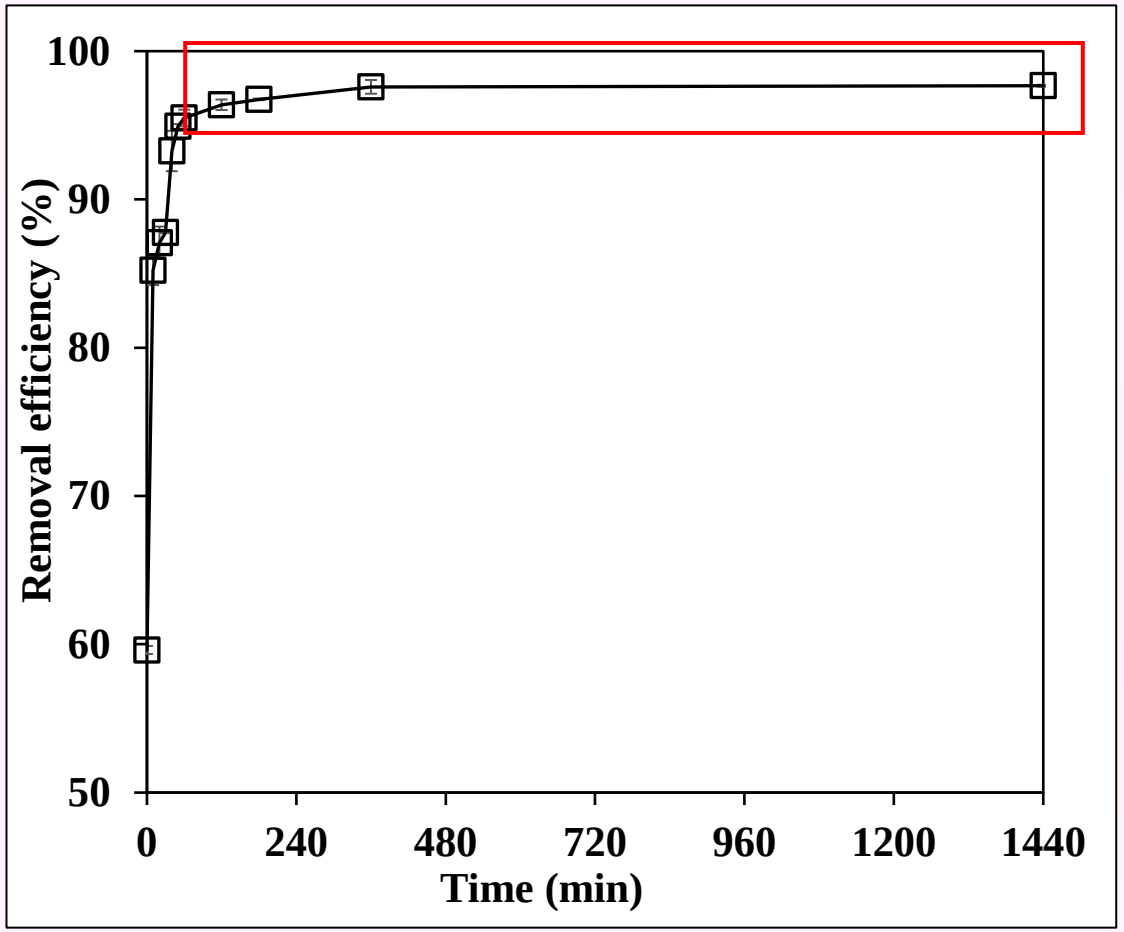


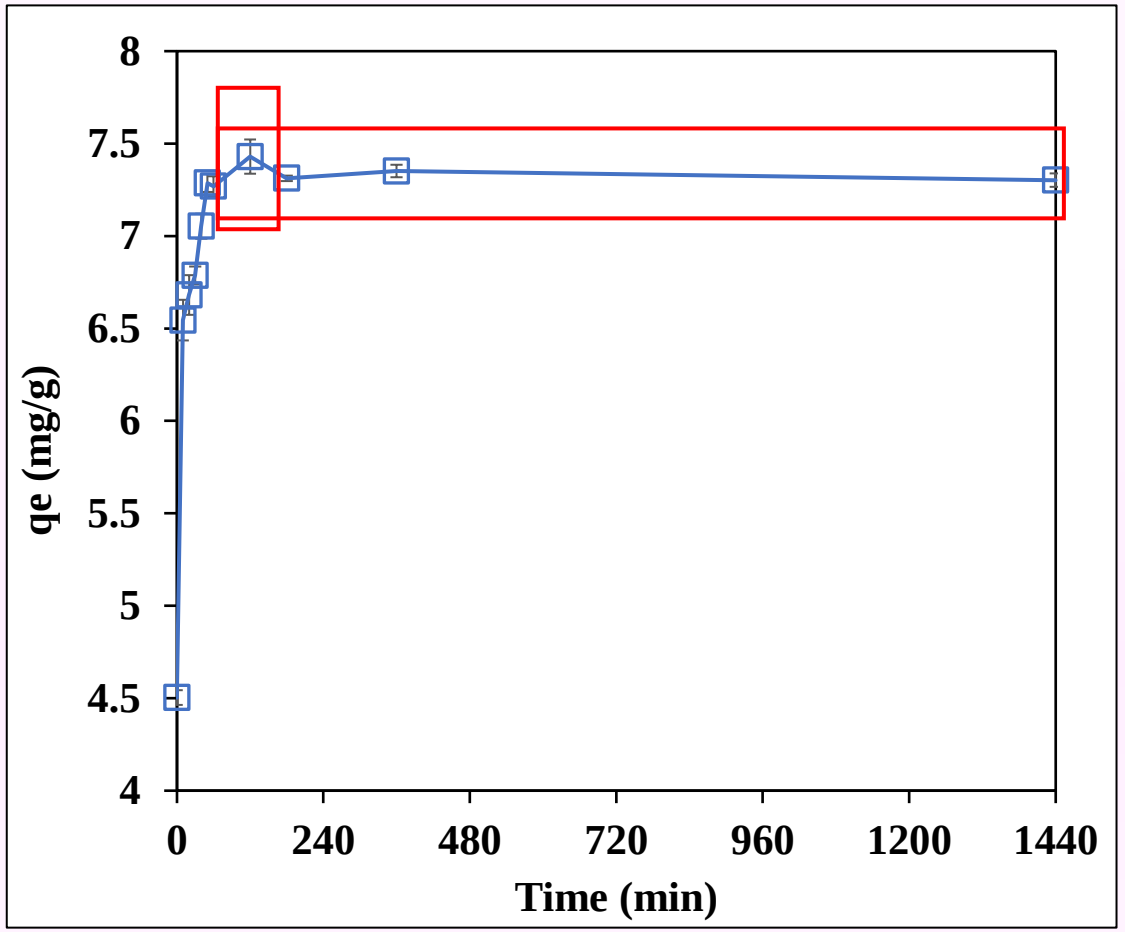
Langmuir	Q_m (mg/g)	K_L (L/mg)	R^2	R_L
Cry	6.1767	-0.2007	0.9935	0.05 to 0.99
Active material$_{DMP}$	42.9185	-0.1159	0.9994	0.09 to 0.53

Freundlich	1/n	K_F	R^2
Cry	-0.0762	7.5440	0.7288
Active material$_{DMP}$	-0.0525	48.4617	0.9400

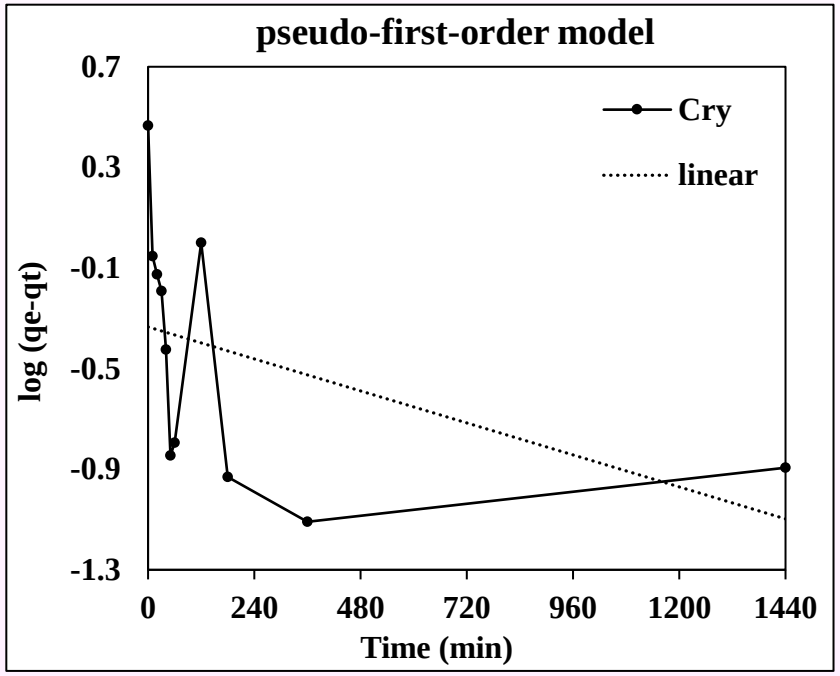
Effect of contact time

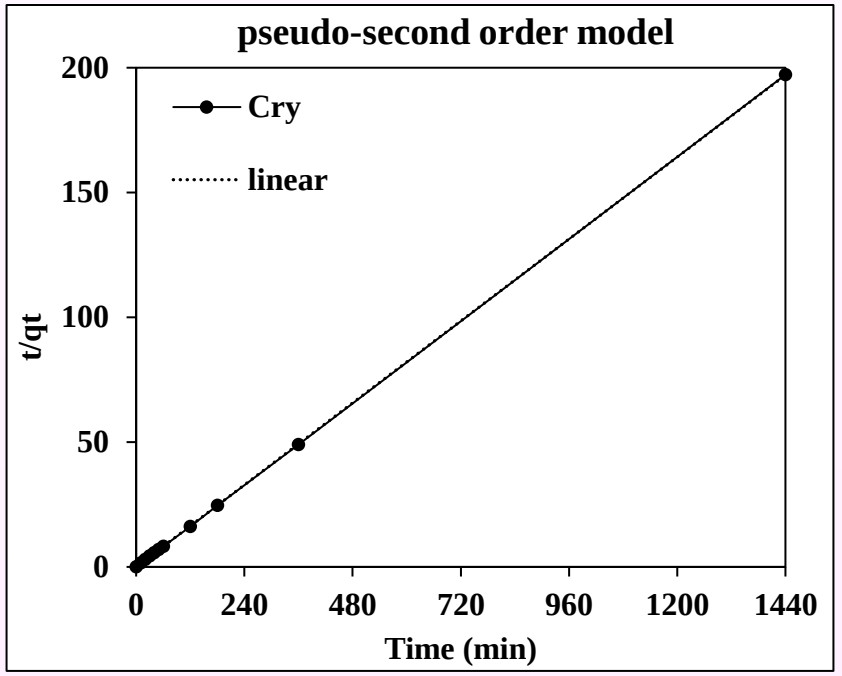
Effect of contact time to remove MB at 0 to 1440 min

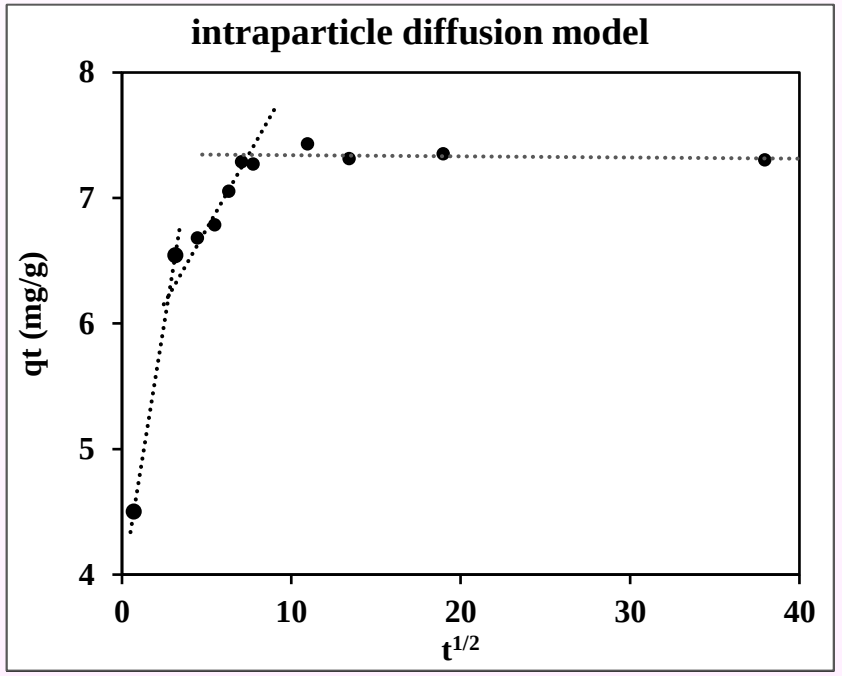




Adsorption kinetics and intraparticle diffusion model





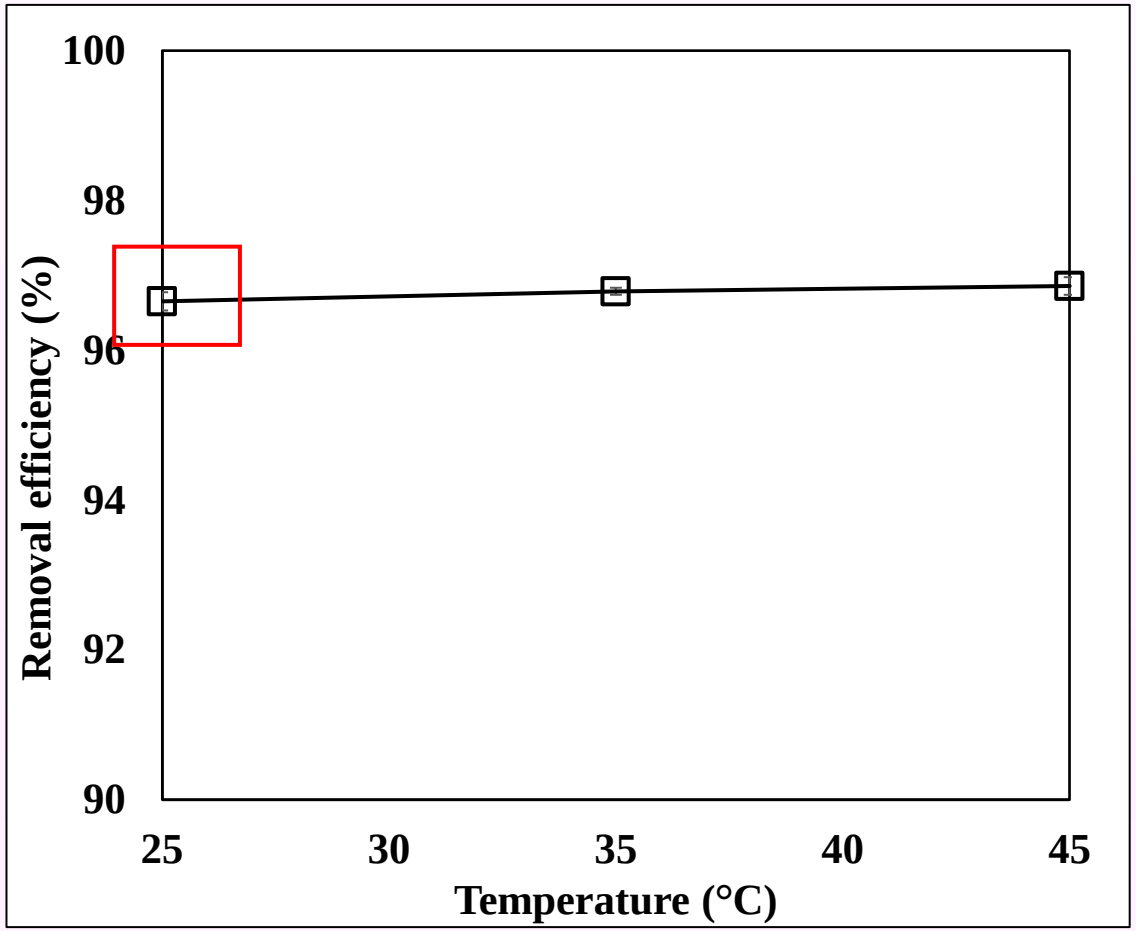


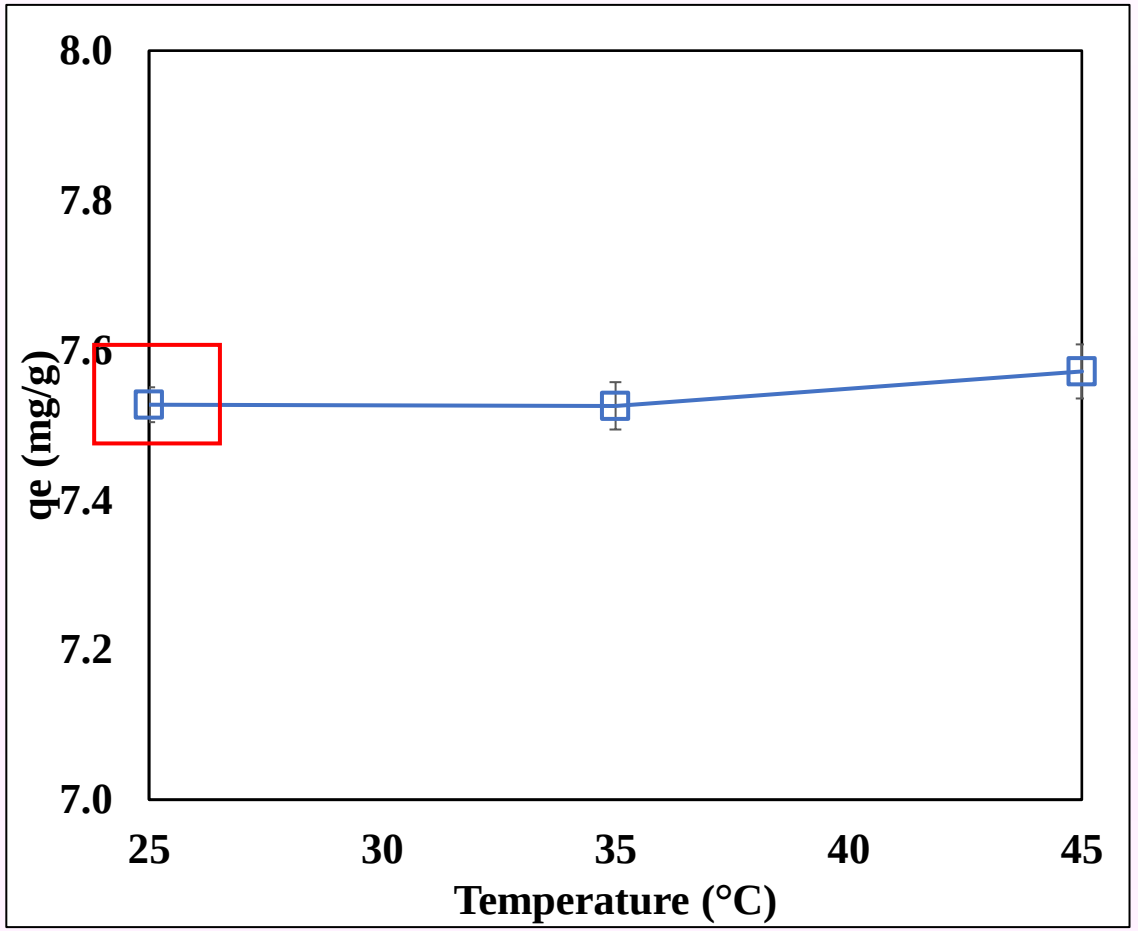
Adsorption kinetic model pseudo-first-order					
	C	qe (cal) (mg/g)	m	k_1 (min^{-1})	R^2
Cry	-0.3345	0.462914	-0.0005	$1.15x10^{-3}$	0.1987
Active $material_{DMP}$	0.3017	2.003088	-0.0005	$1.15x10^{-3}$	0.1005

Adsorption kinetic model pseudo-second-order					
	m	qe (cal) (mg/g)	C	k_2 (g/mg/min	R^2
Cry	0.1368	7.309942	0.0527	0.3551	1
Active $material_{DMP}$	0.0205	48.78049	0.0345	0.0121	1

The intraparticle diffusion model of MB adsorptionti		
	R^2	K_P (g/mg·$min^{1/2}$)
Cry-DMP	1	0.8317
	0.9500	0.2376
	0.0321	-0.0009
Active $material_{DMP}$	1	5.2150
	0.8966	1.6598
	0.6389	0.0302

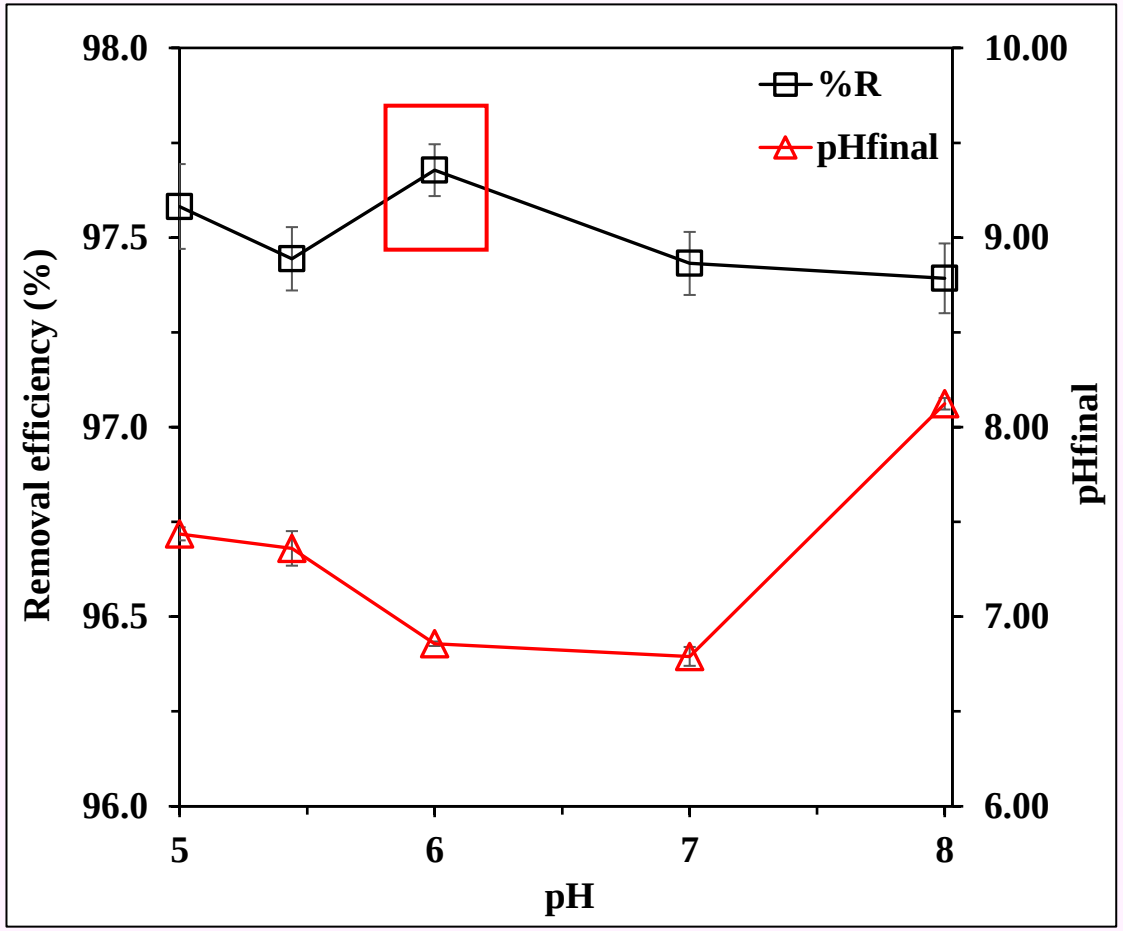
Thermodynamic study

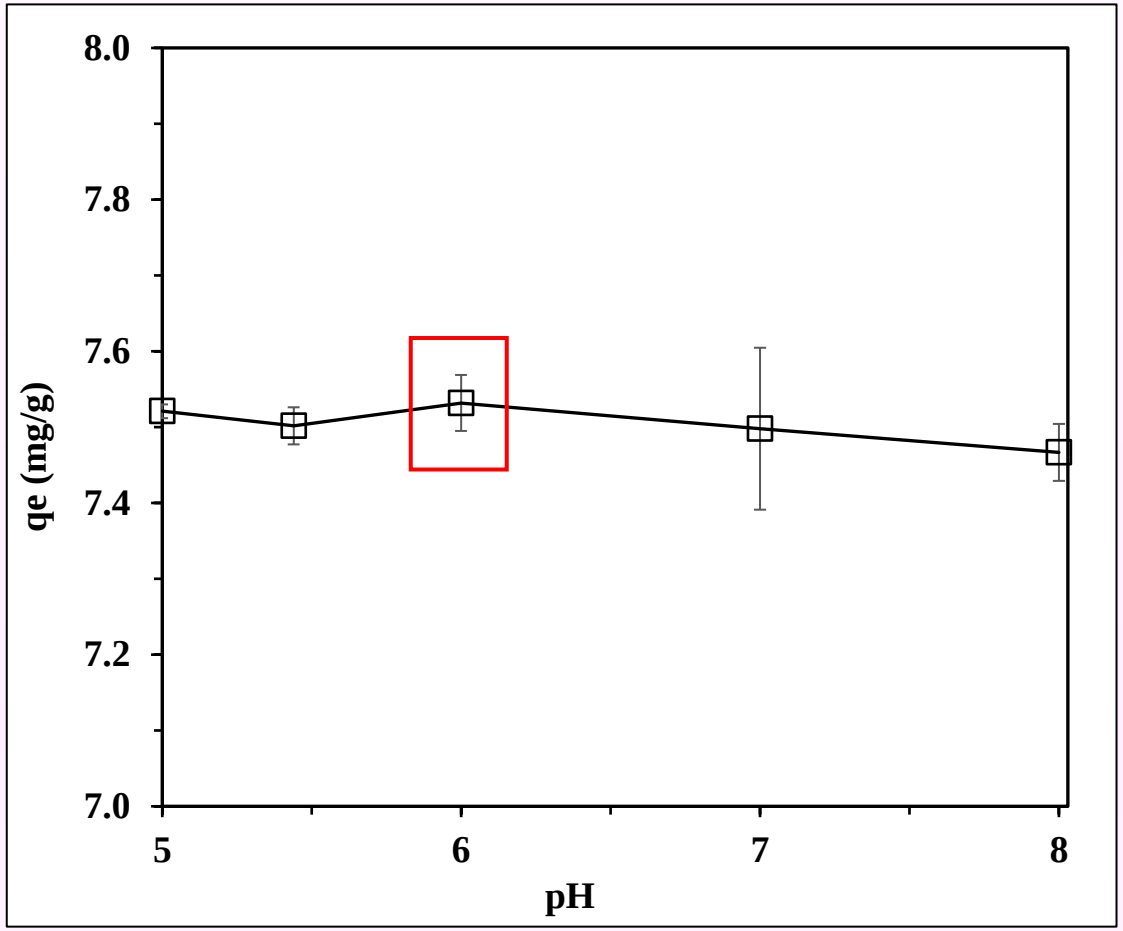




(contact time was fixed at 120 min followed the previous study)

Effect of pH





(contact time and was fixed at 120 min followed the previous study)

Future research plans

- Study about the point of zero charges (pHpzc)
- Study more about the influence of pH on adsorption kinetic
- Study more about the influence of adsorption temperature (adsorption thermodynamic)
- Study the continuous flow system following the batch system condition


Thank You
For
Your Attention