

## Innovative optimization for enhancing $Pb^{2+}$ biosorption from aqueous solutions using *Bacillus subtilis*

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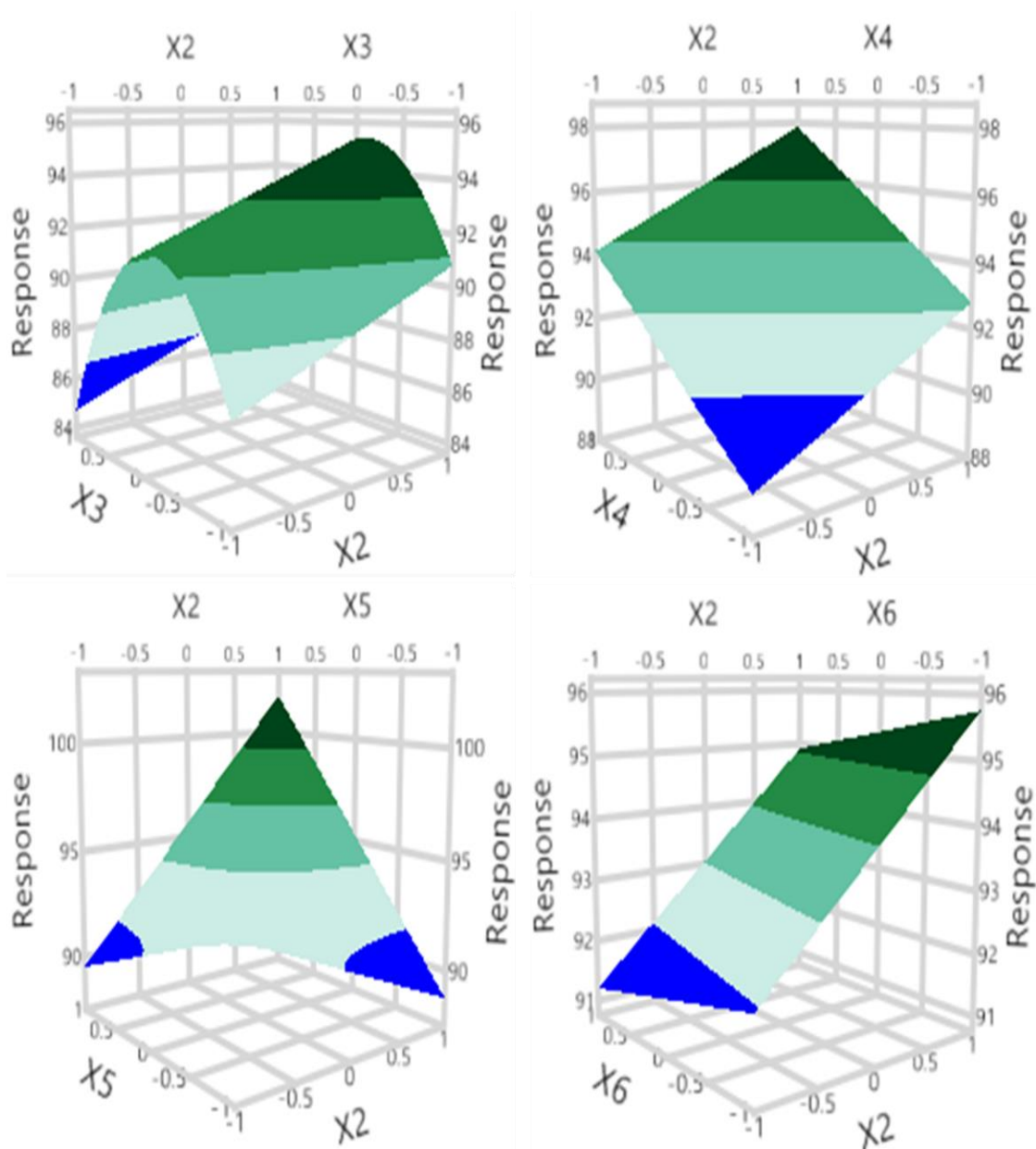
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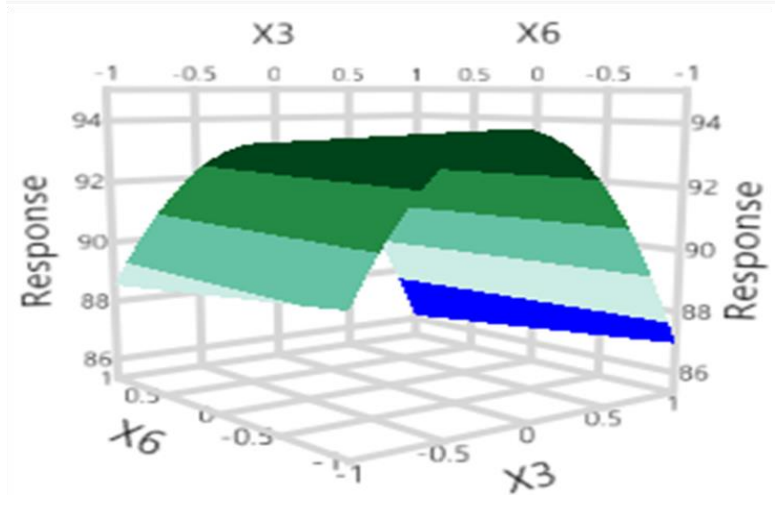
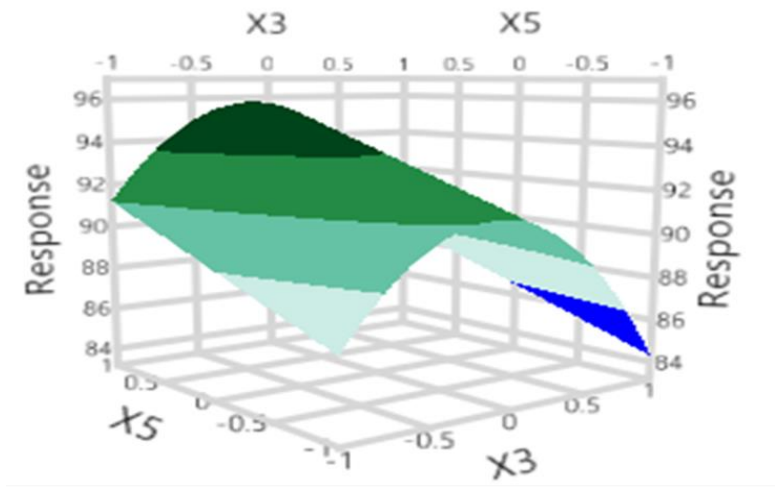
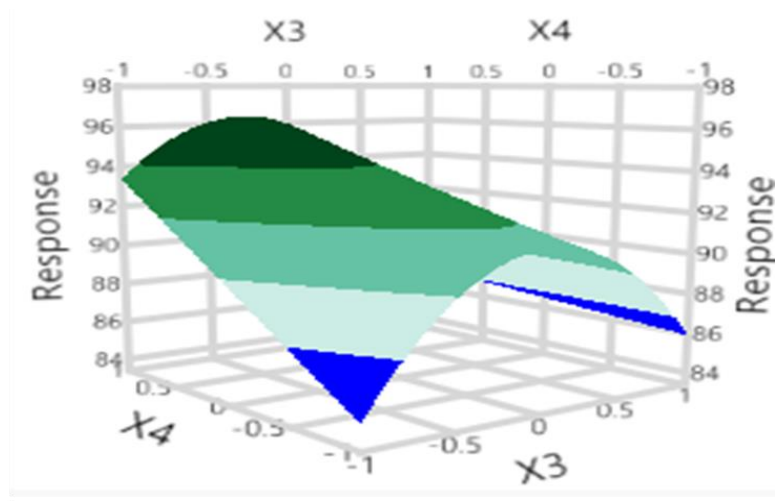
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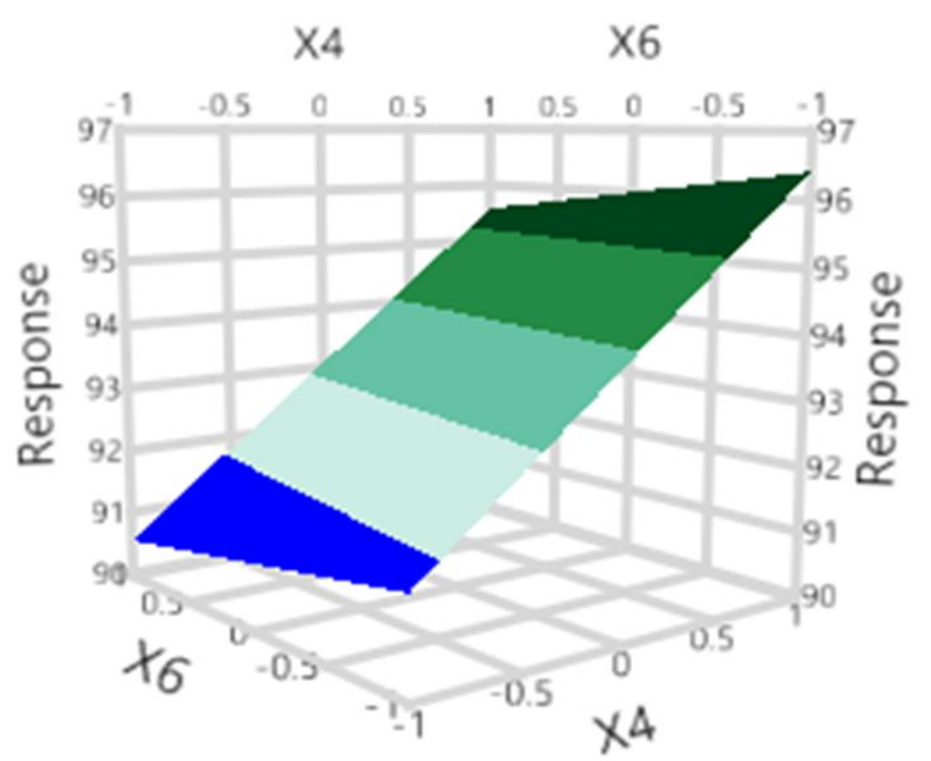
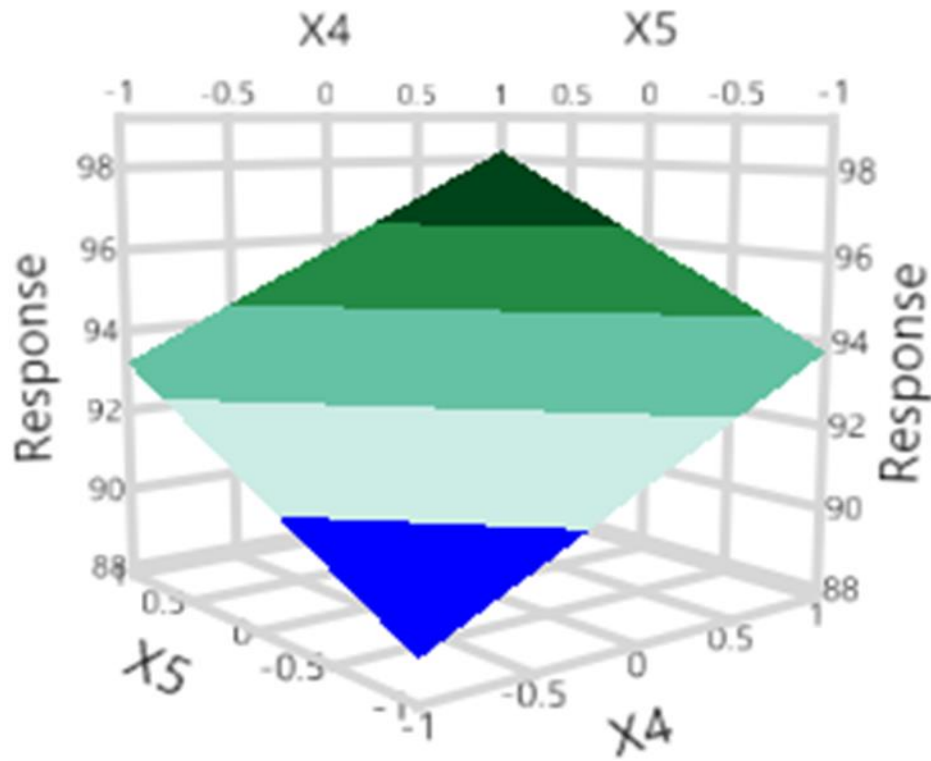
Figure S1: Graphs of three-dimensional surface plots of SDS for the  $Pb^{2+}$  removal by *B. subtilis*, illustrating the interactive configuration of each two set of the independent variables, keeping the other variables at the middle level.



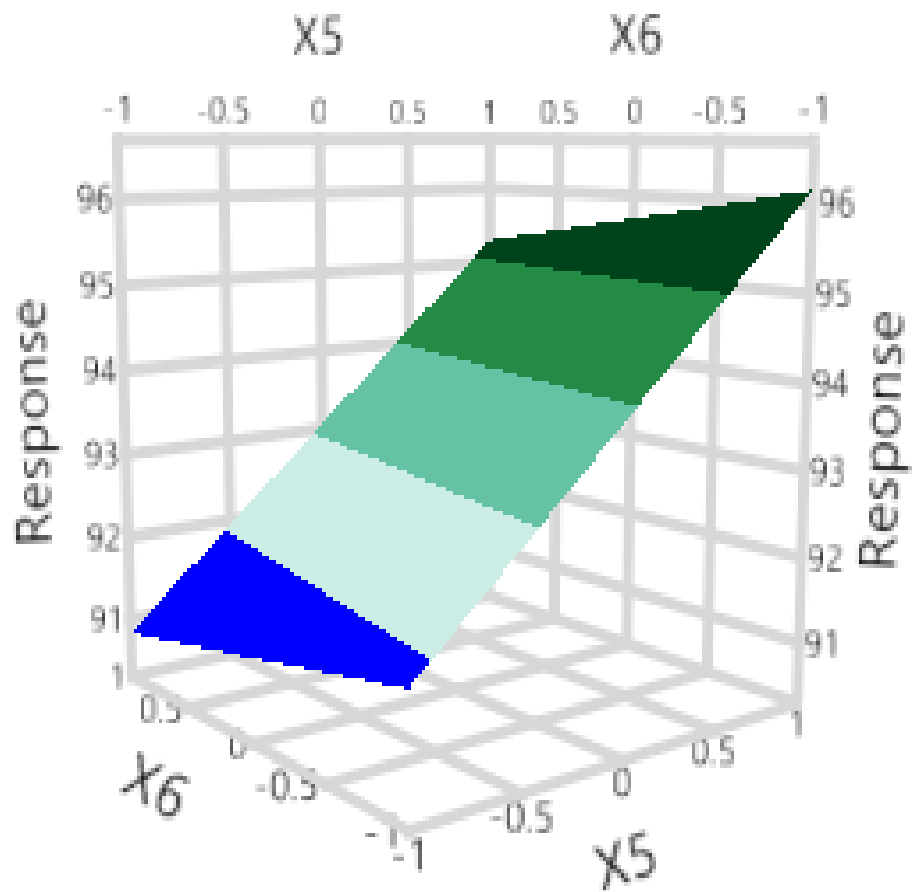
A) interaction of temperature (X<sub>2</sub>, °C) with the other variables.



B) interaction of glucose (X<sub>3</sub>, %) with the other variables.

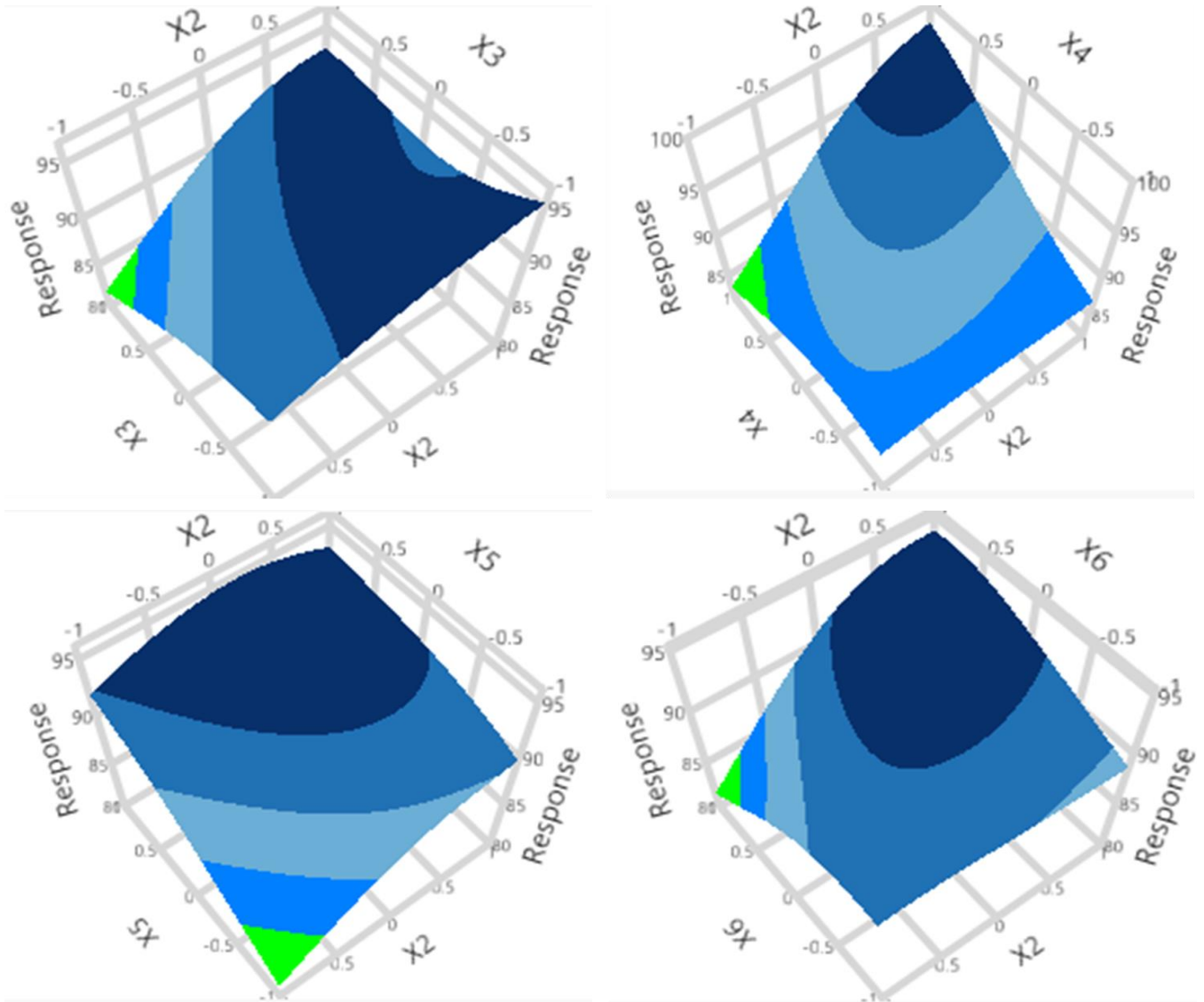


C) interaction of yeast extract (X<sub>4</sub>, %) with the other variables.

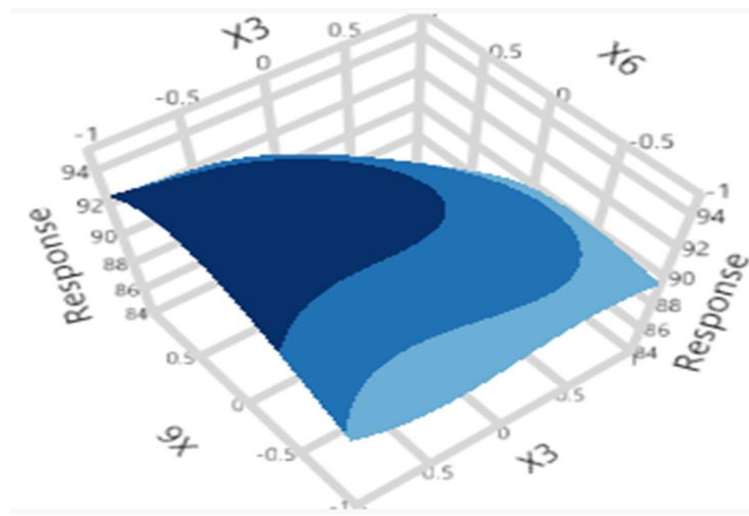
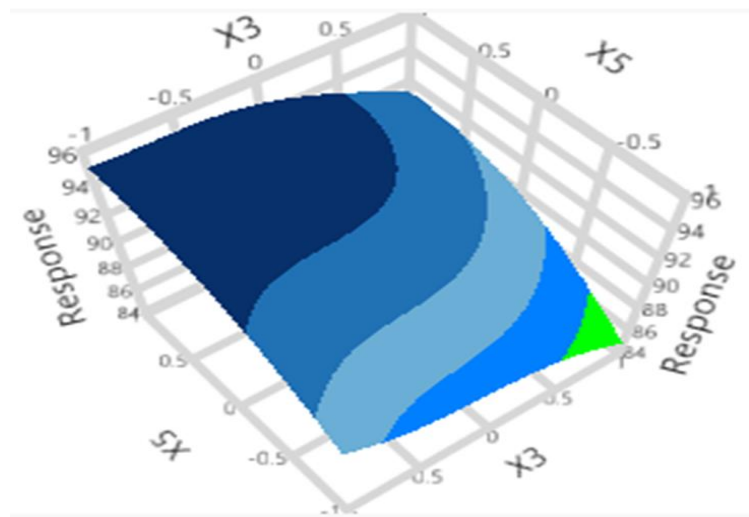
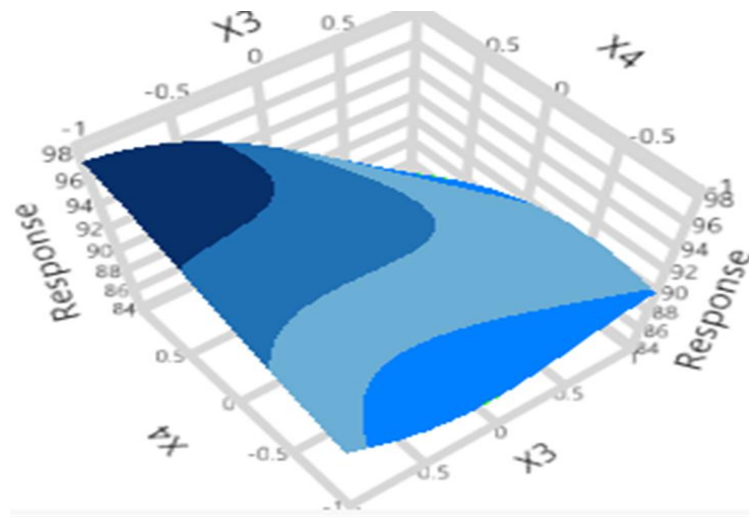


D) interaction of  $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$  (%) ( $X_5$ , %) with  $\text{K}_2\text{HPO}_4$  ( $X_6$ , %) variables.

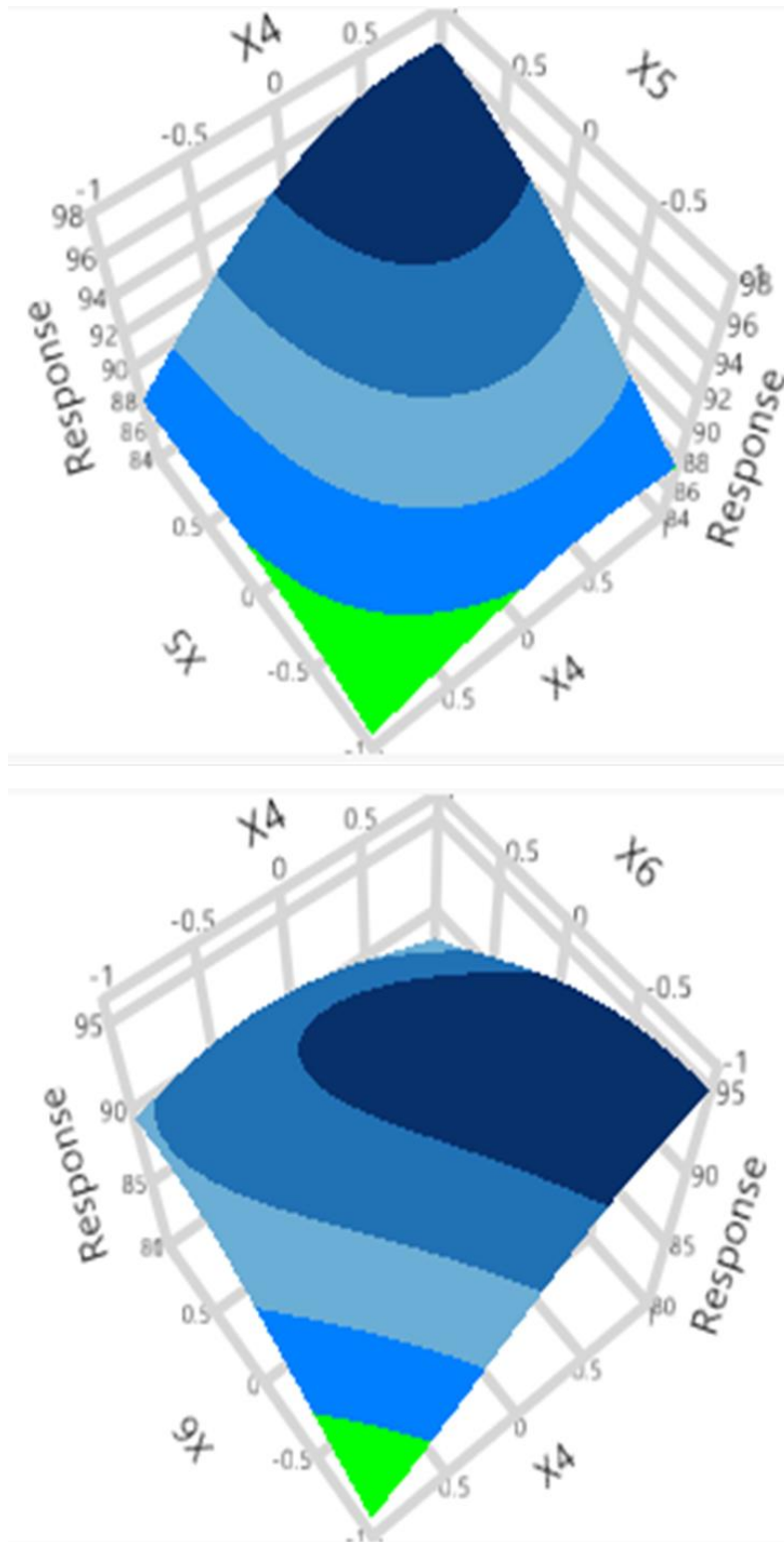
Figure S2: Graphs of three-dimensional surface plots of ANN for the  $Pb^{2+}$  removal by *B. subtilis*, illustrating the interactive configuration of each two set of the independent variables, keeping the other variables at the middle level.



A) interaction of temperature ( $X_2$ , °C) with the other variables.

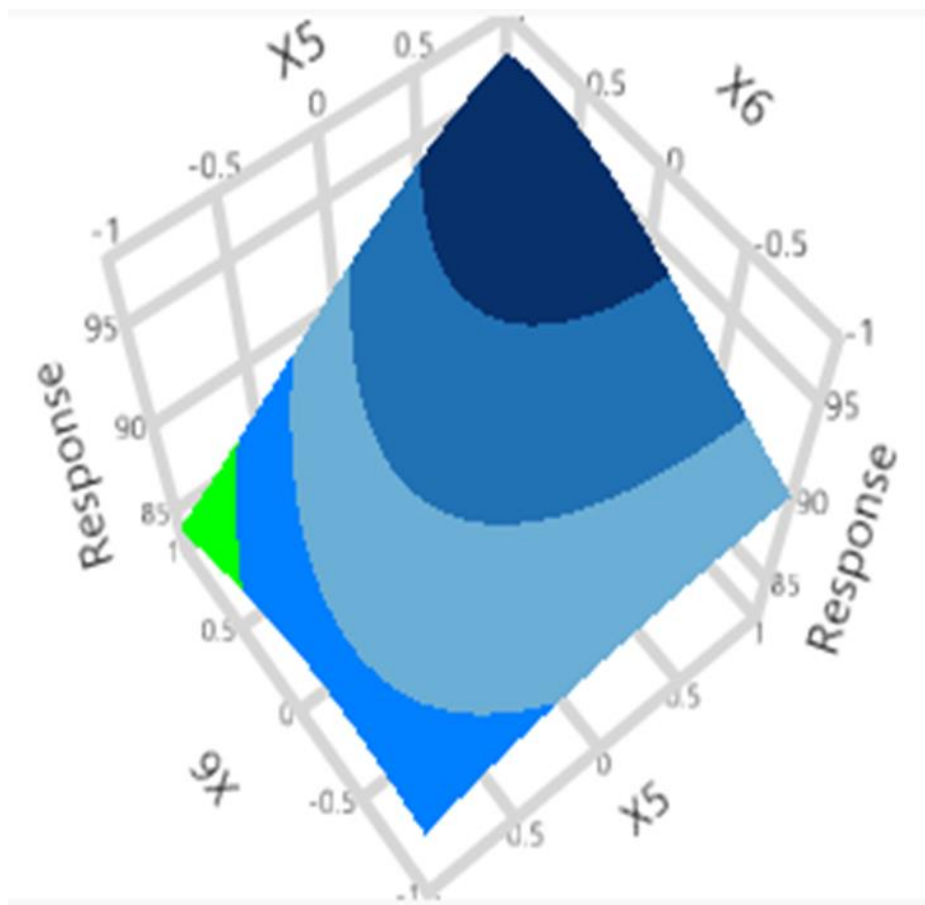


B) interaction of glucose ( $X_3$ , %) with the other variables.



C) interaction of yeast extract (X<sub>4</sub>, %) with the other variables.





D) interaction of  $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$  (%) ( $X_5$ , %) with  $\text{K}_2\text{HPO}_4$  ( $X_6$ ,%) variables.

**Table S1:** Comparison of the DSD and ANN models statistics for the  $\text{Pb}^{2+}$  removal by *B. subtilis*. Variation coefficient ( $R^2$ ), root mean squared error (RMSE), average absolute deviation (AAD), and sum of error's squares (SES) for each operated model were detected.

		<b>Model</b>	
		<b>DSD</b>	<b>ANN</b>
Training	$R^2$	0.8345	0.9865
	RMSE	2.622	0.7496
	Frequency	11	11
Validation	$R^2$	0.8858	0.9964
	RMSE	2.539	0.4482
	Frequency	6	6
Overall model	$R^2$	0.9828	0.9999
	RMSE	1.3925	0.0468
	SES	634.706	88.789
	AAD	1.5077	0.0016
	Frequency	17	17

**Table S2:** The predicted and experimental values of the Pb<sup>2+</sup> removal by *B. subtilis* under optimal conditions.

<b>Independent variable</b>	<b>Optimum conditions</b>	<b>Experimental conditions</b>
pH	6.1	6.1
temperature (°C)	30.8	30
yeast extract (%)	1.7	1.7
Glucose (%)	1.5	1.5
MgSO <sub>4</sub> .7H <sub>2</sub> O (%)	0.2	0.2
K <sub>2</sub> HPO <sub>4</sub> (%)	0.2	0.2
Pb <sup>2+</sup> removal (%)	96.98	96.12