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## Nutritional needs to enhance entomopathogenic toxin production of *Bacillus* by mixed designs modeling

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*Bacillus thuringiensis kurstaki* is a soil bacterium that produces insecticidal toxins called delta-endotoxins. In order to increase the toxic crystal concentrations in a low-cost culture medium and thus improve the biopesticide quality to control insect pests, the Plackett–Burman screening method was applied. It is a tool to evaluate the significance of the selected seven factors ($KH_2PO_4$, $K_2HPO_4$, $MgSO_4$, $MnSO_4$, $FeSO_4$, soybean meal, starch) which are necessary for the production of the delta-endotoxins. This was performed into two different shake flasks (250 and 500 ml). The main factors that affected the production of delta-endotoxins are soybean meal, starch, and $FeSO_4$ in 250 ml culture flasks. In 500 ml culture flasks, soybean meal and $FeSO_4$ are the principal factors influencing the delta-endotoxin production. The multiple linear regressions, a method that was applied as the merging dataset of the two Plackett–Burman designs, established that soybean meal and starch are the factors positively affecting the production of delta-endotoxins, in contrast to $FeSO_4$. Furthermore, the available oxygen in culture flasks showed no significant negative effect on delta-endotoxin production. This study revealed that mixed method designs were useful to identify the significance and the effect of hidden culture parameters.

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## Ameliorating effects of thymoquinone on titanium dioxide nanoparticles induced toxicity in Sprague-Dawley rats

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The ameliorating effect of thymoquinone (TQ), the major active ingredient of *Nigella sativa* seeds on titanium dioxide naonparticles ($TiO_2$ NPs) induced toxicity and oxidative stress in Sprague-Dawley (SD) rats was investigated. 40 rats were divided into four equal groups. The first, second, third and fourth groups received $TiO_2$ NPs, $TiO_2$ NPs and TQ, TQ only for six weeks. The fourth group served as the control. Exposure to $TiO_2$ NPs resulted in increased liver enzyme markers, oxidative stress indices, tumor necrosis factor alpha (TNF-α) and DNA damage by comet assay. $TiO_2$ NPs resulted in decreased level of testosterone hormone. Histopathological alterations were also observed in the liver, brain, lung and testes. Transmission electron microscopy revealed changes in the hepatocytes cytoplasm related to the oxidative stress and presence of nanoparticles in the testicular tissues. Co-administration of TQ with $TiO_2$ NPs decreased the level of liver enzymes, oxidative stress, TNF-α and DNA damage and ameliorate the level of testosterone. Furthermore, TQ increased the total antioxidant and glutathione (GSH) levels. In conclusion, $TiO_2$ NPs induce hazardous effects in different organs and are closely related to oxidative stress. TQ have antioxidative and anti-inflammatory effect against the detrimental effect of $TiO_2$ NPs.

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