

**Title** The effect of montmorillonite on the properties of mung bean starch film  
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### **Abstract**

Starch is an interesting biodegradable polymer due to its excellent film forming properties, availability, and low cost. On the other hand, starch films are often limited by their poor mechanical properties, and water resistance. The addition of montmorillonite clays have improved these properties in both petroleum and biodegradable films. The objective of the research was to determine the effect of montmorillonite clay on the mechanical and barrier properties on mung bean starch films. The addition of 5% clay yielded the optimum balance between mechanical and barrier properties of these composite films with improved tensile strength (TS) of  $20.8763 \pm 0.789$  Mpa, decreased water vapor permeability (WVp) to  $0.49150 \pm 0.0502$  ng m/m<sup>2</sup> sPa and decreased oxygen permeability (OP) to  $5.84 \pm 1.10$  cc-mil/(m<sup>2</sup>-day). Clay levels above 5% improved water vapor barrier properties, with greatest results for 25 and 30% clay of  $0.4519 \pm 0.0826$ , respectively. However, the films became brittle with the further addition of clay and had lower TS values and % elongation at break (EB) values. X-Ray Diffraction showed exfoliated clay microstructures for films with lower clay amount. Above 10% clay, intercalated montmorillonite clay layers and clay were obtained. TEM images confirmed the X-Ray result. The highest ultrasonification times of 30 and 60 minutes (5%wt clay) yielded the highest TS values,  $20.6083 \pm 1.330$  and  $20.4281 \pm 1.355$  Mpa, respectively. Ultrasonification time had an effect on EB. Oxygen permeability decreased as ultrasonification time increased to minimum permeability of  $2.36 \pm 0.27$  cc-mil/(m<sup>2</sup>-day).