

**Title :** Preparation of pH-Responsive Poly(Methyl Methacrylate-co-Methacrylic Acid) (P(MMA-co-MAA))  
Nanocapsules for Food Spoilage Indication

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## ABSTRACT

Food safety has a significant impact on human health and the well-being of the global population. According to the WHO in 2020, foodborne diseases exhibit symptoms that range from mild gastroenteric issues to more severe neurological, hepatic, and renal syndromes, affecting approximately 600 million people worldwide. The World Health Organization (WHO) plays a huge role in promoting food safety globally. Hence, in this research, stimuli-responsive polymers have been developed which can alter their morphological structures through physical or chemical changes in response to external environment such as pH, temperature, or solvents. This study aims to prepare nanocapsules of poly(methyl methacrylate-co-methacrylic acid) (P(MMA-co-MAA)) that respond to pH changes (pH-responsive) in spoiled food. The carboxylic groups (-COOH) in the polymer are pH-sensitive, and food spoilage is typically results from chemical changes such as oxidation, discoloration, or physical changes caused by microbial growth and metabolism. During spoilage, gases such as ammonia, methane, hydrogen sulfide, and carbon dioxide are released.

Nanocapsules were prepared using single-emulsion method. Results showed that the optimal ratio of 0.25% w/v (P(MMA-co-MAA)) in chloroform to polyvinyl alcohol (PVA)-dissolved water medium, at 8:40 mL, produced the highest yield of nanocapsules. Subsequently, the appropriate concentration of PVA, as an emulsifier for nanocapsules preparation was studied at the concentrations of 0.5%, 1%, 2%, 3%, and 4% w/v in water, which produced nanocapsules with sizes of 661.17, 548.83, 688.30, 614.73 and 647.93 nanometers, respectively, as measured by a Zeta-Sizer. These nanocapsules are further intended to encapsulate dyes (such as Nile red) for use as spoilage indicators on PVA film.

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