#### **Influence of Hofmeister cations and composition on carboxymethyl cellulose stabilized o/w Pickering emulsions and application in the encapsulation of vitamin E**

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**Abstract**

Pickering emulsions have gained considerable interest due to their applications in the food, cosmetics, and pharmaceutical industries. In this study, we investigated the roles of pH value, oil/water volume ratio, Hofmeister cations (Na+, NH4+, Ca2+ and Mg2+) as well as chitosan concentrations on carboxymethyl cellulose (CMC) stabilized Pickering emulsions and their application in the encapsulation of vitamin E. Morphology, crystallinity and functional groups were investigated by Scanning Electron Microscopy (SEM), Optical Microscopic Techniques, X-ray Diffractometry (XRD) and Fourier Transform Infrared (FTIR) spectrometry. SEM images revealed a thread-like morphology for CMC, while sponge-like morphology was observed in the images of chitosan and CMC-chitosan complex (CMC-CH). The combination of CMC and chitosan resulted in a complex structure with remarkable improvement in the stability of the emulsions to both creaming and coalescence compared to systems stabilized by either CMC or chitosan alone. At fixed oil:water ratio, the transitional phase inversion of emulsions stabilized by CMC occurred upon increasing the concentration of NH4+, Mg2+ and Ca2+ Hofmeister cations, whereas emulsions containing Na+ ions are o/w at all concentrations. An increase in contact angle upon increasing the salt concentration was observed, which might be responsible for the observed phase inversion. Emulsion stability to coalescence is more favoured at lower pH < 4 for chitosan particles, while CMC is more favoured at higher pH >2. A CMC-Chitosan stabilised Pickering emulsion system was successfully applied in the encapsulation of Vitamin E.

***Keywords*:** Cellulose, Chitosan, Hofmeister, Pickering emulsion, Vitamin E.

References

1. Lawal, O. S. (2009). Specific ion effect on emulsion, foams and gels of a seed protein. *Food Biophys,* 4, 347-352.
2. Sodeinde, K. O., Ojo, A. M., Olusanya, S. O., Ayanda, O. S., Adeoye, A. O., Dada, T. M., Lawal, O. S. (2021). Cellulose isolated from Delonix regia pods: characterisation and application in the encapsulation of vitamin A.  *Ind. Crops Prod,* 160, 113138