Stabilizing Effect of Chitosan on Curcumin from the Damaging Action of Alkaline pH and Ultraviolet Light

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Abstract —The naturally available biopolymer, chitosan (MW = 10 kD) binds to yellow herbal spice, curcumin with high affinity (Ka ~ 400 M) and moderate capacity (n ~ 20 Mole/Mole of Chitosan) at considerably high pH (pH ~ 10.5, 0.1 M NaBO3). Binding is pH sensitive and reduces nearly to zero at the acidic range (pH ~ 5.0). The presence of high salt (0.1 M – 2.0 M NaCl) does not alter the binding affinity (Ka) rather increases the capacity ~ 12%. Interestingly, the affinity (Ka) remains unaltered even when the chitosan was coated on powdered Talc surface causing ~ 40% reduction in binding capacity (n). The chitosan – curcumin complex formed at high pH shows remarkable stability at pH 7.0 - 10.5 and in high salt concentrations (1.0 M – 4.0 M NaCl) showing least dissociation effect. Lowering the pH (< 7.0) enables the complex to dissociate efficiently. The bound curcumin remains chemically unaltered when analyzed by high-pressure liquid chromatography (HPLC). As per logical expectation, the glucosamine unit within chitosan molecule participates in the binding process as evidenced by dose-dependent enhancement of optical density (O.D.) (λ = 440 nm) of curcumin in the presence of glucosamine at pH ~ 8.5. The thin layer chromatography (TLC) of glucosamine – curcumin complex confirms the chemically unaltered state of curcumin within the complex. The enhancement of O.D. in basic environment by glucosamine was unnoticed in acidic condition, pH ~ 4.8. Perhaps, protonation (-NH3 + ) of the - NH2 (s) within sugar moiety in acidic environment hinders curcumin to interact. As for interest, the complexed curcumin molecule in chitosan or glucosamine acquires substantial stability from the alkaline pH (~ 10.5) or UV damage (λ ~ 240 nm).

Keywords : Binding isotherm, Chitosan, Curcumin, Glucosamine, Scatchard analysis, Stability, UV light.