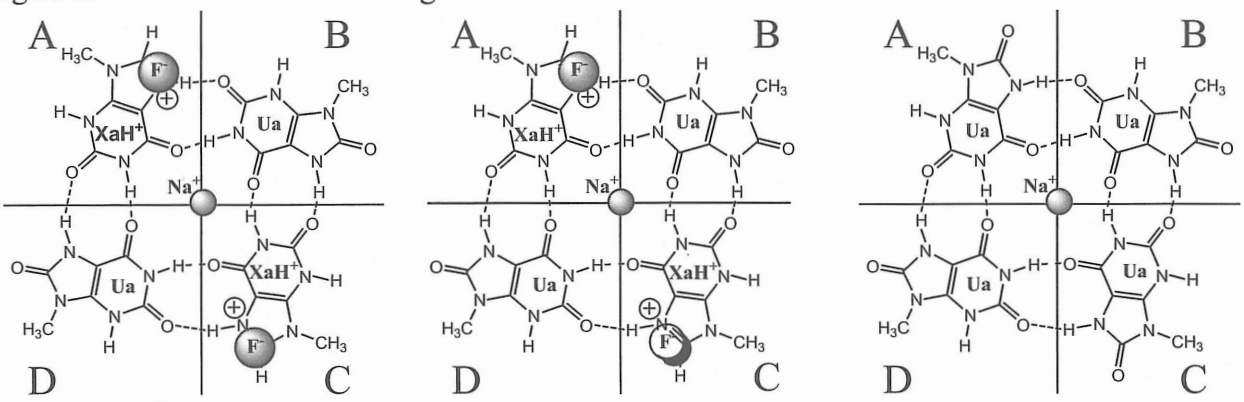
Neutral or positively charged new purine base tetramer structures: a computational study of xanthine and uric acid derivatives

Gábor Paragi[1], Lajos Kovács[2], Zoltán Kupihár[2], Botond Penke[1], Celia Fonseca Guerra[3] and F. Matthias Bickelhaupt[3]

[1] *Supramolecular and Nanostructured Materials Research Group of the Hungarian Academy of Sciences at the University of Szeged, Dóm tér 8, H-6720, Szeged, Hungary*
[2] *Department of Medicinal Chemistry, University of Szeged, Dóm tér 8, H-6720, Szeged, Hungary*
[3] *Department of Theoretical Chemistry, Free University of Amsterdam, De Boelelaan 1083 NL-1081 HV Amsterdam, The Netherlands*
(kovacs@ovrisc.mdche.u-szeged.hu)

New tetramer structures, based on 9-methylxanthine (Xa),[1] 9-methylxanthine protonated at N7 (XaH^+) and 9-methyluric acid (Ua), were investigated by high level density functional calculations. We have found that homo- and heterotetrads can be formed by low barrier hydrogen bond possessing positive charges [$(XaH^+)_4$, $(XaH^+\text{-}Xa)_2$, $(XaH^+\text{-}Ua)_2$,]. Systems with zero charge [$(Xa)_4$, $(Xa\text{-}Ua)_2$, $(Ua)_4$] were also constructed, investigated and compared to guanine quadruplex [$(G)_4$]. It was shown that the new tetramers can bind cations and anions without the necessity of stacking interactions. Application of the calculated systems in higher ordered structures (*e.g.* quadruplexes)[2] are very promising with or without intercalating ions. The Figure and Table display fragment interaction energies for tetrads with intercalating ions.



(a) (b) (c)

fragment interaction energies [kcal/mol]	(AB+Na^+)+ + (CD)	(AD+Na^+)+ + (BC)	(AC+Na^+) + + (BD)	(ABCD)+ + Na^+
(XaH^+ - F^- - $Ua)_2$+Na^+ F^- ions on the same side, (a)	-62.13	-61.86	-77.32	-97.93
(XaH^+ - F^- - $Ua)_2$+Na^+ F^- ions on the opposite sides, (b)	-62.24	-62.04	-77.59	-97.80
$(Ua)_4$+Na^+, (c)	-60.50	-60.50	-79.75	-92.05
$(G)_4$+Na^+	-90.71	-90.71	-109.22	-110.40

References:

1. Davis J. T. and Spada G. P., Chem. Soc. Rev., 36, 296-313 (2007).
2. Kulikowska E., Kierdaszuk B. and Shugar D., Acta Biochim. Pol., 51, 493–531 (2004).

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