Journal of
Bioengineering & Biomedical Science

Heidari A, J Bioeng Biomed Sci 2016, S:3
DOI: 10.4172/2155-9538.S3-006

Opinion Open Access

A Thermodynamic Study on Hydration and Dehydration of DNA and RNA –Amphiphile Complexes

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Rec date: Mar 21, 2016; **Acc date:** Mar 23, 2016; **Pub date:** Mar 31, 2016

Opinion

In the current opinion, we would like to study adhesion of DNA and RNA–amphiphile complexes to non–modified glasses, glasses containing phenylboronic acid (PBA) attached via 3–glycidoxypropyltrimethoxysilane (GPTMS) [(PBA–GPTMS–glasses)] and glasses containing grafted dimethyllacrylamide–acrylamide phenylboronic acid (DMAA–AAPBA) copolymer (DMAA–AAPBA–glasses). We prepared glasses modified with GPTMS and then attached PBA to them. After that, we modified glasses by (3–mercaptoropyl) trimethoxy silane (MPTMS) and grafted DMAA–AAPBA copolymer to the modified glass plates. For increasing the measuring sensitivity, DNA and RNA–amphiphile complexes were stained with Procion Red HE3B, Red 4GE, Red 510, Red KE3B, Red 120, Red ABO, Red A4G, Red 3B, Red KE3B, Red HE3G, Red 53 L, Red HE3BI, Red E3B, Red CT3B, Red ES3B, Red LHE3B, Red I3B, Red HE3BFC, Red MEB, Red SE3BI, Red 24990, Red SE3B, Red 3BHE and other active and reactive dyes. DNA and RNA–amphiphile complexes stained with Procion Red HE3B, Red 4GE, Red 510, Red KE3B, Red 120, Red ABO, Red A4G, Red 3B, Red KE3B, Red HE3G, Red 53 L, Red HE3BI, Red E3B, Red CT3B, Red ES3B, Red LHE3B, Red I3B, Red HE3BFC, Red MEB, Red SE3BI, Red 24990, Red SE3B, Red 3BHE and other active and reactive dyes formed denser and more stable layer on the copolymer–grafted supports compared onto supports modified with phenylboric acid via a organosilane spacer [1–18]. Adhesion of DNA and RNA–amphiphile complexes to boronate–containing polymer fixed on solid support in different conditions such as pH, precipitation time and different concentrations of glucose (dextrose), fructose (levulose) and galactose were studied.

Furthermore, the internal structure of DNA/RNA–CTAB and DNA/RNA–DDAB is investigated by X–Ray Diffraction (XRD), Energy–Dispersive X–Ray Spectroscopy (EDX) and Small Angel X–Ray Scattering (SAXRS). Hexagonal packing of DNA and RNA was observed for DNA and RNA complexes with Cetyltrimethyl Ammonium Bromide (CTBA) and for Dimethyldioctadecyl Ammonium Bromide (DDAB) complexes is observed lamellar structure. Variations in the internal spacing and degree of long–range ordering are dependent on both surfactant type and concentrations of added salt [19–29]. When we increased the amount of salt into our complexes, we observed that the d spacing (d=2Π/r) are increased.

On the other hand, we present a novel method for monitoring isothermal DNA/RNA –Gemini surfactants hydration and dehydration using a sorption microcalorimeter. Gemini surfactant is a name assigned to a family of synthetic amphiphiles surfactants such as: Alkanediyl–α–ω–bis (dimethylammonium bromide) surfactants referred to as m–s–m where s is the number of Carbon atoms in the polymethylene chains connecting the two CnH2n+1N+(CH3)2Br–moieties [30–38]. We present measurements of isothermal DNA/RNA +12–s–12 (with s=2, 4, 6, 8, 10, 12, 14, 16, 18, 20) complexes at room temperature. This calorimeter provides simultaneous measurement of (a) Water activity (sorption isotherms) and (b) The partial molar enthalpy of water as a function of water uptake. The enthalpy is strongly positive at high water contents. The hydration and dehydration of the DNA/RNA+12–2–12, DNA/RNA+12–4–12, DNA/RNA+12–6–12, DNA/RNA+12–8–12, DNA/RNA+12–10–12, DNA/RNA+12–12–12, DNA/RNA+12–14–12, DNA/RNA+12–16–12, DNA/RNA+12–18–12 and DNA/RNA+12–20–12 (1:1) complexes are exothermic but after incorporation of the first 16.8±0.1, 8.4±0.1, 6.3±0.1, 11.7±0.1, 14.3±0.1, 17.5±0.1, 18.8±0.1, 13.7±.0.1, 19.9±0.1 and 24.2±0.1 water molecules the enthalpy changes sign, respectively. This means that, after these points, the sorption is driven by an entropic rather than enthalpy–entropy effect.

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This article was originally published in a special issue, entitled: **"Design of Biosensors"**, Edited by Dr. Eduardo De Faria Franca, Federal University of Uberlandia