Electronic Supplementary Material (ESI) for RSC Advances.

Supporting information

Surface Interaction of Ribonucleic Acid Constituents with Spinel Ferrite Nanoparticles: A Prebiotic Chemistry Experiment

Md. Asif Iqubal, Rachana Sharma and Kamaluddin*

Department of Chemistry, IIT Roorkee, Roorkee 247667, Uttarakhand, India

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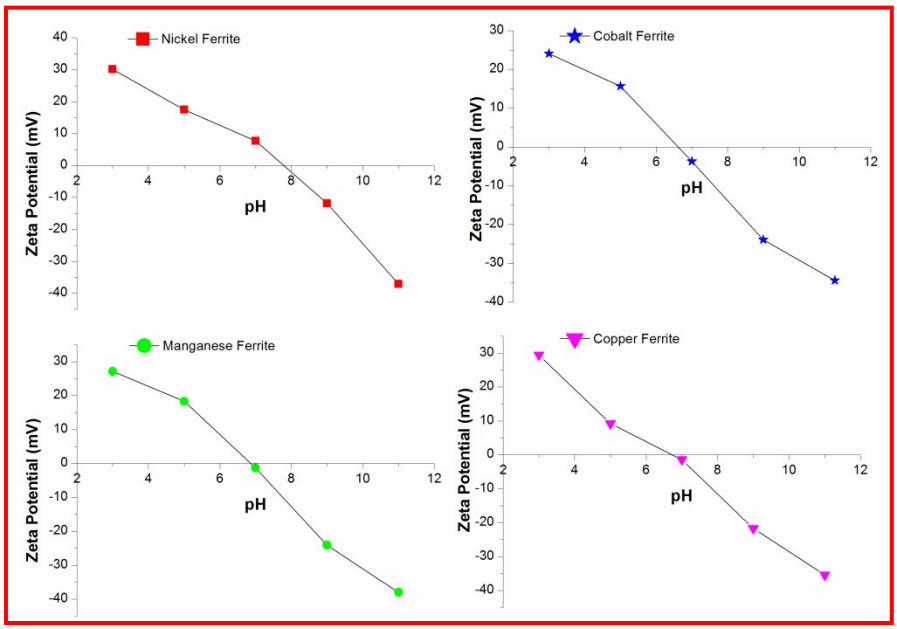

Figure S1: Zero point charge curve of metal ferrites

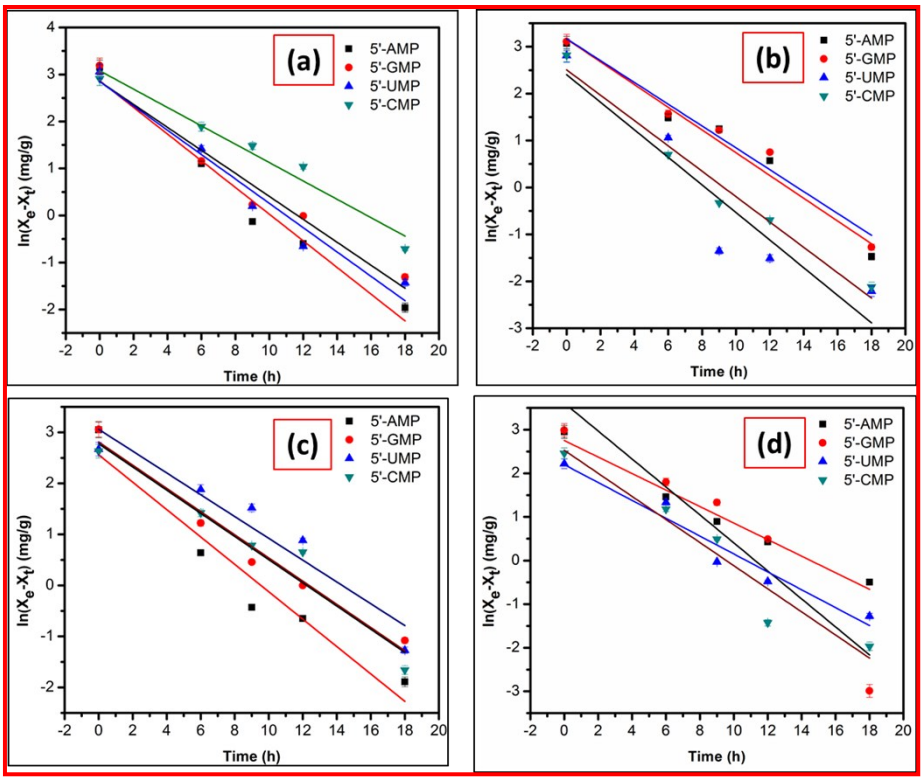

Figure S2: The pseudo first order plots of metal ferrites (a) $NiFe_2O_4$ (b) $CoFe_2O_4$ (c) $CuFe_2O_4$ and (d) $MnFe_2O_4$

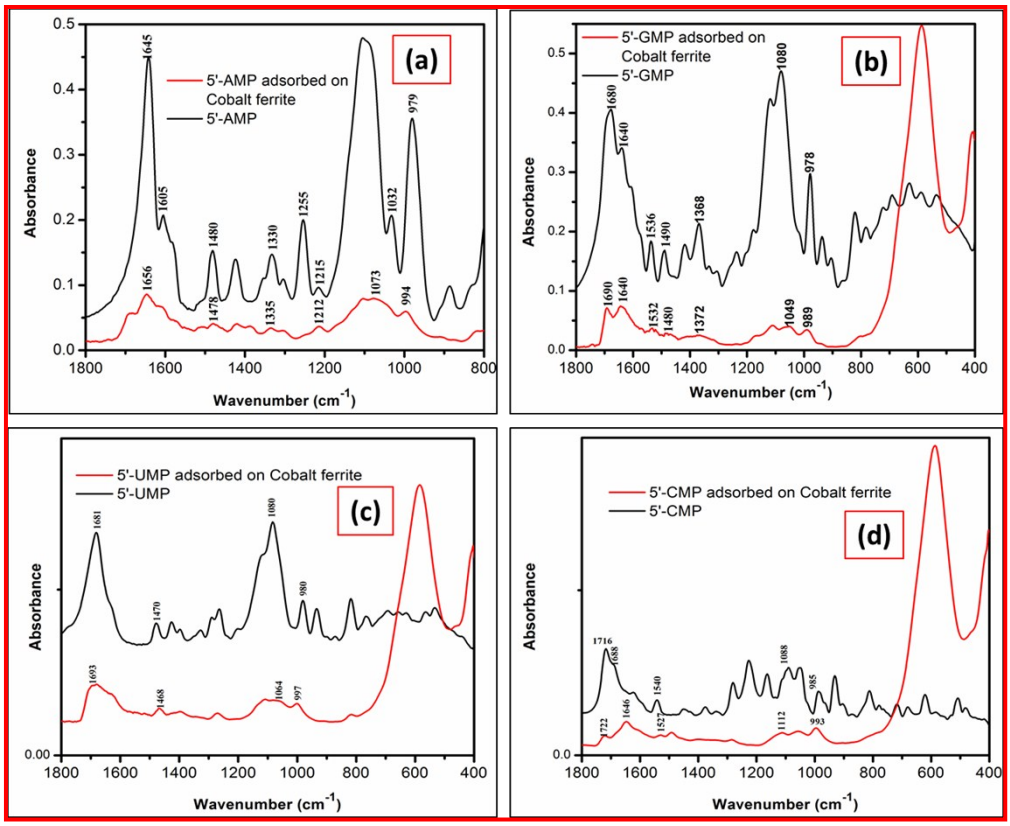

Figure S3: Infra-red spectra of ribonucleotides (a) 5′-AMP, (b) 5′-GMP, (c) 5′-UMP and (d) 5′-CMP before and after interaction with cobalt ferrite

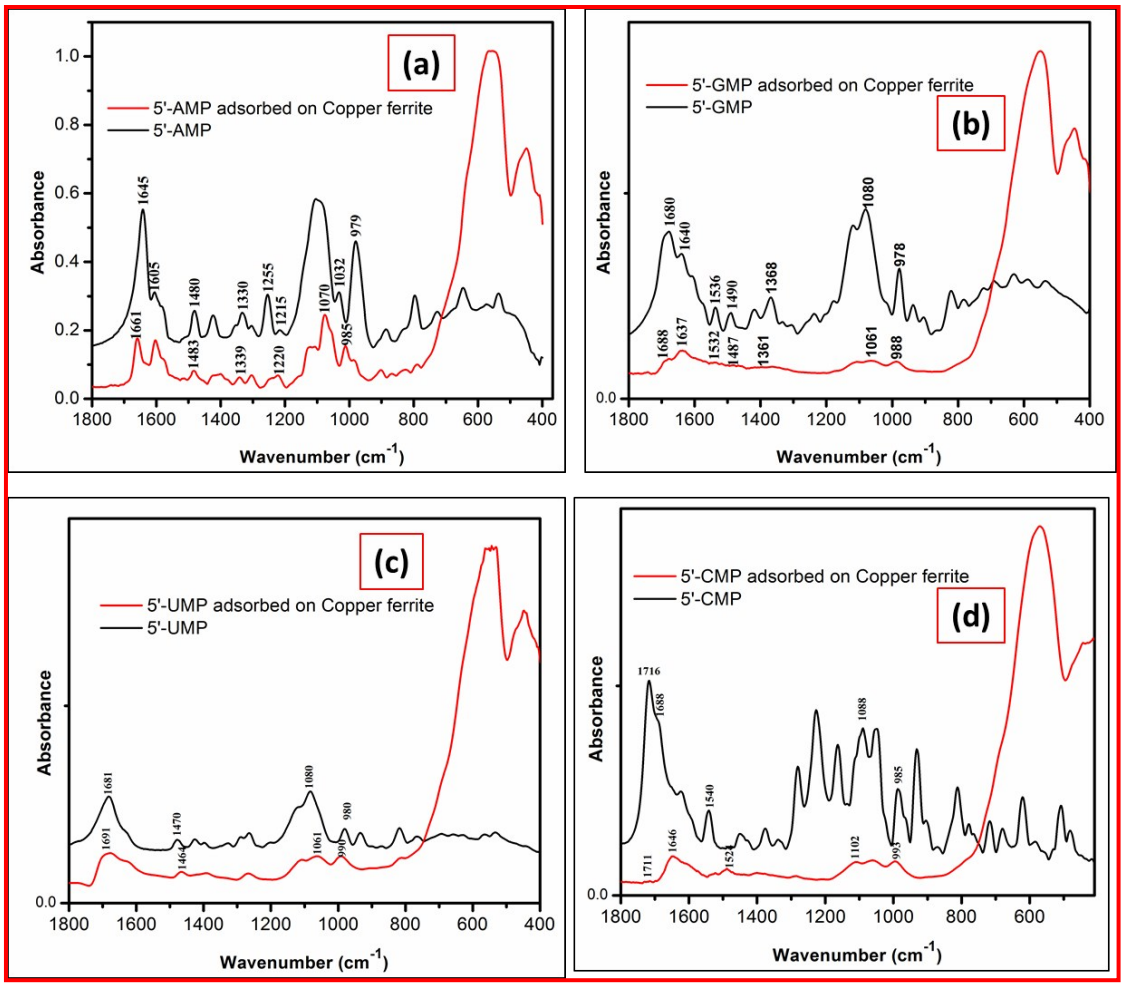

Figure S4: Infra-red spectra of ribonucleotides (a) 5′-AMP, (b) 5′-GMP, (c) 5′-UMP and (d) 5′-CMP before and after interaction with copper ferrite

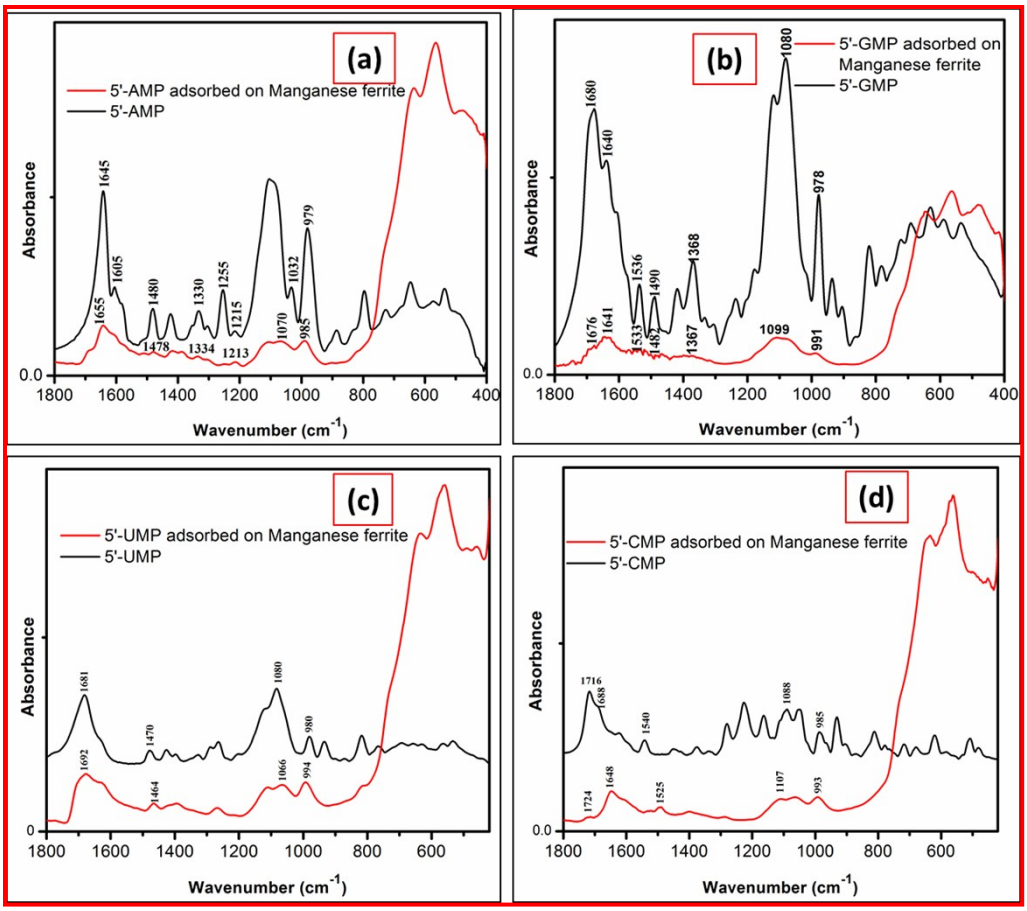

Figure S5: Infra-red spectra of ribonucleotides (a) 5′-AMP, (b) 5′-GMP, (c) 5′-UMP and (d) 5′-CMP before and after interaction with manganese ferrite

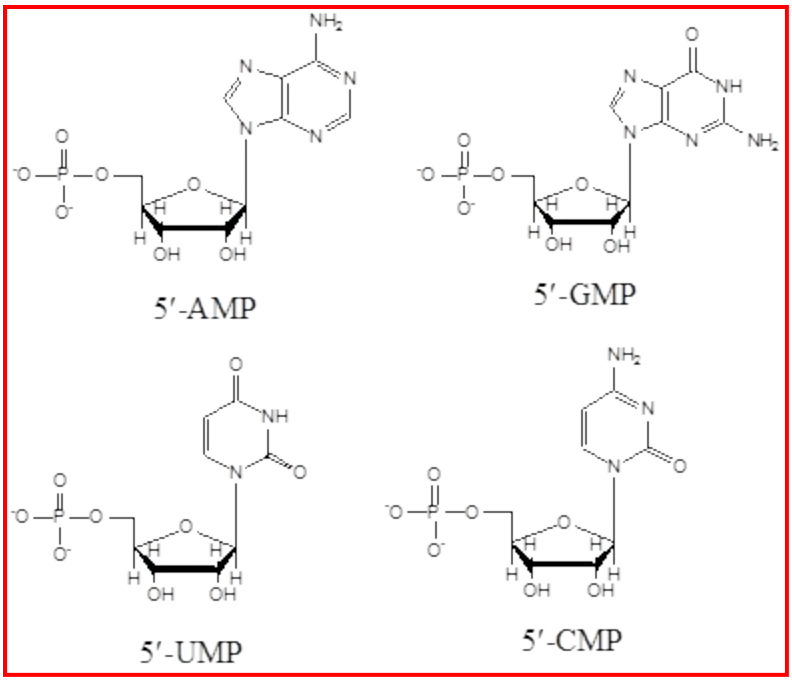

Figure S6: Structure of purine (5′-AMP and 5′-GMP) and pyrimidine (5′-UMP and 5′-CMP) ribonucleotides

Table S1:Langmuir constants for adsorption of ribose nucleotides on metal ferrite at pH~4.00

Metal ferrite	**5′-AMP**			**5′-GMP**			**5′-UMP**			**5′-CMP**		
	R^2	**X_m (mg/g)**	**$K_L \times 10^4$ (L/mol)**	**R^2**	**X_m (mg/g)**	**$K_L \times 10^4$ (L/mol)**	**R^2**	**X_m (mg/g)**	**$K_L \times 10^4$ (L/mol)**	**R^2**	**X_m (mg/g)**	**$K_L \times 10^4$ (L/mol)**
$NiFe_2O_4$	0.99	33.78	0.22	0.99	30.65	0.22	0.99	25.13	10.63	0.99	20.08	8.41
$CoFe_2O_4$	0.98	30.20	3.81	0.99	23.58	4.13	0.97	21.56	1.42	0.99	17.20	3.30
$CuFe_2O_4$	0.99	22.57	5.00	0.99	21.21	4.59	0.98	14.10	3.02	0.99	12.98	2.21
$MnFe_2O_4$	0.98	21.54	3.08	0.99	15.92	12.38	0.99	9.56	2.12	0.99	9.46	1.88

Table S2: Comparison of rate constants calculated based on first-order and second-order kinetic models for $NiFe_2O_4$

Kinetic model	5′-AMP	5′-GMP	5′-UMP	5′-CMP
Pseudo first order				
R^2	0.96	0.95	0.95	0.95
k_1 (L/hr)	0.28	0.29	0.26	0.20
X_e(mg/g)	16.94	17.32	17.27	21.73
Pseudo second order				
R^2	0.99	0.99	0.99	0.99
k_2 (g/mg hr)	0.09	0.07	0.06	0.02
X_e(mg/g)	23.75	24.78	21.88	19.71

Table S3: Comparison of rate constants calculated based on first-order and second-order kinetic models for $CoFe_2O_4$

Kinetic model	5′-AMP	5′-GMP	5′-UMP	5′-CMP
Pseudo first order				
R^2	0.96	0.96	0.83	0.96
k_1 (L/hr)	0.24	0.23	0.29	0.27
X_e(mg/g)	23.57	23.80	11.02	12.25
Pseudo second order				
R^2	0.99	0.99	0.99	0.99
k_2 (g/mg hr)	0.04	0.03	0.11	0.11
X_e(mg/g)	22.37	23.41	17.04	17.15

Table S4: Comparison of rate constants calculated based on first-order and second-order kinetic models for $CuFe_2O_4$

Kinetic model	5′-AMP	5′-GMP	5′-UMP	5′-CMP
Pseudo first order				
R^2	0.92	0.96	0.89	0.93
k_1 (L/hr)	0.27	0.23	0.21	0.23
X_e(mg/g)	12.93	15.96	21.30	16.61
Pseudo second order				
R^2	0.99	0.99	0.96	0.99
k_2 (g/mg hr)	0.10	0.06	0.01	0.03
X_e(mg/g)	21.74	21.99	17.09	14.88

Table S5: Comparison of rate constants calculated based on first-order and second-order kinetic modelsfor $MnFe_2O_4$

Kinetic model	5′-AMP	5′-GMP	5′-UMP	5′-CMP
Pseudo first order				
R^2	0.97	0.87	0.93	0.91
k_1 (L/hr)	0.19	0.32	0.20	0.26
X_e(mg/g)	15.64	36.96	9.00	12.54
Pseudo second order				
R^2	0.99	0.99	0.98	0.99
k_2 (g/mg hr)	0.04	0.03	0.04	0.06
X_e(mg/g)	20.00	21.09	10.30	12.42

Table S6: Typical infrared spectral frequencies (cm^{-1}) of ribonucleotides before and after absorption on $NiFe_2O_4$

Group/Moiety	5'-AMP	Adsorbed 5'-AMP	5'-GMP	Adsorbed 5'-GMP	5'-UMP	Adsorbed 5'-UMP	5'-CMP	Adsorbed 5'-CMP
NH_2	1645	1655	1640	1640	-	-	1688	1645
> C(6)=O	-	-	1680	1687	-	-	-	-
> C(2)=O	-	-	-	-	1681	1694	1716	1721
Pyrimidine/ Imidazole vibration	1330	1336	1536	1533	-	-	-	-
Imidazole	1215	1212	1368	1364	-	-	-	-
υN-7-C-8 + δC-8-H	1480	1474	1490	1483	-	-	-	-
PO_3^{2-}antisymmetric stretching	1032	1061	1080	1056	1080	1057	1088	1114
PO_3^{2-} symmetric stretching	979	991	978	988	980	997	985	994

Table S7: Typical infrared spectral frequencies (cm^{-1}) of ribonucleotides before and after absorption on $CoFe_2O_4$

Group/Moiety	5'-AMP	Adsorbed 5'-AMP	5'-GMP	Adsorbed 5'-GMP	5'-UMP	Adsorbed 5'-UMP	5'-CMP	Adsorbed 5'-CMP
NH_2	1645	1656	1640	1640	-	-	1688	1646
> C(6)=O	-	-	1680	1690	-	-	-	-
> C(2)=O	-	-	-	-	1681	1693	1716	1722
Pyrimidine/ Imidazole vibration	1330	1335	1536	1532	-	-	-	-
Imidazole	1215	1212	1368	1372	-	-	-	-
υN-7-C-8 + δC-8-H	1480	1478	1490	1480	-	-	-	-
PO_3^{2-}antisymmetric stretching	1032	1073	1080	1049	1080	1064	1088	1112
PO_3^{2-} symmetric stretching	979	994	978	989	980	997	985	993

Table S8: Typical infrared spectral frequencies (cm^{-1}) of ribonucleotides before and after absorption on $CuFe_2O_4$

Group/Moiety	5'-AMP	Adsorbed 5'-AMP	5'-GMP	Adsorbed 5'-GMP	5'-UMP	Adsorbed 5'-UMP	5'-CMP	Adsorbed 5'-CMP
NH_2	1645	1661	1640	1637	-	-	1688	1646
> C(6)=O	-	-	1680	1688	-	-	-	-
> C(2)=O	-	-	-	-	1681	1691	1716	1711
Pyrimidine/ Imidazole vibration	1330	1339	1536	1532	-	-	-	-
Imidazole	1215	1220	1368	1361	-	-	-	-
υN-7-C-8 + δC-8-H	1480	1483	1490	1487	-	-	-	-
PO_3^{2-}antisymmetric stretching	1032	1070	1080	1061	1080	1061	1088	1102
PO_3^{2-} symmetric stretching	979	985	978	988	980	990	985	993

Table S9: Typical infrared spectral frequencies (cm^{-1}) of ribonucleotides before and after absorption on $MnFe_2O_4$

Group/Moiety	5'-AMP	Adsorbed 5'-AMP	5'-GMP	Adsorbed 5'-GMP	5'-UMP	Adsorbed 5'-UMP	5'-CMP	Adsorbed 5'-CMP
NH_2	1645	1655	1640	1641	-	-	1688	1648
> C(6)=O	-	-	1680	1676	-	-	-	-
> C(2)=O	-	-	-	-	1681	1692	1716	1724
Pyrimidine/ Imidazole vibration	1330	1334	1536	1533	-	-	-	-
Imidazole	1215	1213	1368	1367	-	-	-	-
υN-7-C-8 + δC-8-H	1480	1478	1490	1482	-	-	-	-
PO_3^{2-}antisymmetric stretching	1032	1070	1080	1099	1080	1066	1088	1107
PO_3^{2-} symmetric stretching	979	985	978	991	980	994	985	993