

# FT-Raman Study of Hemoglobin with Quercetin and Naringin

S. Bakkialakshmi\* & Jayoti Roy

Department of Physics, Annamalai University, Annamalainagar, Tamilnadu, India-608 002

## Abstract:

In this article the FT-Raman spectra of human hemoglobin (HHb), Quercetin (Q) and Naringin (N) have been recorded separately. FT-Raman spectra for the complexes (1.) Hemoglobin-Quercetin and (2.) Hemoglobin-Naringin have also been recorded. The detailed interpretations of vibrational spectra of the complexes are furnished here, in terms of Potential energy distribution analysis.

**Keywords:** Hemoglobin, Quercetin, Naringin, FT-Raman.

## I. INTRODUCTION

Vibrational spectroscopy is used extensively in organic chemistry, for the identification of functional groups of organic compounds, for studies in molecular conformation, reaction kinetic, etc. Flavonoids have emerged as potential therapeutic drugs and are effective against several diseases. Prominent among them, are free radical mediated [1, 2] and cell proliferative diseases [3, 4]. Flavones and flavonols are found in nature and have shown promising antioxidant and anticancer activity [5, 6].

Naringin has been reported to exhibit antioxidant, anti-inflammatory, anti mutagenic and anti carcinogenic effects and inhibits lipid per oxidation in biological membranes. It has antiviral and anti allergic actions and reduces the level of cytochrome P450 1A2 protein.

## II. MATERIALS AND METHODS

FT-RAMAN spectra have been recorded on BRUKER RFS 27: Stand alone FT-Raman Spectrometer in the range  $4000 - 100 \text{ cm}^{-1}$  at room temperature. The excitation line at 785nm has been taken from an Nd: YAG laser. Its scan number is 100, the resolution is  $2\text{cm}^{-1}$  and the sample is in solid phase.

## III. RESULTS AND DISCUSSION

FT-Raman spectra of Hemoglobin have been depicted in Fig 1. FT-Raman spectra of Quercetin, Naringin and the complexes Hemoglobin - Quercetin and Hemoglobin - Naringin are given in Figs 2, 3, 4 & 5 respectively. FT-Raman absorption peak intensities of Hemoglobin before and after complex formation have been tabulated in Tables 1 & 2.

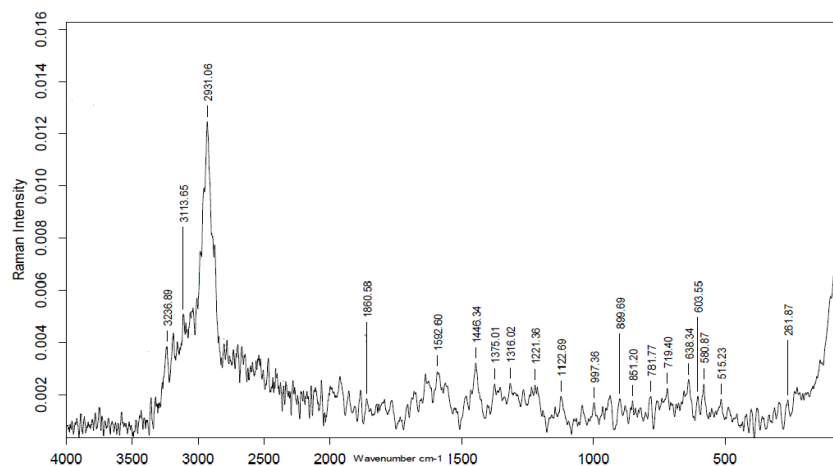


Fig. 1 FT-Raman Spectra of Hemoglobin

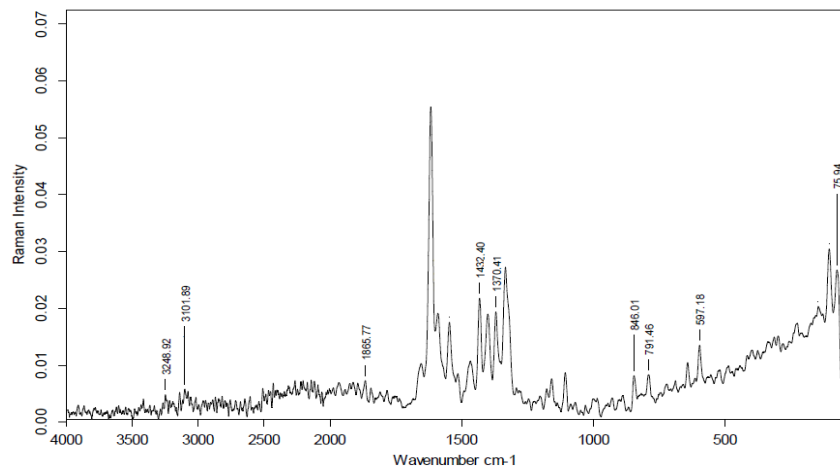


Fig. 2 FT-Raman Spectra of Quercetin

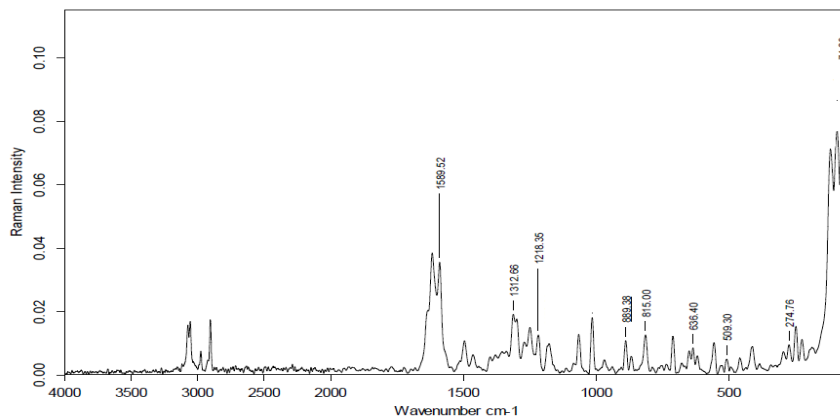


Fig. 3 FT-Raman Spectra of Naringin

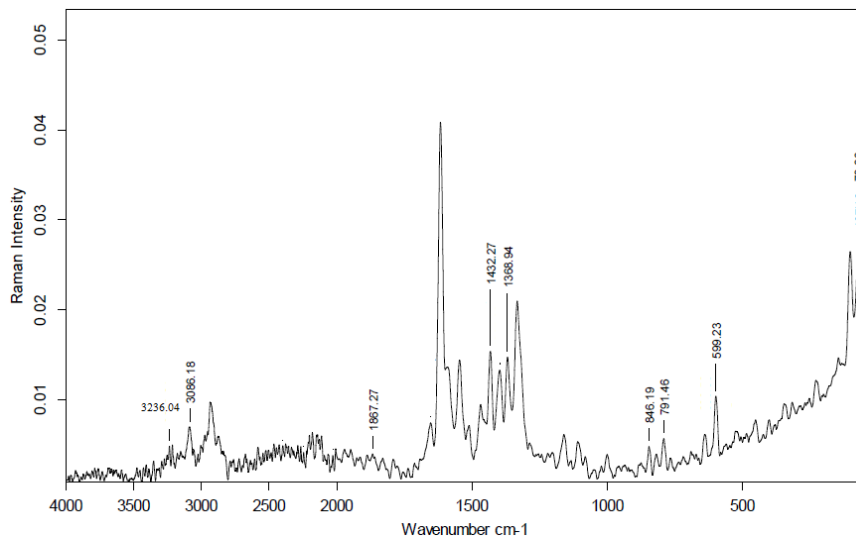
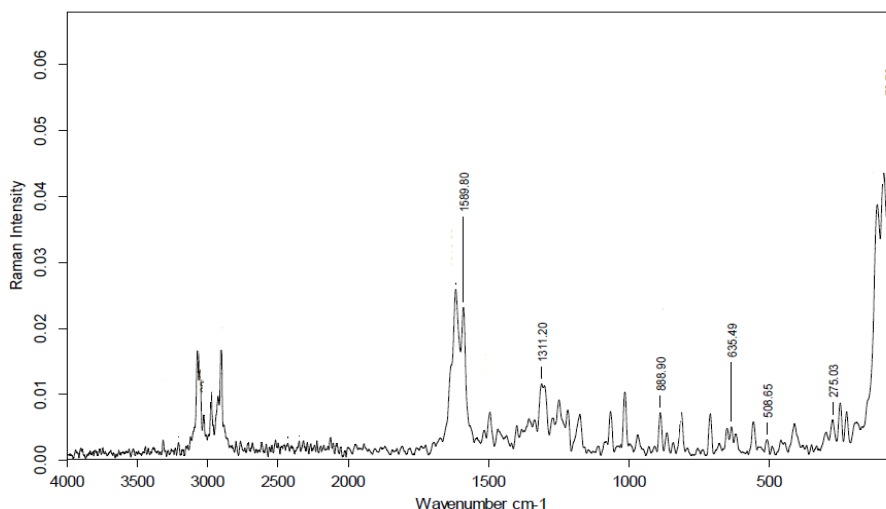


Fig. 4 FT-Raman Spectra of Hemoglobin + Quercetin



**Fig. 5 FT-Raman Spectra of Hemoglobin + Naringin**

O-H vibration has been observed at  $3236 \pm 10 \text{ cm}^{-1}$ . Aromatic ring vibrations were observed at  $1432 \pm 20 \text{ cm}^{-1}$ . O-O vibrations have been observed at  $846 \pm 20 \text{ cm}^{-1}$ . Aliphatic chain vibrations have been observed at  $597 \pm 20 \text{ cm}^{-1}$ .

**Table 1 Difference In FT-Raman Absorption Peak Intensities of Hemoglobin Before and After Complex Formation with Quercetin**

HbA	Intensities ( $\text{cm}^{-1}$ )		Difference in intensities prior to and after %	Tentative assignment
	Q	HbA + Q		
3236.89	3248.92	3236.04	0.00094	O-H vibration
3113.65	3101.89	3086.18	0.00187	O-H vibration
1860.58	1865.77	1867.27	0.00212	C=C vibrations
1446.34	1432.40	1432.27	0.01217	Aromatic ring vibrations
1375.01	1370.41	1368.94	0.01233	Heme group vibrations, $\text{CH}_3$ vibrations
851.20	846.01	846.19	0.00304	O-O vibrations
781.40	791.46	791.46	0.00375	C-C chain vibration
603.55	597.18	599.23	0.00845	aliphatic chain vibrations
70.63	75.94	73.86	0.0183	Lattice vibrations

**Table 2 Difference in FT-Raman Absorption Peak Intensities of Hemoglobin Before and After Complex Formation with Naringin**

HbA	Intensities ( $\text{cm}^{-1}$ )		Difference in intensities prior to and after %	Tentative assignment
	N	HbA + N		
1592.60	1589.52	1589.8	0.02031	Aromatic vibration
1316.02	1312.66	1311.2	0.00917	aliphatic chain vibrations
1221.36	1218.35	1218.4	0.00525	C-C chain vibration
899.69	889.38	888.9	0.0054	O-O vibrations
638.34	636.40	635.49	0.00247	C-C chain vibration
515.23	509.3	508.65	0.00136	aliphatic chain vibrations
261.87	274.76	275.03	0.00438	aliphatic chain vibrations
70.63	74.29	73.76	0.04396	Lattice vibrations

#### **IV. CONCLUSION**

FT-Raman spectra of Hemoglobin, Quercetin, Naringin and the complexes (1.) Hemoglobin-Quercetin and (2.) Hemoglobin-Naringin were recorded and the detailed vibrational assignments were presented.

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