Available online www.jocpr.com

Journal of Chemical and Pharmaceutical Research, 2014, 6(9):236-240

Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

Ultraviolet-Visible spectrum characterizations of Quercetin in aqueous ethanol solution with different pH values

Yu Duan

College of Pharmaceutical and Biological Sciences, Weifang Medical University, Weifang, Shandong Province, P. R. China

---

ABSTRACT

The structure changes of flavonoids in strong acid and alkaline solution can be characterized by means of ultraviolet-visible (UV-Vis) spectrum. In this paper, the shifts of UV-Vis spectrum of quercetin in aqueous ethanol solution with different pH values were investigated. The UV-Vis spectrum of quercetin in 50% (v/v) aqueous ethanol solution showed two characteristic adsorption bands setting at 374 nm and 256 nm, respectively. When the pH value was adjusted to 14.0 with sodium hydroxide, the band at 374 nm shifted to about 400 nm, and the band at 256 nm disappeared, a new band at 314 nm appeared. The pH value of alkaline solution was adjusted to 7.0 with hydrochloric acid, and the UV-Vis spectrum of precipitate was the same with quercetin, but the UV-Vis spectrum of filtrate was different. When the pH value of quercetin in 50% (v/v) aqueous ethanol solution was adjusted to 1.0 with hydrochloric acid, there was little shift of UV-Vis spectrum. But after concentrating the acid solution and filtering, the UV-Vis spectrum of precipitation was the same with quercetin, while the UV-Vis spectrum of filtrate was different. It was concluded that strong acid and alkaline caused some degradation of quercetin.

Key words: Quercetin; Hydrochloric Acid; Sodium Hydroxide; Degradation; Ultraviolet-Visible Spectrum

---

INTRODUCTION

Quercetin is one of the most common flavonols which are widely present in the vegetal kingdom and in most cases exist as glycosides. Quercetin exhibits a broad range of biological activities and is a potential agent that protects against cardiovascular diseases [1].

Quercetin will decompose if the pH value of solution is higher than 10.2 [2]. The characteristic adsorption bands of UV-Vis spectrum of quercetin in 50 % (v/v) aqueous ethanol solution will shift to long wave when the solution is adjusted to alkaline, and a new band at 321 nm appears. The shifts of spectrum strengthen with increasing of ionic strength [3, 4].

Some extraction and content determination of flavonoids are executed in acid or alkaline solution. The extraction of rutin involves dissolving raw material in alkaline solution and then depositing in acid solution [5-7]. The running buffer solution used in separating or content determining of flavonoids by means of capillary electrophoresis is alkaline commonly [8-10].The buffer solution used in complexation reaction of quercetin and rare metal is acidic [11-12]. Because the structure and the UV-Vis spectrum of flavonoids are different with the changes of pH values, there are some deviations in the content determination. The research about structure changes of flavonoids with different pH values is helpful to determining the content of flavonoids accurately.

In this paper the shifts of UV-Vis spectrum of quercetin in 50 % (v/v) aqueous ethanol solution with different pH values were investigated.

EXPERIMENTAL SECTION

Chemicals and Apparatus

Quercetin (3,5,7,3',4'-pentahydroyflavone) (99%) was purchased from Xi'an Huifeng biochemistry share CO., LTD.. Ethanol, hydrochloric acid and sodium hydroxide were all analytical reagent and purchased form Chengdu Kelong chemical reagent factory. Distilled water was used in all experiments.

Spectrophotometric measurements were performed on TU-1901 UV-Vis spectrophotometer (Beijing Purkinje General Instrument CO., LTD.).

Preparation of quercetin solution

A standard solution of quercetin (No.1) was obtained by dissolving a certain amount of quercetin in 50 % (v/v) aqueous ethanol solution, which was straw yellow, transparent solution, and the pH value was 6.8. The color of solution turned to brown yellow when the pH value was adjusted to 14.0 with sodium hydroxide, and this was the No.2 solution. Adding chlorhydric acid to No.2 solution to adjust the pH value to 7.0, a brown transparent solution (No.3) was obtained. After concentrating the solution to remove most of the ethanol, the precipitate appeared. The brown filtrate was No.4 solution. The precipitate was washed with water to neutral, and then dissolved in 50 % (v/v) aqueous ethanol solution (No.5). Adding chlorhydric acid to standard solution to adjust the pH value to 1.0, a straw yellow and transparent solution (No.6) was obtained. After concentrating the acid solution to remove most of the ethanol and filtering, the straw yellow, transparent filtrate (No.7) was obtained. The residue was washed with water to neutral and dissolved in 50 % (v/v) aqueous ethanol solution (No.8).

Determination of UV-Vis spectrum

Spectrophotometric measurements were performed by scanning all the solution of quercetin on TU-1901 UV-Vis spectrophotometer. Wavelength range was 200 - 700 nm. Bandwidth was 2 nm. Sampling interval was 1.00 nm.

RESULTS AND DISCUSSION

Effects of alkali on the UV-Vis spectrum of quercetin in 50 % (v/v) aqueous ethanol solution

The UV-Vis spectrum of flavonoids has two bands that are attributed to different parts of the conjugated aromatic rings. The first band (Band Ⅰ) at the 300 - 380 nm corresponds to the cinnamyl and the second band (Band Ⅱ) at 240 - 280nm corresponds to the benzoyl. Fig.1, 2, 3, 4 and 5 show the UV-Vis spectrum of No.1, 2, 3, 4, 5 quercetin solution respectively. Comparing Fig.1 and Fig.2, it is obvious that in the quercetin solution of pH 14.0, the band at 374 nm shift to about 400 nm, and the band at 256 nm disappeared; a new band at 314 nm appears. The shoulder bands at 301 nm and 269 nm disappear.

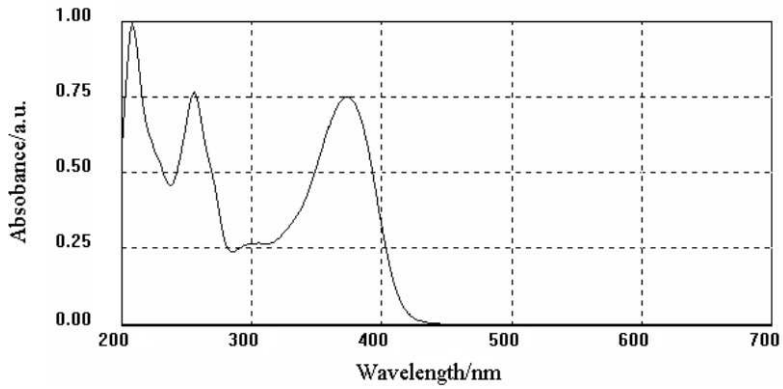

Fig. 1 UV-Vis spectrum of No. 1 quercetin solution

In the UV-Vis spectrum of No. 3 quercetin solution, the intensity of both bands at 256 nm and 374 nm greatly weaken. In Fig. 4, the two characteristic bands of UV-Vis spectrum of the filtrate are completely different with those of quercetin. While in Fig. 5, the consistency of two characteristic bands of UV-Vis spectrum of the precipitate and quercetin appears. It suggested that alkaline may induce some irreversible chemical reactions to quercetin, the reaction products is dissolved in 50% (v/v) aqueous ethanol solution, and the precipitation is the unreacted quercetin.

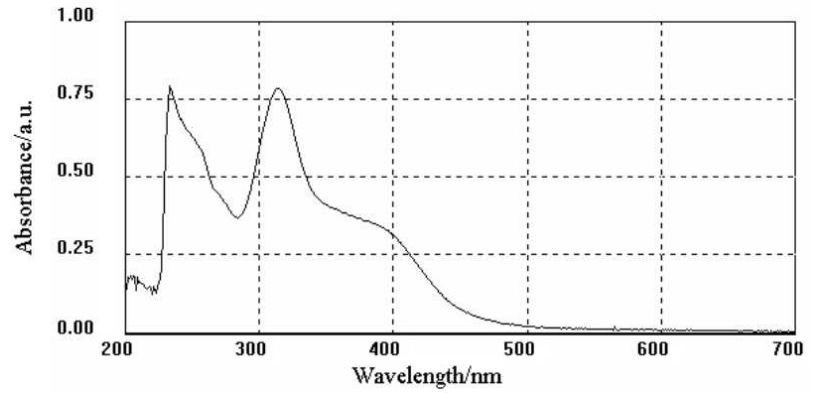

Fig. 2 UV-Vis spectrum of No. 2 quercetin solution

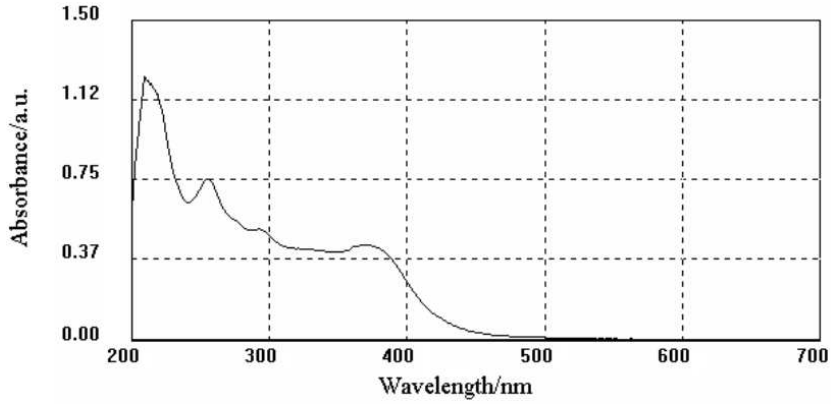

Fig. 3 UV-Vis spectrum of No. 3 quercetin solution

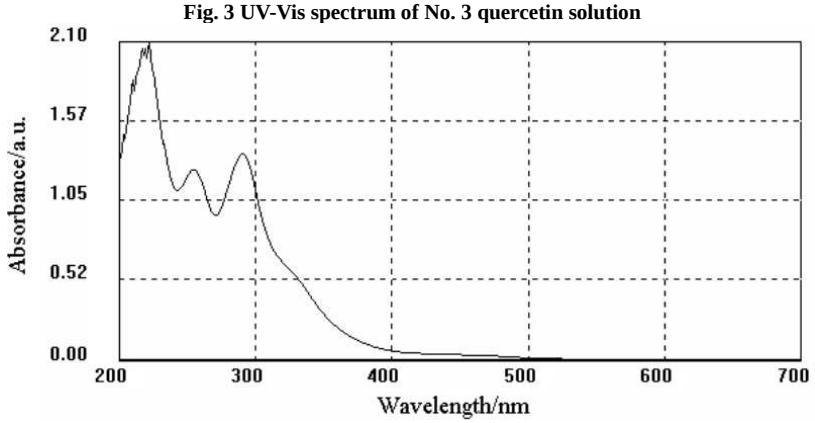

Fig. 4 UV-Vis spectrum of No. 4 quercetin solution

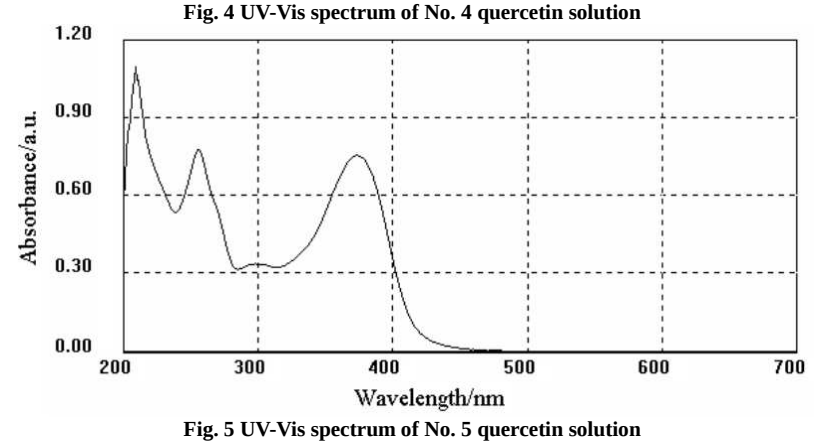

Fig. 5 UV-Vis spectrum of No. 5 quercetin solution

Effects of acid on the UV-Vis sp**ectrum of quercetin in 50 % (v/v) aqueous ethanol solution**

The pH value of standard solution of quercetin was adjusted to 1.0 with chlorhydric acid. The UV-Vis spectrum of the acid solution is showed in Fig.6. Although the shapes and band values of Fig.6 are same with those of Fig.1, after removing the ethanol, the characteristic band values in UV-Vis spectrum of the filtrate (Fig.7) are completely

different with those of Fig.1. It suggested that acid may induce the structure changes of quercetin and there are new substances generated.

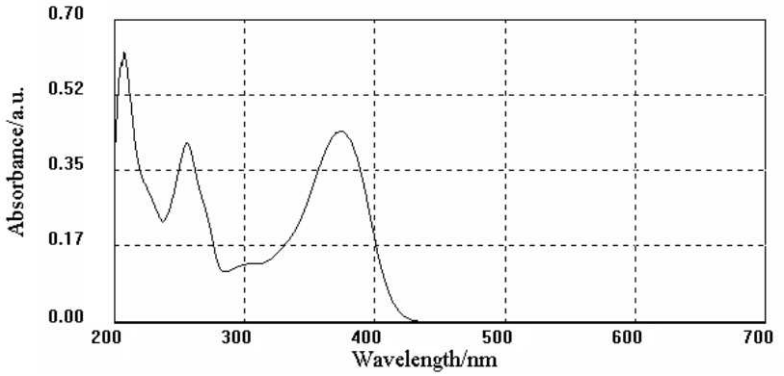

Fig. 6 UV-Vis spectrum of No. 6 quercetin solution

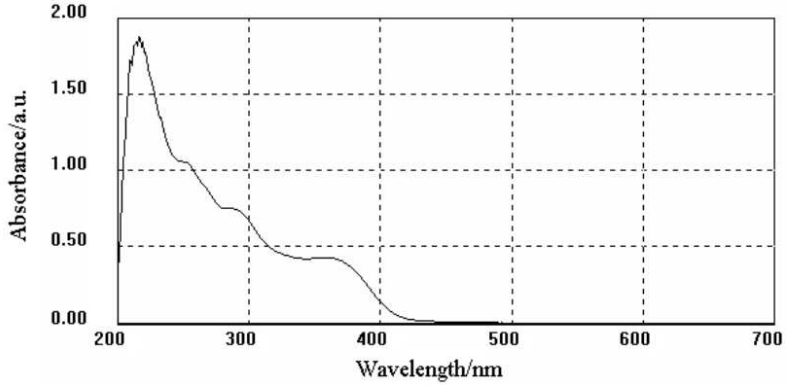

Fig. 7 UV-Vis spectrum of No. 7 quercetin solution

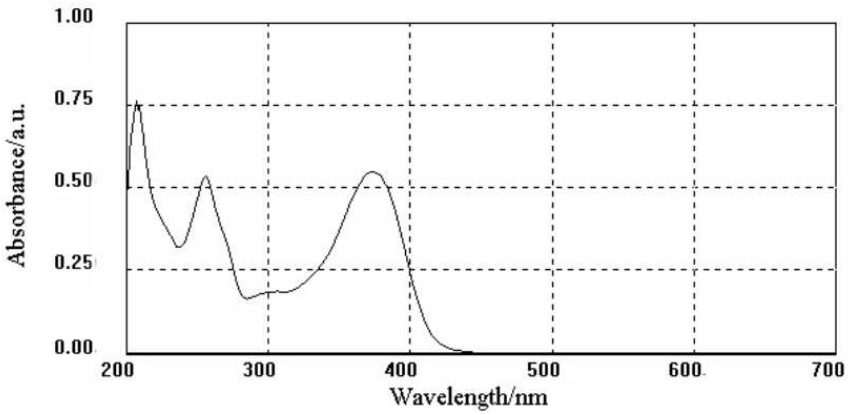

Fig. 8 UV-Vis spectrum of No. 8 quercetin solution

CONCLUSION

The pH values of quercetin in 50 % (v/v) aqueous ethanol solution were adjusted to 1.0 and 14.0 with chlorhydric acid and sodium hydroxide respectively. Adding sodium hydroxide to the standard solution, the color of solution turned to brown yellow from initial straw yellow, and the bands of UV-Vis spectrum shifted to long wave. These changes are the results of presence of decomposition products of quercetin in the solution. Also, quercetin decomposes when contacting with chlorhydric acid. It should be in mind that the bands of the UV-Vis spectrum of quercetin in strong acid and alkaline solution will change, and when measuring spectrums in acid and alkaline solution, the adsorption spectrums of quercetin in neutral solution can not be regard as standard, otherwise, it will induce some deviations. Knowing this is helpful for the extraction and content determination of quercetin.

Acknowledgments
We thank Dacheng Wu, Zongliang Du and Ruixia Li for their helpful assistance in the experiment.

The work was supported by the Natural Science Foundation of Shandong Province (ZR2010HQ052), the Medical and Health Science and Technology Development Project of Shandong province (2011QZ025), and the Pharmaceutical Technology Development Project of Shandong province (2013-238).

REFERENCES

[1] W Thomas. *Free Radical Biol. Med*. **2004**, 36 (7), 829-837.
[2] HA Milane; G Ubeaud; TF Vandamme; L Jung. *Bioorg. Med. Chem*. **2004**, 12, 3627-3632.
[3] N Pejic; V Kuntic; Z Vujic; S Micic. *Farmaco*. *SCi*. **2004**, 59, 21-24.
[4] K Gomathi; D Gopinath; MR Ahmed. *Biomaterials*. 2003, 24(16), 2767-2772.
[5] Q He; XL Xu; ZH Ke, ZR Zhang; LL Li. *Chin. Trad. Herb. Drugs*. 2003, 5, 409-412.
[6] B Wang; HT Li; M Miao; XL Yan. .*J Zhengzhou Eng. Univ*. **2004**, 25 (3), 61-63.
[7] XH Shu; M Feng; H Chen; BJ Zhang; S Deng. *J. Dallian Med. Univ*. **2005**, 27(2), 91-92.
[8] XJ Li; YP Zhang; ZB Yuan. *Chin. J Anal. Lab*. **2003**, 22(2), 39-41.
[9] YZ Deng; DX Yuan; XY Jin; QM Lin. *Chin. J. Anal. Chem*. **2003**, 31(5), 580-583.
[10] L Sun; L Meng; J Chen. *Chin. J. Chromatogr*. **2001**, 19(5), 395-397.
[11] L Yu , DL Mai. *Phys. Test. Chem. Anal., B: Chem. Anal*. **2005**, 41, 174-176.
[12] HY Zhou; FQ Zhou; ZH Bai; FY Deng. *J. Anal. Sci*. **2005**, 21(1), 107-108.