Research Article

Spectrophotometric Determination of Paracetamol in Some Manufactured Tablets in Iraqi markets.

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ABSTRACT

This research involved the estimation of the percent of paracetamol drug in some manufactured tablets in Iraqi markets using UV spectroscopy method by determining the active ingredient in ten different samples of tablets and comparisons with standard material of paracetamol. The process was conducted using different solvent (water, water – methanol mixture 95:5 v/v, water – methanol mixture 90:10 v/v, water – ethanol mixture 95:5 v/v and water – ethanol mixture 90:10 v/v). The results of tablets weighing indicate that there is a significant difference in weight of the tablets with RSD ranged from (0.53 – 4.89). The percentage recovery for different solvents were found to be ranged between (98.19 – 104.16) and RSD ranged from (0.101 – 0.422). The methods were linear in the range of 1 – 30 mg/L with an R^2 of (0.9994, 0.9989, 0.9990, 0.9997 and 0.9998) for water, methanol and ethanol respectively with a maximum absorbance at 243 nm. Linearity was determined by the regression analysis. The accuracy of the method was validated by mean percentage recovery, which was found to be in the acceptable range of 99 -101.2%. The results compare favorably with those of official methods.

Keywords: Paracetamol, Spectrophotometric, Manufactured, Tablets, Iraqi markets.

INTRODUCTION

Paracetamol (PCM) is used as antipyretic, analgesic and anti-inflammatory. The antipyretic, analgesic and anti-inflammatory effect of paracetamol is due to inhibiting prostaglandin synthesis cyclooxygenase-1 (COX-1) and cyclooxygenase-2 (COX-2)[1 - 3]. Dosage form of paracetamol has been listed in various pharmacopoeias[4, 5]. It is extensively used in the treatment of mild to moderate pain and fever and available without a prescription[6].

Overdose of paracetamol can lead to hepatic necrosis or renal failure, particularly when concentrations in serum exceed 150 µg / ml after 4 h ingestion. Nevertheless, paracetamol is a very safe analgesic in therapeutic doses[7] and is available in different dosage form: tablet, capsules, drops, elixirs, suspension and suppositories. Thus, determination of paracetamol in pharmaceuticals (quality control) and in biological fluids (overdose monitoring) is of great interest.

Numerous analytical methods were reported for the determination of paracetamol in pharmaceuticals such as, spectrophotometric[8-11], chromatographic (HPLC) [12-15], volumetric[16], electrochemical[17,18], in addition topolarography[19]. Because PCM is being increasingly used for therapeutic purposes, its determination and quality control are of vital importance and one of the determining techniques most frequently used in pharmaceutical analysis is UV – VIS spectrophotometry[20]. The aim of the present work is to use the ease and accurate spectrophotometric method for the determine the paracetamol content in tablet sample from different pharmaceutical companies available in Iraqi pharmaceutical market, to give information about these products, which may or may not comply with the requirements of the U.S.P. 37, standard method.

MATERIALS AND METHODS

Materials

PCM was supplied from Sammara Drug Industeries (SDI), Iraq.

Tablets containing PCM (500 mg) were used as marketed formulation (Table 1). Methanol, ethanol HPLC grade (BDH) and freshly prepared double distilled water were used throughout the experiment.

Apparatus

UV - VIS spectrophotometer (Jasco V-650 Japan), sartorius balance (Germany), stirring hot plate (Korea), sonic bath (Korea), shaking water bath (Taiwan) and furnace (Germany) were used through this study.

Preparation of Stock Solutions for Paracetamol (1000 mg/L)

Five portions of 0.1 g of standard paracetamol were weighed and dissolved in (water, water – methanol mixture 95:5 v/v, water – methanol mixture 90:10 v/v, water – ethanol mixture 95:5 v/v and water – ethanol mixture 90:10 v/v) respectively, transferred to a 100 ml volumetric flask and completed to the mark with the same solvent.

More diluted solutions were prepared by simple dilution of stock solution of the above solutions.

Procedure for the Paracetamol Assay in Pharmaceuticals Tablets

Ten tablets were accurately weighed and crushed to a

powder.

Amount equivalent to 0.1 g was weighed, dissolved in (water, water – methanol mixture 95:5 v/v, water – methanol mixture 90:10 v/v, water – ethanol mixture 95:5 v/v and water – ethanol mixture 90:10 v/v) respectively, transferred to a 100 ml volumetric flask and completed to the mark with the same solvent.

A known volume containing the appropriate amount of paracetamol corresponding to the range of the calibration graph was further transferred in 25 ml flask and analyzed at the same λ_{max} applied for standard measurements.

The equation of straight line was applied to calculate Paracetamol concentration & its weight.

RESULTS AND DISCUSSION

Determination of Wavelength (λ_{max}) of Paracetamol

The UV-VIS spectra of solutions containing 100 mg/L paracetamol were carried out and the maximum absorbance was found at (λ_{max} = 243 nm) for all solutions as shown in Figure 1.

Weighing of the Tablet Samples

Ten tablets from each sample were weighty individually and the results obtained were illustrated in Table 1, which revealed that there is a significant difference in the weight of the tablets for the same company due to the high values of standard deviation ranged from 0.53 – 4.89.

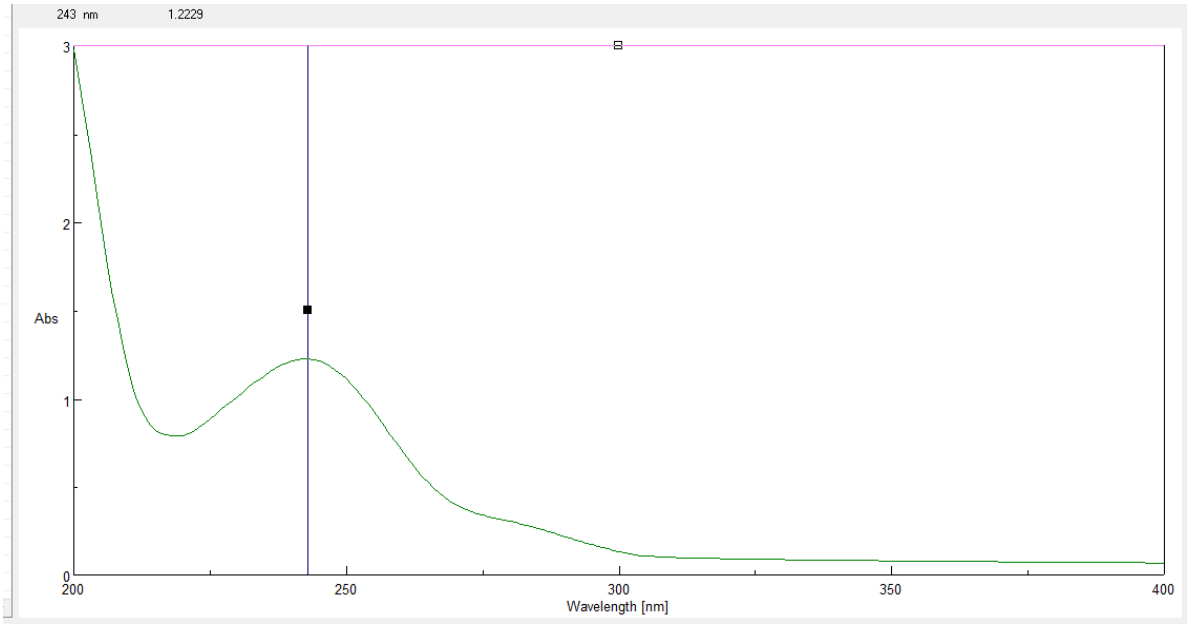

Figure 1: Absorption Spectrum of a (100 mg/L) paracetamol solution

Table 1: List of Samples under Study

Sample Name	Company	Country	Manufactured Date	Expired Date	The mean of tablet weight (mg)	R.S.D n = 10
Paracetamol	Haditha	Iraq	2/2015	2/2018	650	1.78
Panadol	Unipharma (gsk)	GlaxoSmithKline	4/2015	4/2018	583	0.53
Paracetamol	MEHECO	China	12/2014	11/2017	550	1.63
Panda	JOSWE	Jordan – Sweden	3/2014	4/2017	557	1.97
Pmol	Oman	Jordan	8/2014	8/2017	600	2.00
Piodol	Pioneer	Iraq	8/2015	8/2018	547	0.64
Paracetamol	SDI	Iraq	8/2015	8/2018	629	1.60
APMOL	NKD	India	12/2014	11/2017	600	1.66
adol	Julphar	U.E.A	3/2015	3/2018	630	1.58
Paracetamol	TROGE	Germany	10/2013	10/2017	593	4.89

The active substance is paracetamol and each tablet contains 500 mg of paracetamol as written on the claim with other ingredients are maize, starch, potassium sorbate, purified talc, stearic acid, povidone, and soluble starch.

Table 2: Summary of linear regression for the variation of absorbance verses paracetamol concentration using first degree equation of known form y = b [X] + a

Type of solvent	Linear range (Mg/L)	Straight line equation Abs. = b [X] + a	Correlation coefficient (r)	Percentage linearity (r^2%)	Calculated (t) values $t_{cal.} = \frac{/r/\sqrt{n-2}}{\sqrt{1-r^2}}$	Molar Absorptivity L. $mol.^{-1}$. Cm^{-1}
Water	1 - 30	y = 0.0126 [X] + (- 0.0015)	0.9996	99.94	115.42 >> 2.31	1.8487×10^3
5% methanol	1 - 30	y = 0.0117 [X] + 0.0081	0.9994	99.89	85.66 >> 2.31	1.9566×10^3
5% ethanol	1 - 30	y = 0.0117 [X] + 0.007	0.9994	99.90	88.33 >> 2.31	1.9365×10^3
10% methanol	1 - 30	y = 0.0134 [X] + 0.0003	0.9998	99.97	163.46>> 2.31	2.0012×10^3
10% ethanol	1 - 30	y = 0.0129 [X] + 0.0019	0.9998	99.98	122.81>> 2.31	1.9569×10^3

Table 3: Accuracy and Precision of Proposed Method for the Determination of Paracetamol in Aqueous Solutions

Paracetamol mg/L		% Recovery		% Error	RSD n = 3
Taken	Found				
5	5.03	100.6	Mean = 100.26	0.60	0.12
15	14.85	99.0	SD = 0.9285	1.00	0.16
25	25.30	101.2	RSD = 0.926	1.20	0.21

Table 4: Comparison between the New Method and Official Method

Sample No.	Drug Sample	% Recovery	
		New Method	Official Method
1	Pure PAC	100.6	100
2	SID	102.5	101.8
3	Haditha	98.99	99.7
4	Julphar	99.44	100

* n = 3

** U.S.P. 37, standard method.

T-test carried out as shown in Table 4, indicated that there was no significant difference between the developed method and the official one at 95% confidence interval as the calculated t-value (0.69) is less than tabulated one (2.78) also.

Table 5: Summery of the estimated quantity of paracetamol in tablets using different types of solvents.

Company	The values of recovery for different solvents					Paracetamol mg in claim	Acceptance criteria U.S.P. 37
	water	5% methanol	5% ethanol	10% methanol	10% ethanol		
Haditha	494.2	495.3	495.05	494.50	495.70	500	NLT* 90.0% 450 mg. NMT** 110.0% 550 mg.
gsk	491.0	491.0	492.70	490.93	492.27	500	
MEHECO	519.8	520.8	518.40	518.67	517.43	500	
JOSWE	510.2	507.2	510.00	505.40	509.67	500	
Oman	491.9	495.3	495.60	495.37	496.87	500	
Pioneer	492.5	493.8	494.75	493.53	493.37	500	
SDI	513.0	514.1	511.65	513.86	510.27	500	
NKD	491.6	492.9	494.35	492.60	492.53	500	
Julphar	495.5	498.7	496.75	498.47	496.63	500	
TROGE	509.3	516.1	513.15	516.40	511.63	500	

*NLT = Not less than; **NMT = Not more than

Preparation of Calibration Graph and Linearity Study

For determining the linearity, a series of solutions with a different paracetamol concentration range of (1, 3, 5, 8, 10, 12, 15, 20, 25, 30 mg/L) were prepared by simple dilution of stock solutions. The absorbance of these solutions was measured at (λ_{max} = 243 nm). The calibration graphs were obtained by plotting absorbance versus known concentrations in mg/L. Figures 3 shows the calibration graph plots of the paracetamol in water and the obtained results were tabulated in Table 2, which show that the values of t_{cal} are larger than t_{tab} values. The methods were linear with an R^2 of (0.9994, 0.9989, 0.9990, 0.9997 and 0.9998) for water, methanol and ethanol respectively, indicating that there is a strong correlation between the variation of concentration and response. . Linearity was determined by the regression analysis.

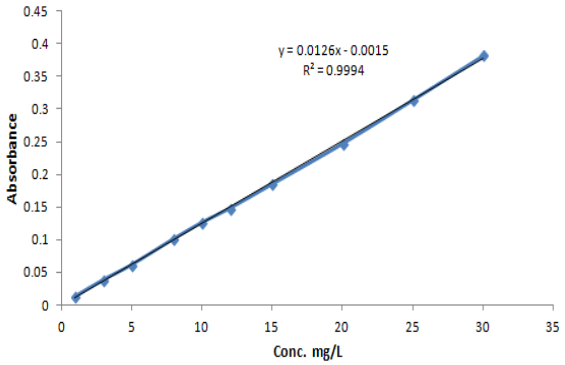

Figure 2: Calibration Graph for Paracetamol using Water as Solvent

Accuracy and Precision of Proposed Method

Paracetamol was determined at three different selected concentrations (5, 15, 25 mg/L). The obtained results were shown in Table 3, which indicated that the proposed method for the determination of paracetamol using this method was quite satisfactory in reality with respect to the procedure and parameters calculated.

The Applications (estimated of paracetamol quantity in tablets)

Ten types of pharmaceutical formulations containing paracetamol have been analyzed as described under recommended procedure; a good accuracy and precision were obtained. The obtained results were confirmed the reality and the applicability of the proposed method for the determination of paracetamol in pharmaceutical formulations. The results indicate that the recovery percentages for applying methods are with an acceptable range of 98.19 – 104.16, and an RSD range of 0.101 – 0.422.

Table 5 and Fig 3, are illustrating the obtained results for five solvent. The results indicate that the quantity of paracetamol in tablets is accepted within the normal percentage 90% - 110% according to U.S.P. 37, standard method. Recovery percentages were found to range from 98.19 - 104.16 %, which confirmed the validity of the method for the analysis of paracetamol in pharmaceutical formulations.

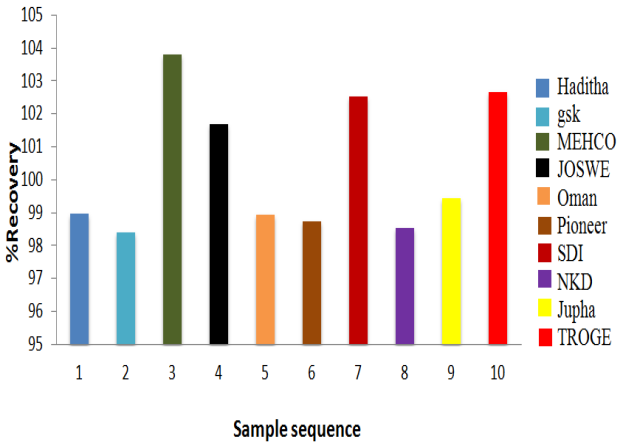

Figure 3: The % recovery of paracetamol for different samples

CONCLUSION

A simple and rapid UV spectrophotometric method was developed and validated for the quantitative determination of paracetamol in bulk and pharmaceutical formulations.

The obtained results indicate that the quantity of paracetamol in tablets is accepted within the normal percentage 90%-110%, according to U.S. P.37 and there is a significant difference in the weights of tablets in the same sample of all companies.

The methods were linear with an R^2 of (0.9994, 0.9989, 0.9990, 0.9997 and 0.9998) for water, methanol and ethanol respectively.

The comparison of the results obtained from the application of five solvents on the test sample, indicates that the adol (Julphar) is the most effective one among them.

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