Sys Rev Pharm 2021;12(1):254-258
A multifaceted review journal in the field of pharmacy

Using Of Area Under The Curve Method For The Spectrophotometric Determination Of Betamethasone Sodium Phosphate In Its Pure And Pharmaceutical Forms

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ABSTRACT

A new, fast, accurate, economic, sensitive spectrophotometric method for the determination of Betamethasone (BSP) was developed. The method includes the use of the area under the curve (AUC) of the BMT UV-spectrum in methanol. This method was very suitable to the determination of BSP because it gave good linearity which up to 10-100 µg/ml, good accuracy and precision, through Rec% values which were ranged between 98.40914-101.40864% and RSD% values were ranged between 0.05507-0.97609%, LOD was 0.029701 µg/ml and LOQ was 0.098013 µg/ml. The method successfully applied to the determination of BSP in pure and trading forms..

Keywords: Spectrophotometric, Determination, Betamethasone, Area, Curve, pharmaceutical forms

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INTRODUCTION

The IUPAC name of BSP is 9-fluoro11β,17,21-trihydroxy-16 βmethylpregna-1,4-diene-3,20-dione 21-(disodium phosphate) [1]. Its molecular formula is $C_{22}H_{28}FNa_2O_8P$,Molecular Weight is 516.4 g/mol, and its structure as in figure 1.[2].

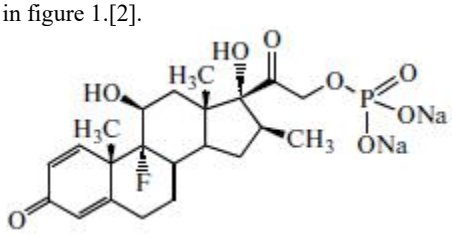

Figure 1, Structure of Betamethasone sodium phosphate

BSP is a steroid drug, It is used for a lot of diseases just as rheumatic disorders, for example, rheumatoid arthritis and systemic lupus erythematosus, skin ailments, for example, dermatitis and psoriasis, allergic conditions such asthma and angioedema, preterm labor to progress the development of the infant's lungs, Crohn's disease, cancers, for example, leukemia, together with fludrocortisone for adrenocortical insufficiency, in the midst of others.[3]It causes to be assumed orally, injections, or as a cream [3] [4]. It's used causes in a number of dangerous side effects such as muscle shortcoming, serious hypersensitivities, Euphoria, Depression, Adrenal suppression, Hypertension, petechiae, hypertrichosis, and psychosis. [5,6]. The cutout of BMS unawares after long-dated use can be surrounded by danger. [3] The cream rises hair growth and skin aggravation. [4] BMS from within the glucocorticoids. [3]. BMS was enlisted in 1958 and therapeutically endorsed in the United States in 1961. [7]There are a lot of methods for the determination of BMS in pure or in trading forms either individual or combined with other compounds, for example, Chromatographic methods such as the HPLC method for determination of BMS with different components [8-11], Thin layer chromatography[12], Spectrophotometric methods[13-17], and Voltammetric methods[18-20].This study aims to develop a new, simple, accurate, economic spectrophotometric method for the determination of BSP depending on the use of the area under their UV-absorption curves.There are a lot of methods for the determination of BMS in pure or in trading forms either individual or combined with other compounds , for example, Chromatographic methods such as HPLC method for determination of BMS with different components [8-11], Thin layer chromatography[12], Spectrophotometric methods[13-17], and Voltammetric methods[18-20].This study aim to developing a new, simple, accurate, economic spectrophotometric method for the determination of BSP depending on the using of area under their UV-absorption curves.

PRACTICAL PART

CHEMICAL MATERIALS AND APPARATUS

Analytical grade (BSP) produced by Mahima Life Science PVT.LTD. India, Shimadzu UV-Visible-1800 – Japanese apparatus was used in the measurements by using the 1cm quartz cells, and Ultrasonic Sensitive Water Bath from LabTech- Korea, to complete the solubility of the substances.Preparation of Standard solutions.

PREPARATION OF STANDARD SOLUTIONS

STANDARD SOLUTION OF BSP (100µG/ML)

The solution was prepared by dissolve 10 mg of pure BSP in methanol and complete the volume to the mark in a 100 ml volumetric flask.

PREPARATION AND ANALYSIS OF PHARMACEUTICAL FORMS

Twenty tablets of Betasons form 0.5 mg, form produced by Julphar for pharmaceutical products-United of Arabian Emirates, and Furason form 0.5 mg produced by Alfurat company for pharmaceutical Industries-Iraq were crushed and mixed. A weight equivalent to one tablet (1.095 g and 0.1174 g of each form respectively) dissolved in methanol,

Sonicated, filtrated by Whatman No 42 filter paper, and the volume was completed to the mark in 100 ml volumetric flask with methanol. The prepared solutions containing 50µg/ml of BSP were kept to the next experiments.The analysis of BSP was achieved by using the regression equation either directly for 30.40, and 50 µg/ml of each form or by standard addition method (SAM). SAM was applied by transferred a fixed volume (8 ml) of 50 µg/ml of the solution of each form to two groups of 10 ml volumetric flasks (each group consisting of two flasks), added 1ml and 2ml of 100 µg/ml BSP standard solution to the first group and same volumes to the second group, then the volumes were completed to the mark with methanol when needed. The absorption spectra were scanned between 190-400 nm.

PROCEDURE AND CONSTRUCTION OF CALIBRATION CURVE

Aliquot volumes of BSP standard solution(100 µg/ml) were transferred to a series of 10 ml volumetric flasks, diluted to the mark with methanol, the wavelengths were scanned between 190-400 nm, and the calibration curve of AUC against the concentration of BSP was plotted at 242 nm.

RESULTS AND DISCUSSION

The absorption spectrum of the BSP solutions in the concentrations up to 10-100 µg/ml showed maximum absorbance at 242 nm as in figure 2. The AUC between 214-276 nm for this spectrum was used in the determination of BSP in pure and in pharmaceutical forms as in figure 3.The concentrations of BSP against AUC have obeyed the lambert-Beer's law up to 10-100 µg/ml as in figure 4. The slope of the standard curve was 0.477 and the correlation coefficient was 0.9999 as in table 1.

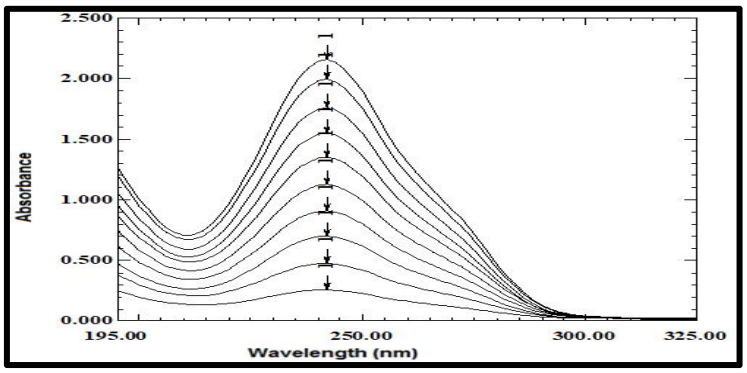

Figure 2, the absorption spectra of BSP ,

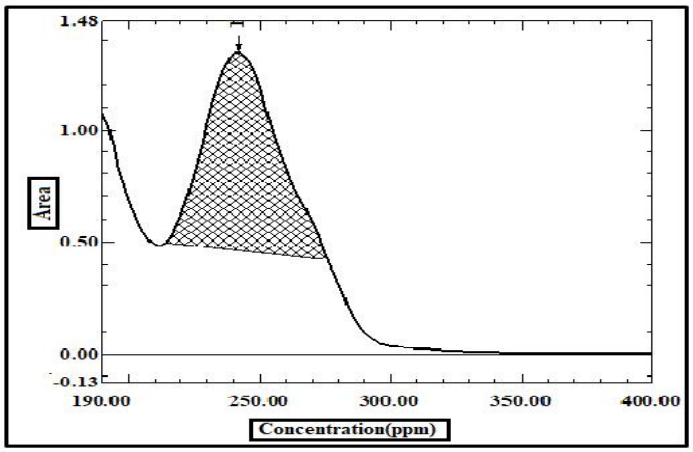

Figure 3, the area under curve of the BSP absorption spectrum

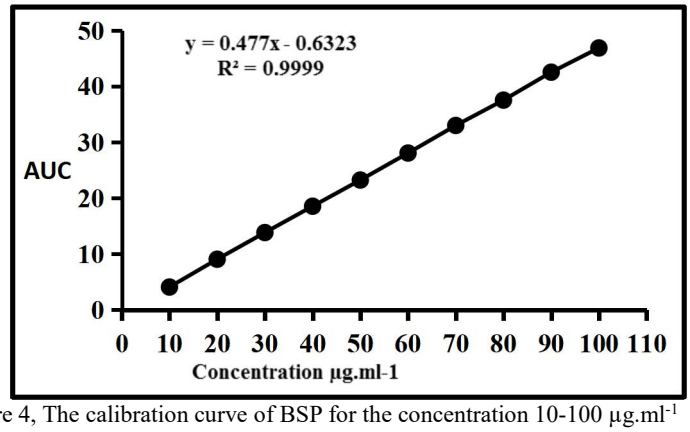

Figure 4, The calibration curve of BSP for the concentration 10-100 µg.ml^{-1}

Table 1, the analytical characteristic of the calibration curve of BSP

Drug	λ(nm)	Regression equation	R	Slope
BSP	214-276	y=0.477x-0.6323	0.9999	0.477

EXCIPIENTS EFFECT

The BSP was determined in the presence of many excipients, for example, Sodium Bicarbonate, Sodium Citrate, Sodium benzoate, Saccharin. The results showed that these excipients haven't any effect on the BSP analysis either as Betasone or as Furason until ten times the concentration of 40 µg/ml and 50 µg/ml of BSP in its form. The Rec% values were ranged between 99.907891-100.304665% and RSD% values were ranged between 0.032908-0.136321% for all mention excipients and for two forms as in table 2.

Table 2, effect of excipients on the analysis of 40 and 50 µg/ml BSP in its forms

excipient	Character	BSP(Betasone) Concentration µg/ml		BSP (Furason) Concentration µg/ml	
		40	50	40	50
Sodium-Bicarbonate	RSD%	0.088284	0.087516	0.108330	0.065919
	Rec%	100.011200	99.912294	99.970833	99.867996
Sodium Citrate	RSD%	0.124097	0.088956	0.136321	0.089808
	Rec%	99.973548	99.908119	99.947327	99.907891
Sodium benzoate	RSD%	0.162323	0.035282	0.173830	0.032908
	Rec%	100.205870	99.991744	100.304665	99.957375
Saccharin	RSD%	0.240405	0.043879	0.227560	0.043112
	Rec%	100.147746	99.920231	100.288742	99.906449

VALIDATION OF THE METHOD

The validation of the method was carried out according to International Conference on harmonizations [21] throw selectivity, linearity, accuracy, precision, and sensitivity.Selectivity is the ability of the method to differentiate between the active material and other substances in the same sample under assessment. The procedure was selective to the estimation of BSP, in the sample without any interference with excipients, the recovery percentage estimation of BSP values were agreement values which were 100±5%.The linearity description by plotting the taken concentrations against AUC. The linearity was up to 10-100 µg/ml as in table 3.The accuracy and precision were tested for the calibration curve's concentrations. The method appeared good accuracy and precision. The values of Rec% were ranged between 98.409140-101.408637% and RSD% values were ranged between 0.05507-0.97609% as in table 3.The limit of detection (LOD) is the smallest concentration of detectable materials that can determine the presence of the substance in the sample with certainty compatibility without specifying. The limit of quantification (LOQ) is the smallest concentration of substances that can be quantifiable. The LOD and LOQ for determination of BSP Indicate a good sensitivity, their values were 0.029701 µg/ml and 0.098013 µg/ml respectively.

Table 3, the accuracy and precision of the calibration curve of AUC

Drug	Concentration ($\mu g.ml^{-1}$)		Rec%	RSD%
	Taken	Found		
BSP	10	9.840914	98.409140	0.073231
	20	20.28173	101.408637	0.168873
	30	30.29124	100.970790	0.191352
	40	40.17701	100.442531	0.161881
	50	49.99689	99.993782	0.162886
	60	60.13749	100.229154	0.073274
	70	70.49236	100.703371	0.976094
	80	79.99989	99.999866	0.215462
	90	90.48585	100.539830	0.470262
	100	99.57783	99.577834	0.109393

METHOD APPLICATION

There were two methods used in the determination of BSP by regression equation of the straight line:

The first method was done by choosing three different concentrations, 30, 40, and 50 µg.ml-1with in the concentrations of the calibration curve, then the suggested method was applied by repeating each measurement seven times. The results showed good accuracy and precision, the values of Rec% and RSD% were ranged between 100.028981-100.561286% and 0.056454-0.240461% respectively as in table 4.The second method was the standard addition method, this method was done as mentioned above for the concentration of 40 µg/ml. the method succeeded in the determination of BSP in Betasone and Furason forms. The values of REC% were ranged between 98.40914-101.6183% and RSD% values were ranged between 0.122233 – 0.398312% for two forms as in table 5.Table 4, the results of the direct application of the suggestion method in the determination of Betamethasone sodium Phosphate in their forms.

Table 4, the results of the direct method in the determination of of Betamethasone sodium Phosphate in their forms

Samples	Concentration (µg.mL^{-1})		Rec%	RSD%
	Taken	Found		
BMSP (Betasone)	30	30.168386	100.561286	0.056454
	40	40.057585	100.143962	0.240461
	50	50.014491	100.028981	0.151054
BMSP (FURASON)	30	30.169623	100.565409	0.046717
	40	40.020084	100.050210	0.284265
	50	49.936881	99.873761	0.213904

Table 5, the results of the standard addition method in the determination of Betamethasone sodium Phosphate in their forms

Samples	Concentration (µg.mL^{-1})			Rec %	RSD %
	Taken	added	Found		
BMSP (Betasone)	40	10	9.840914	98.40914	0.243741
	40	20	20.323656	101.6183	0.398312
BMSP (FURASON)	40	10	9.854259	98.54259	0.203923
	40	20	20.279119	101.3956	0.122233

CONCLUSION

The suggested method is accurate, precise, selective, and sensitive for the estimation of BSP at a maximum wavelength of 242 nm. The proposed technique can be done with no requirement for additional means, for example, dissolvable extraction step, pH or Temperature control and it tends to be applied effectively for in the assessment of BSP medicate in tablets.

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