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Characterization of Eu(III) Complex for Determination of Bumetanide in Pharmaceutical Preparations and in Biological Fluids

M. M. Abd-Elzaher[1]*, Mona. A. Ahmed [2], A. B. Farag [3], M.S. Attia [4], A. O. Youssef [4] and Sh. M. Sheta [1]

[1]Inorganic Chemistry Department, National Research Centre, 33, El-Behouth St., Dokki, Giza, [2]Department of Chemistry, College of Women for Art, Science and Education, Ain Shams University, Cairo, [3]Department of Chemistry, Faculty of Science, Helwan University, Helwan and [4]Department of Chemistry, Faculty of Science, Ain Shams University, Cairo, Egypt.

EU(III)-Acetylacetone complex 1 was prepared and characterized by elemental analysis, UV/Vis, IR, ^{1}H-NMR spectroscopy, conductance and magnetism. The spectral results indicated that the composition of this complex is $[Eu(acac)_2(NO_3)(EtOH)_2(H_2O)_2]$.We development simple, sensitive and selective spectrofluorimetric method for the determination of trace amounts of bumetanide in pharmaceutical tablets and biological fluids (serum and urine) using complex 1. The bumetanide can remarkably enhance the fluorescence intensity of the complex in acetonitrile at $\lambda_{ex/Em}$ = 385/619 nm and pH 7.1. The dynamic ranges for the determination of bumetanide concentration were found from 1 x 10^{-11} to 1 x 10^{-4} mol L^{-1}, and the limit of detection (LOD) and quantitation limit of detection (LOQ) are 1.6 ×10^{-10} and 3.2 x 10^{-9} mol L^{-1}, respectively.

Keywords: Acetylacetone, Europium, Complex, Characterization, Bumetanide, Spectrofluorimetric, Fluorescence intensity.

Bumetanide [chemical name: 3-Butylamino-4-phenoxy-5-sulphamoylbenzoic acid] (Fig. 1) is considered one of loop diuretic group and used in the treatment of hypertension, and oedema associated with heart failure and with renal and hepatic disorders[(1-3)].

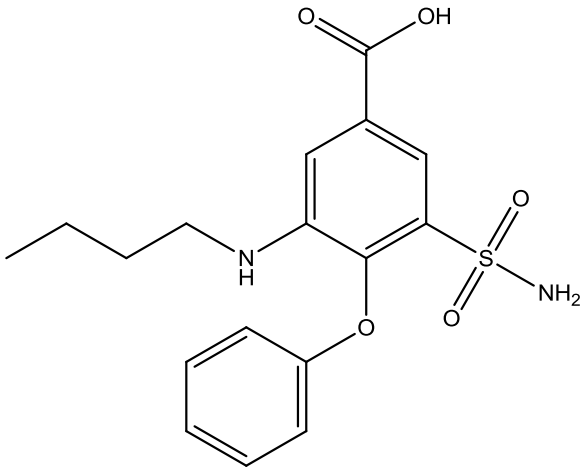


Fig. 1. Chemical structure of bumetanide.

A marked dieresis is additionally associated to loss of weight (rapidly lower body weight), so it's abused in sports that weight classes are concerned. Fast and intense dieresis hides the ingestion of other doping drugs by dilution of their concentration in urine samples [(4)]. The World Anti-Doping Agency (WADA) (Medical Commission of the International Olympic Committee) has forbidden the use of bumetanide in 1986 for this reason [(5)].

Due to clinical wide use of bumetanide, different analytical methods to determine bumetanide in pharmaceuticals preparations and biological fluids have been improved [(6, 7)] . The methods like spectrophotometry [(8, 9)] , variable-angle scanning fluorescence spectrometry [(10)] , spectrofluorimetry [(11- 12)] , potentiometry [(13)] , voltammetry [(14)] and chromatography [(15 - 17)] . were used. However, most of these methods are time-consuming and technically demanding and So, we need an alternative method simple, low-cost, sensitive and rapid for the determination of bumetanide in pharmaceuticals preparations and biological samples.

The europium complexes are very important, because of the saturated red emission resulting from emitting strong fluorescence arising from f– f hyper sensitive transition with a large Stokes shift and long lifetime [(18)]. The distinguished properties of the europium complexes enabled the development of a fluorescence chemical sensor with high sensitivity. According to Laporte rule, the 4f– 4f transitions in rare earth ions are forbidden to some extent; so the absorption and emission spectra observed in the Eu(III) ions have always weak intensity. The excited states of the Eu(III) ions may increase by its coordination to organic ligands, which act as sensitizers, and the ligands that have this property are called by Lehn

" antennas" [19] . The organic ligand in Eu(III)-complex absorbs and transfers energy efficiently to the metal ion and increases its luminescence intensity consequently.

In this article an Eu(III)-acetylacetone complex 1 was prepared and characterized using different spectroscopic techniques, then used in determination of bumetanide in pharmaceuticals and biological samples (serum and urine).

Experimental

Chemicals and reagents

All chemicals used were of analytical reagents grade obtained from Aldrich Chemical Company (USA). The drug standard (bumetanide) was obtained from Sigma-Aldrich. The pharmaceutical preparations containing the drugs obtained from local drug stores. Urine and serum samples were obtained from healthy volunteers during morning hours.

Instruments

Elemental analyses were carried out in Cairo University, Egypt. The IR spectra of the ligand and solid complex were recorded as KBr discs using JASCO FT/IR-460 infrared spectrophotometer. The electronic spectra (200-900nm) were carried out using a Perkin-Elmer 550 spectrophotometer. The ^{1}H-NMR spectra in deutrated dimethylsulfoxid (DMSO) as a solvent and were recorded on Gemini-300 MHz NMR spectrometer. The molar conductance of 10^{-3} M solution of metal complex in DMSO was measured on a dip cell and a Bibby conductimeter MC1 conductivity meter model. A magnetic measurement of the solid complex was measured at room temperature using Gouy' s method by a magnetic susceptibility balance from Johnson Metthey and Sherwood model. The fluorescence measurements were carried out on a Shimadzu RF5301 spectrofluorophotometer in the range 290– 750 nm.

Procedures

General procedure

Eu(III)-Acetylacetone complex 1, was synthesized by mixing 20 ml aliquot of 1×10^{-2} M of the ligand with a 10 ml aliquot of 1×10^{-2} M Eu(III) nitrate (2:1 ligand to metal molar ratio) with stirring. The mixture was refluxed at about 80^{o}C for two hours; then the mixture was cooled to 0^{o}C. The resulting precipitate of the complex 1 is greenish yellow; the resulting precipitate of the complex was filtered off, and washed.

To 10 ml clean measuring flasks, the standard solution of bumetanide was prepared by different additions of 1 x 10^{-3} mol L^{-1} drug stock solution to give the following concentrations of the drug, 1 x 10^{-4} to 1 x 10^{-12} mol L^{-}

[1]. The solutions were diluted to the mark with DMSO or acetonitrile or methanol or deionized water at room temperature. The above solutions were used for subsequent measurements of absorption and emission spectra as well as the effect of solvents and pH. The fluorescence intensities were measured at $\lambda_{ex}/\lambda_{em}$ =385/619.

Determination of bumetanide in pharmaceutical preparations

Ten tablets of bumetanide were carefully weighed and ground to finely divided powders. Accurate weights equivalent to 1.0 mg bumetanide was dissolved in 50 ml acetonitrile and mixed well and filtered up using 12 mm filter papers. The concentration of the drug was determined by using different concentrations from the corresponding calibration graph.

Determination of bumetanide in serum samples

A 1.0 ml of samples of blood collected from various healthy volunteers was centrifuged for 15 min at 4500 r/min to remove proteins. The unknown amount of drug in human serum samples was determined using the standard addition (spiking) techniques.

Determination of bumetanide in urine samples

The urine samples studied, which were obtained from healthy male and female volunteers who had taken no drug previously, were processed in the laboratory as follows: 10 ml of urine were centrifuged for 15 min at 4500 r/min to remove precipitate salts, crystals, pus cells, and red blood cells (RBCs). A 1.0 ml of urine was supplied with the volume of drug solutions. The unknown amount of drug in human urine samples was determined using the standard addition (spiking) techniques.

Analytical performance and method validation

The Analytical performance and validation of the method is carried out by studding the following parameters:

A. Calibration curve : A linear correlation was found between fluorescence intensity of the Eu(III)-Acetylacetone complex at λ_{em} = 619 nm and concentration of bumetanide. The obtained calibration curve and the graph were described by the regression equation:

$$Y = a + bX$$

(where Y = fluorescence intensity of the sensor at λ_{em} = 619 nm; a = intercept; b = slope and X = concentration in mol L^{-1}).

Regression analysis of bumetanide intensity data using the method of least square was made to evaluate the slope (b), intercept (a) and correlation

coefficient (r). The limit of detection (LOD) and quantitation (LOQ) calculated according to ICH guidelines [31, 32] using the formulae:

$$LOD = 3.3\ S/b \text{ and } LOQ = 10\ S/b$$

(where S is the standard deviation of blank fluorescence intensity values, and b is the slope of the calibration plot).

B. Accuracy and precision of the method: To compute the accuracy and precision, the assays described under " general procedures" were repeated three times within the day to determine the repeatability (intra-day precision) and three times on different days to determine the intermediate precision (inter-day precision) of the method. These assays were performed for three levels of analyte. The low percentage relative standard deviation (%RSD) values (intra-day) and (inter-day) indicating high precision of the method. The accuracy of the method is evaluated as percentage relative error (RE) between the measured mean concentrations and the taken concentrations of bumetanide. Bias {bias % = [(Concentration found - known concentration) x 100 / known concentration]} is also calculated.

C. Selectivity: The proposed methods were tested for selectivity by placebo blank and synthetic mixture analysis. A placebo blank containing talc (250 mg), starch (300 mg), lactose (30 mg), calcium carbonate (50 mg), calcium dihydrogen orthophosphate (20 mg), methyl cellulose (40 mg), sodium alginate (70 mg) and magnesium stearate (100 mg) was extracted with water and solution made as described under " analysis of dosage forms" . A convenient aliquot of solution was subjected to analysis according to the recommended procedures. In the method of analysis, there was no interference by the inactive ingredients.

A separate test was performed by applying the proposed method to the determination of bumetanide in a synthetic mixture. To the placebo blank of similar composition, different amount of bumetanide of different products were added, homogenized and the solution of the synthetic mixture was prepared as done under " analysis of dosage forms" . The filtrate was collected in a 100 ml flask. Five ml of the resulting solution was assayed (n=3) by proposed method and then calculate the recovery percent.

D. Application to formulations: The proposed methods were applied to the determination of bumetanide in Burinex tablets 1.0 mg (minapharm Com.) which is purchased from local market and containing other inactive ingredients and in serum and urine samples of the health state human.

E. Recovery study: To further assess the accuracy of the methods, recovery experiments were performed by applying the standard-addition technique. The recovery was assessed by determining the agreement between the measured standard concentration and added known concentration to the sample. The test was done by spiking the pre-analysed tablet powder with pure bumetanide at three different levels (0.1, 1.0 and 10.0 n mol L -1) of the content present in the tablet powder (taken) and the total was found by the proposed method. Each test was repeated three times.

Results and Discussion

Characterizations of the Eu(III) Acetylacetone complex 1

The electronic absorption spectra of the prepared complex 1 and acetylacetone compounds were measured in ethanol at room temperature. Spectra data of the ligand and complex are represented in Table 1. Uv/Vis spectra of the Eu(III) complex showed an absorption band (intense high-energy) at about 218 nm. These high-energy absorption bands are assigned to n-π* and π – π* transition in the complex [20].

The IR spectrum of complex 1 was summarized in Table 1. The stretching band at 1637 cm^{-1} found in the ligand L1 was appointed to the C=O group, and this stretching band shifted to decrease energy by 15 cm^{-1} in complex 1. This result may be due to the resonance of the deprotonated anion which affords the C=O bonds the mixed character of single and double bonds. This shift confirmed L1 also the participation of the carbonyl group in the complexation with Eu(III) ion [21]. The IR absorption bands appeared at 1176, 783 cm^{-1} for L1; which resulting from the in-plane and out-of-plane vibrations of C-H bonds. These bands were shifted (26-38 cm^{-1}) by complexation, and these changes could be attributed to the change in rigidity of the ligand ring due to complexation [20]. In complex 1 a broad band appeared in the range 3000–3600 cm^{-1} assigned to the water molecules and/or to the OH stretching vibration of the ligands and/or the ethanol molecules present in the complex [22-24]. The new bands at 505 cm^{-1} observed in complex 1 were attributed to M-O bond in complex 1 [25-32].

The ^{1}H-NMR spectra of the ligand L1, and Eu(III)-complex 1 were measured in DMSO-d_6 at room temperature. The chemical shift data are given in Table 1, but unfortunately we could not obtain good spectra for the complex which may be due to highly paramagnetic properties of the complex. This adds difficulty to assigning the NMR peaks.

The molar conductivity of 1 x 10^{-3} M solution of the metal complex 1 in DMSO at room temperature was found to be 32.52 ohm^{-1} cm^2 mol^{-1} (Table 2) indicating that the complex is nonelectrolytic in nature [24, 25]. The magnetic moment value of complex 1 was measured using Gouy method and was found 3.12 B.M (Table 2). The Eu(III) ions were paramagnetic due to their 4f-electrons that were effectively shielded by $5s^2 5p^6$ electrons [24] .

The elemental analysis of the complex is consistent with the calculated results from the empirical formula (Table 2). The results indicated that complex 1 is ten-coordinated.

TABLE 1. Electronic absorption, IR, and ^{1}H-NMR data of the ligand and Eu(III)-complex.

Ligand/ Complex	Absorption Bands (λ) nm	IR spectral data				^{1}H NMR (DMSO-d_6), δ in ppm
		$\upsilon_{C=O}$	δ_{C-H} (in plane)	δ_{C-H} (out of plane)	υ_{Eu-O}	
L1	238, 274	1637	1176	783	……	2.01 (S, 6H, $2CH_3$), 2.08 (S, 6 H, $2CH_3$), 3.80 (S, 2H, CH_2 *Keto form*), 5.69 (S, H, CH-*enol form*), 15.61 (S, H, OH)
1	218	1622	1150	745	505	2.51 (m, 6 H, 2CH3), 3.35 (S, 2H, CH2)

TABLE 2. Conductivity, magnetism and elemental analysis of complex 1.

Complex	Formula (formula weight)	Calcd. (found)			Am (Ω^{-1} cm^2 mol^{-1})	μ_{eff} (B.M.)
		C	H	N		
1	$C_{14}H_{34}EuNO_{11}$ (544.38)	30.89 (30.67)	6.30 (6.47)	2.57 (2.43)	32.52	3.12

From the physical and spectral data of the complex 1 discussed above, we can deduce that the metal ions are bonded to two molecules of the ligand as well as one molecule of the nitrate ion and two molecules of water and two molecules of ethanol. Complex 1 may take the formula [$Eu(acac)_2$ (NO_3) $(EtOH)_2(H_2O)_2$], as illustrated in Fig. 2 [20, 26].

Determination of bumetanide using Eu(III) complex 1 by spectrofluorimetric method

Spectral characteristics

A. Absorption spectra: The absorption spectrum of bumetanide is showed in Fig. 3. Threshold two bands at 266 nm and band at 352 nm appeared and can be attributed to n-π* and π-π* transitions. The absorbance is also enhanced, by increasing the concentration of the bumetanide.

B. Emission and excitation spectra: Figure 4 represents the emission and excitation spectra of bumetanide (spectrum 1), and that of Eu^{3+} ions (spectrum 2) and that of complex (1) [Eu^{3+}-Acetylacetone] (spectrum 3), and bumetanide-Eu^{3+}-Acetylacetone (spectrum 4). From the spectra in Fig. 4, it was concluded that Eu^{3+} ion has two very weak peaks. Comparing spectrum 1 with spectrum 3 [after the addition of bumetanide into the Eu^{3+}-Acetylacetone], the results showed that bumetanide can form a new complex with Eu^{3+}-Acetylacetone. It can be observed that the characteristic peak of Eu^{3+} at 619 nm has been increased remarkably by addition of bumetanide. This is an evidence that bumetanide enhances the energy of bumetanide-Eu^{3+}-Acetylacetone complex.

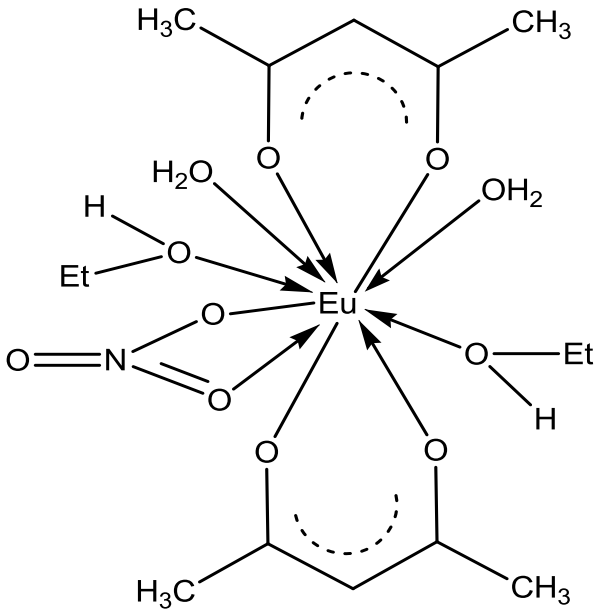


Fig. 2. Structural representation of complex 1.

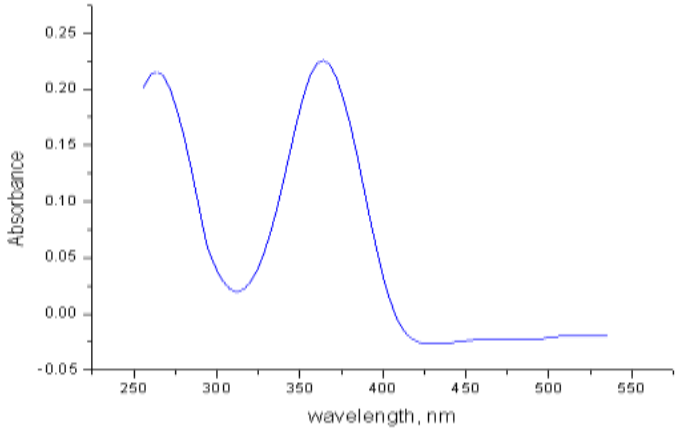


Fig. 3. The absorption spectrum of bumetanide .

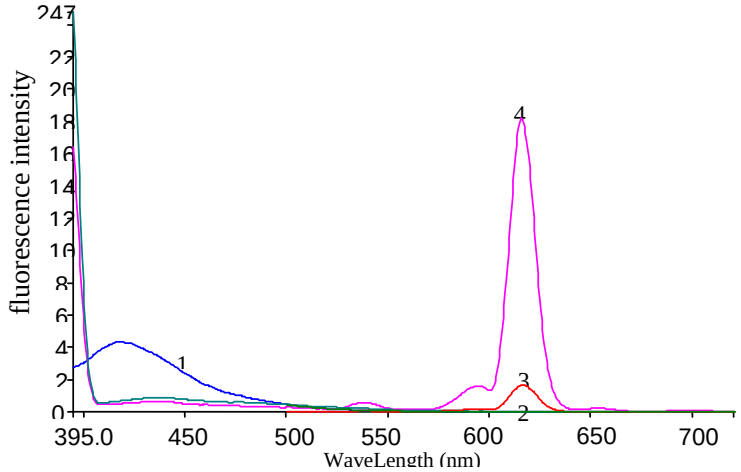


Fig. 4. The fluorescence spectra of (1) the bumetanide, (2) Eu^{3+}ion, (3)Eu^{3+}-Acetylacetone and (4) bumetanide-Eu^{3+}-Acetylacetone complex .

Experimental parameter effect

A. *pH effect :* The fluorescence intensity and absorption spectrum of the bumetanide depend on pH medium which adjusted using NH_4OH and HCl. The highest intensity peak which appears at 619 nm was obtained at pH = 7.1.

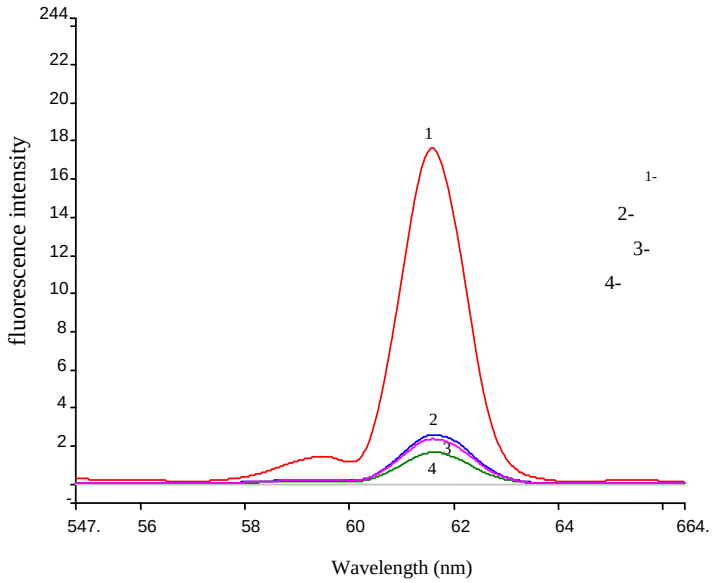
B. Solvent effect: The fluorescence intensity of the bumetanide was measured in different solvents. From the results we found that in the presence of

acetonitrile there is no quenching in the emission intensity of bumetanide (Fig. 5).

C. Bumetanide concentration effect: The bumetanide-concentrations effect on the fluorescence intensities of the Eu^{3+}-Acetylacetone complex was investigated. The emission spectra of the Eu^{3+}-Acetylacetone gives a characteristic band at 617 nm after excitation at 385 nm and the fluorescence intensity was enhanced by increasing the concentration of the bumetanide till 1x 10^{-4} mol L^{-1} then it became constant in the acetonitrile preparations (Fig. 6).

Method validation

1. *Calibration curve:* A linear relationship between fluorescence intensity of the Eu(III)-Acetylacetone complex at λ_{em} = 619 nm and bumetanide-concentration in the ranges are given in Table 3. The eleven-point ($1x10^{-4}$ - $1x10^{-11}$) calibration curve was obtained (Fig. 7). Table 3 presented regression analysis of bumetanide intensity data, whereas Table 4 contained a comparison of spectrofluorimetric technique with some published methods and from Table 4 we noted that the low value of LOD indicates the high sensitivity of our present method for the determination of bumetanide compared with the previous



methods.

Fig. 5. The fluorescence spectra of 1x10^{-5} M of Bumetanide measured in different solvents.

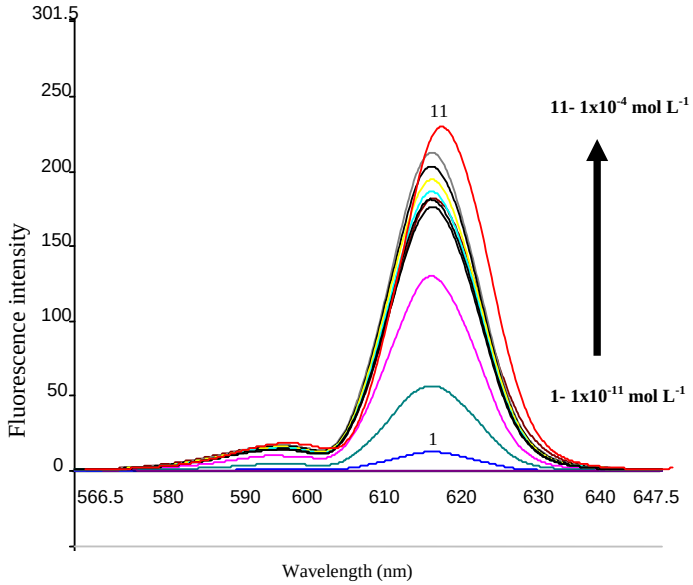


Fig.6. The fluorescence spectra of the Eu(III)-Acetylacetone at different concentrations of bumetanide in acetonitrile. at λ_{ex} = 385 nm and pH 7.1.

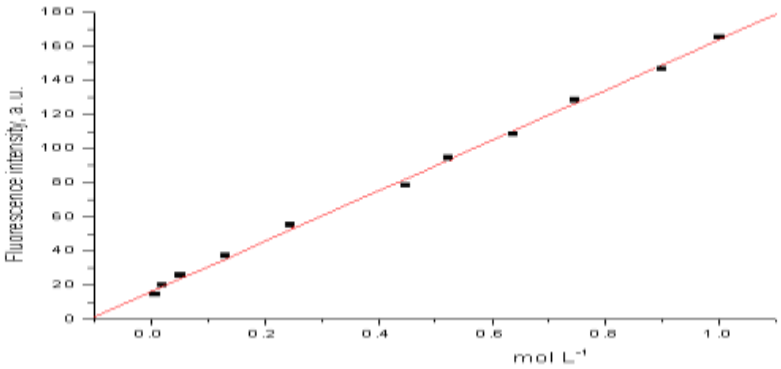


Fig. 7. linear relationship between concentration of bumetanide and fluorescence intensity of Eu^{3+}-Acetylacetone complex in acetonitrile .

TABLE 3. Sensitivity and regression parameters for the method.

Parameter	Method
λ_{em} nm	619
Linear range, mol L^{-1}	1×10^{-11} - 1×10^{-4}
Limit of detection (LOD), mol L^{-1}	1.6×10^{-10}
Limit of quantification (LOQ), mol L^{-1}	3.2×10^{-9}
Regression equation, Y*	Y=a+bX
Intercept (a)	1.55
Slope (b)	2.9×10^{9}
Standard deviation	0.34
Variance (Sa2)	8.99
Regression coefficient (r)	0.9986

*Where Y= fluorescence intensity, X= concentration in n mol L^{-1}, a= intercept, b= slope.

TABLE 4. Comparison of spectrofluorimetric technique with some existing methods for the determination of bumetanide.

Method	Linear range	Detection limit	Ref.
liquid-chromatography electrospray time-of-flight mass spectrometry	$1 \times 10^{-12} - 3.5 \times 10^{-3}$	5.8×10^{-10}	[Juan C. D., *et al.*, 2015]
Potentiometric method	$1 \times 10^{-6} - 1 \times 10^{-3}$	3.9×10^{-7}	[El-Tohamy, M. *et al.*, 2006]
LC-MS method	$1 \times 10^{-11} - 1 \times 10^{-4}$	1×10^{-10}	[Deventer, K., *et al.*, 2002]
HPLC method	$1 \times 10^{-9} - 1 \times 10^{-5}$	1×10^{-8}	[Richter, K., *et al.*, 1996]
Spectrofluorimetric method: Bumetanide-Eu^{3+}-Acetylacetone	1×10^{-11} - 1×10^{-4}	3.2×10^{-9}	The present work

2. Accuracy and precision of the method: The accuracy and precision computed according to general procedures and the results are given in Table 5. The relative standard deviation percentage (%RSD) values were ≤ 2.35% (intra-day) and ≤ 1.29 % (inter-day) and this indicates that our method is highly precise. Also, the percent of relative error (%RE) was ≤ 4.0 % (intra-day) and ≤ 3.18 % (inter-day) which indicates that our method is highly accurate.

3. Selectivity: Our method was tested for selectivity by studying the effect of placebo blank and synthetic mixture analysis which present with our drug. From the results we found that the recovery percent was 99.50 ± 0.65, 98.9 ± 1.75, and 97.60 ± 0.80 for tablet, urine, and serum samples, respectively. The results confirmed the accuracy as well as the

precision of our present method. The results showed that high selectivity was found in case of our drug in present of placebo blank.

*4. Application to formulations:*Our present method was applied to the determination of bumetanide in pharmaceutical tablets and in serum and urine samples taken from healthy male and female. The results in Table 5 indicated that the present method is very good for the determination of bumetanide. The data represented in Table 6, were statistically compared with the reference method [35, 36]. The average recovery percent and R.S.D in our method found to be (100.2 ± 1.43 %), (99.6 ±0.70 %), and (103.1 ± 1.70 %) for the tablet, serum, and urine samples, respectively. Data obtained by B. P. method showed the average recovery (99.99 %, 98.92 and100.2.) and R.S.D 0.1 % for the tablet, serum, and urine samples, respectively; were also presented for comparison and show a good correlation with those obtained by the present methods. Our results obtained by the present method were found in good agreement with that of the reference method [35, 36].

TABLE 5. Evaluation of intra-day and inter-day accuracy and precision.

Method	Bumetanide Added (x 10^{-7} mol L^{-1})	Intra-day accuracy and precision (n=3)			Inter-day accuracy and precision (n=3)		
		Bumetanide average found ± CL	RE %	RSD %	Bumetanide average found ± CL	RE %	RSD %
Burinex tablets	10.0	10.06 ± 0.11	1.50	0.13	10.03 ± 0.13	0.75	1.29
	5.0	5.05 ± 0.17	0.83	1.12	4.95 ± 0.18	0.83	1.23
	1.0	1.20 ± 0.23	2.50	1.11	1.19 ± 0.24	2.37	1.19
Urine sample	10.0	10.16 ± 0.23	4.00	2.22	9.99 ± 0.30	2.19	0.16
	5.0	5.05 ± 0.28	0.83	1.86	5.04 ± 0.41	3.18	0.13
	1.0	1.19 ± 0.48	2.37	2.35	1.03 ± 0.31	1.59	0.12
Serum sample	10.0	9.99 ± 0.11	0.25	1.11	10.11 ± 0.13	2.75	1.26
	5.0	5.04 ± 0.16	0.66	1.06	5.02 ± 0.18	0.33	1.21
	1.0	1.13 ± 0.21	1.62	1.02	0.98 ± 0.26	1.37	1.15

%RE: percent relative error, %RSD: relative standard deviation and CL: confidence limits were calculated from: CL = ±t S √n. (The tabulated value of t is 4.303, at the 95% confidence level; S = standard deviation and n = number of measurements.)

5. Recovery study

From the results of studding the recovery percentage for our proposed method (Table 7) we found that the values of recovery % for tablet, urine, and serum samples, ranged between (99.75 and 102.09 %), 103.85 %), and (97.00 and 100.20 %) with relative standard deviation in the range (0.25 - 0.69 %), (0.61 - 0.85%), and (0.25 - 1.15%) respectively. Closeness of the results to 100 % showed the fairly good accuracy of the proposed methods.

TABLE 6. Results of analysis of tablets by the proposed method and statistical comparison of the results with the reference method.

Tablet brand name	Nominal amount, Added (x 10^{-7} mol L^{-1})	Found (Percent ± SD) [b]			
		Reading	Average Found (x 10^{-7} mol L^{-1}) [a]	B.P. (LC)	Proposed method
					Recovery ±RSD (%)
Burinex tablets	5 1 0.1	5.09, 4.99, 5.13 1.06, 1.11, 0.99 0.09, 0.13, 0.088	5.13 1.05 0.103	99.99± 0.39	100.2 ± 1.43
Urine sample	5 1 0.1	5.19, 5.09, 4.92 0.98, 1.11, 0.96 0.08, 0.13, 0.097	5.07 1.02 0.102	100.2± 0.1	103.1 ± 1.70
Serum sample	5 1 0.1	5.0, 5.09, 4.92 1.0, 1.11, 0.96 0.13, 0.10, 0.087	5.00 1.02 0.106	98.92± 2 .2	99.6 ± 0.70

a, each reading was repeated three times (average was taking for three reads by three analysts) b, Average of three determinations.

5

TABLE 7. Results of recovery study using standard addition method.

Proposed method				
Tablet studied	Bumetanide in tablet extract, x 10^{-7} mol L^{-1}	Pure Bumetanide added, x 10^{-7} mol L^{-1}	Total Bumetanide found, x 10^{-7} mol L^{-1}	Pure Bumetanide recovered (Percent±SD)
Tablet	10 1.0 0.1	1.5 3.0 4.5	11.40 3.95 4.65	99.75 ± 0.25 98.75 ± 0.45 102.09 ± 0.69
Urine sample	10 1.0 0.1	1.5 3.0 4.5	11.38 4.15 4.43	98.96 ± 0.61 103.85 ± 0.75 97.33 ± 0.85
Serum sample	10 1.0 0.1	1.5 3.0 4.5	11.46 3.92 4.61	99.65 ± 1.15 97.0 ± 0.35 100.2 ± 0.25

Conclusion

Complex 1 (Eu^{3+}-Acetylacetone complex) in the presence of bumetanide has high sensitivity and characteristic peaks. The peaks intensities are

enhanced by increasing the concentration of bumetanide, due to energy transfer from bumetanide to the Europium ion and can be used for bumetanide determination in biological fluids and pharmaceutical preparations with high accuracy.

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توصيف متراكب الاربييوم الثلاثي *واستخدامه* لتقدير البيوماتانيد في تركيباته الصيدلية والسوائل البيولوجية

مخلص محمد عبد الظاهر[*] ، منى عبد العزيز أحمد[**] ، عبد الفتاح بسطاوى فرج[***] ، محمد سعيد عطيه[****] ، أحمد عثمان يوسف[****] و شتا محمد شتا[*]

[*]قسم الكيمياء غير العضوية المركز القومى للبحوث** قسم الكيمياء التحليلية كلية البنات – جامعة عين شمس[***]قسم الكيمياء التحليلية كلية العلوم – جامعة حلوان – [****]قسم الكيمياء غير العضوية كلية العلوم – جامعة عين شمس – مصر .

فى هذا البحث تم تحضير متراكب رقم 1 من تفاعل الاسيتل اسيتون مع الاربييوم الثلاثي وتوصيفه بواسطة طيف الاشعة فوق البنفسيجية والمرئيه، طيف الاشعة تحت الحمراء، الرنين النووي المغناطيسي، التحليل العنصري ، التوصيل المولارى والعزم المغناطيسي. وقد اثبتت النتائج ان التركيب الجزيئي للمتراكب هو $[Eu(acac)_2(NO_3)(EtOH)_2(H_2O)_2]$، وقد تم تطوير طريقة وميضية بسيطة وحساسة وانتقائية لتحديد كميات ضئيلة من البيوماتانيد في صورته الطبيعية أو فى السوائل البيولوجية (الدم والبول) وفى تركيباته الصيدلية باستخدام المتراكب المحضر.

تم توصيف طريقة وميضية مباشرة لتقدير البيوماتانيد اعتمادا على قياس الطيف الوميضى عند اس هيدروجيني مناسب7.1 فى محلول الاسيتونتريل. وكان مدى القياس للطريقة يتراوح من10^{-11} – 10^{-4} مولاري. تم الحصول على علاقة خطية بين شدة الطيف الوميضى وتركيزتلك الماده. ولقد أظهرت النتائج دقة عالية للطريقة فكان مدى الكشف عن البيوماتانيد يصل الى $1.6*10^{-10}$ مولارين وكان مدى تقدير هذه الماده يصل الى $3.2 * 10^{-9}$.