Polymeric Membrane Sensors for the Selective Determination of Metoclopramide Hydrochloride and their Applications to Pharmaceutical Analysis

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Abstract

Metoclopramide (MCP) ion selective electrodes based on metoclopramide-phosphotungstic acid (MCP-PT) ion pair complex in PVC matrix membrane were constructed. The plasticizers used were tri-butyl phosphate (TBP), di-octyl phenyl phosphonate (DOPP), di-butyl phthalate (DBPH), di-octyl phthalate (DOP), di-butyl phosphate (DBP), bis 2-ethyl hexyl phosphate (BEHP). The sensors based on TBP, DOPP, DBPH and DOP display a fast, stable and linear response with slopes 59.9, 57.7, 57.4, 55.3 mV/decade respectively at pH ranged 2-6. The linear concentration range between 1.0×10^{-5} – 1.0×10^{-2} M with detection limit 3.0×10^{-6} and 4.0×10^{-6} M for electrodes using TBP, DOPP and DBPH while electrode using DOP shows a linear concentration range between 3.0×10^{-5} – 1.0×10^{-2} M and detection limit 6×10^{-6} M. The selectivity coefficient values were calculated for MCP with respect to different inorganic cations, sugars and amino acids using the MCP depending on TBP plasticizer which is also used for the determination of MCP in pure solutions and in pharmaceutical preparations by direct, standard addition methods and as an indicator electrode in potentiometric titration with phosphotungstic acid (PT) giving satisfactory results.

Key words: Metoclopramide-HCl membrane sensors , Metoclopramide determination , pharmaceutical analysis , PVC membrane sensors

أقطاب غشائية بوليمرية انتقائية لتعيين ميتوكلوبرامايد هيدروكلورايد وتطبيقاتها في التحليل الدوائي

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الخلاصة

تناولت الدراسة تحضير اقطاب انتقائية غشائية بوليمرية سائلة للميتوكلوبرامايد باستعمال الزوج الايوني (MCP-PT) كمادة متحسسة في مادة كلوريد متعدد الفنيل (PVC) كوسيط لها مع المواد الملدنة:

Tri-butyl phosphate (TBP), di-octyl phenyl phosphonate (DOPP), di-butyl phthalate (DBPH), di-octyl phthalate (DOP), di-butyl phosphate (DBP), bis 2-ethyl hexyl phosphate (BEHP).

أظهرت دراســـة خـــواص ومواصفـــات هذه الأقطاب، ان الأقطاب المعتمـدة على المـواد الملدنـــة DOP, DBPH, DOPP, TBP أعطت استجابة سريعة ومستقرة وخطية بانحدارات قدرها ٥٩.٩ ، ٥٧.٧ ، ٥٧.٤ ، ٥٥.٣ mV/decade على التوالي عند دالة حامضية تراوحت ٢ – ٦ فيما تراوح مدى التراكيز الخطية بين ١×١٠$^{-٥}$ - ١×١٠$^{-٢}$ مولاري وحـد تحسس ٣×١٠$^{-٦}$ ، ٣×١٠$^{-٦}$ ، ٤×١٠$^{-٦}$ مولاري للأقطاب المعتمـدة على DBPH, DOPP, TBP على التوالي بينما أعطى القطب المعتمد على DOP استجابة خطية للتركيز تراوحت بين ٣×١٠$^{-٥}$ - ١×١٠$^{-٢}$ مولاري وحد تحسس ٦×١٠$^{-٦}$ مولاري. حسبت قيم معامل الانتقائية لقطب الميتوكلوبرامايد بوجود ايونات موجبة وسكريات وحوامض امينية مختلفة باستعمال القطب المعتمد على الملدن TBP. تم اختبار القطب المذكور في تعيين تراكيز الميتوكلوبرامايد في محاليل نقية محضرة مختبرياً ومحاليل دوائية باستعمال الطريقة المباشرة وطريقة الاضافات القياسية فضلا عن استعمال القطب كدليل في التسحيح المجهادي ضد محلول phosphotungstic acid (PT) معطياً نتائج جيدة.

الكلمات المفتاحيه : أقطاب غشائية للميتوكلوبرامايد هيدروكلورايد، تقدير الميتوكلوبرامايد، التحليل الدوائي، الأقطاب الغشائية الدوائية.

Introduction

Metoclopramide hydrochloride 4-amino-5-chloro-N-[(2-diethyl amino) ethyl]-2-methoxy benzamide hydrochloride, MCP is an antiemetic procaine derivative which is currently used in gastrointestinal (GI) diagnostics. It is the active ingredient of many pharmaceutical formulations concerned with the treatment of (GI) disorders due to the elective character of its action in various digestive manifestations in medical practice such as, nausea, meteorism, vomiting, epigastric discomfort and to increase the gastrointestinal motility. This drug act on the muscles within the wall of the upper intestinal tract causing them to contract and to move food and fluids along. It also crosses from the blood stream into brain cells and may cause significant side effects e.g., head ache, dizziness, fatigue, dry mouth, rash.[1-3]

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Several analytical procedures have been reported for the quantitative determination of metochlopramide in dosage forms or in biological fluids. Among these are fluorimetric,[4] spectrophotometric,[5-8] voltammetric,[9] gas chromatography (GC),[10] high performance liquid chromatography (HPLC),[11,12] flameless atomic absorption spectrophotometry[13] and membrane sensors.[14,15] In recent years, the development and application of new ion selective electrodes (ISEs) have played an important role in pharmaceutical and biological analysis.[16-18] The great challenge in this field is the combination of simplicity, low cost, relatively fast response, reasonably selectivity, low detection limit, high accuracy and applicability to colored and turbid solutions. This work deals with the construction of membrane sensors that insure the determination of MCP based on the MCP ion-pair with phosphotungstic acid embedded in a PVC polymer matrix plasticized with different plasticizers. The performance characteristics of the proposed electrodes (e.g., slope, detection limit, concentration range, response time, pH effect, and selectivity) were studied and the determination of MCP in pharmaceutical formulations has also been investigated.

Experimental Part

Equipment

All potentiometric measurements were carried at 25°C ± 1°C in a constant stirring with a Philips PW9421 (England) digital pH/mV meter using the following cell assembly: Ag, AgCl| internal filling solution | membrane | test solution | saturated calomel electrode. A Philips PW 9418 pH meter with an Orion 91-02 combined glass electrode (Switzerland) were used for pH adjustment.

Reagents

All chemicals used were of analytical grade and were used without further purification. Metoclopramide hydrochloride was provided by the state company of drugs and medical supplies industry (SDI, Samara, Iraq), phosphotungstic acid (PT), tetrahydrofuran (THF) and PVC for ISEs by BDH, dioctyl phthalate (DOP), dibutyl phosphate (DBP), dibutyl phthalate (DBPH), dioctyl phenyl phosphonate (DOPP), tributyl phosphate (TBP) and bis 2-ethyl hexyl phosphate (BEHP) by Fluka. Pharmaceutical formulations were obtained from the SDI, Iraq (meclodin tablets and oral pediatric drops); ZMC Hamborg GMBH, Germany (placeela injection ampoules); the Arab company for drugs industry, Jordan (clopram syrup).

Preparation of the ion association complex

The MCP-PT ion association was prepared by mixing 40 ml of an aqueous solution of metoclopramide hydrochloride (1 mmol) with 40 ml solution containing an equimolar amount of phosphotungstic acid. The resultant precipitate was filtered, washed thoroughly with double distilled water then dried at room temperature. This ion association complex was used as electro-active material in the proposed sensors.

Electrode preparation

Ion association complex (40 mg) was mixed with a plasticizer (360 mg) and PVC (170 mg). The mixture was dissolved in THF (7 ml). The solution was poured into a glass ring (3.5 cm in diameter) standing on a leveled glass plate, covered with a filter paper and the solvent was allowed to evaporate slowly at room temperature.[19] A transparent membrane was obtained, from which a disc of about 8mm in diameter was cut out and glued to the smoothened end of a 3 cm long PVC tube by means of a PVC-THF solution. The other end of the tube was connected to a glass tube which was ¾ filled with 10^{-2} M solution of MCP hydrochloride as the internal reference solution in which the Ag/AgCl reference electrode was dipped. The constructed electrode was conditioned by soaking in 10^{-2}M standard solution of drug for at least 2 hours before measurements.

Electrode calibration

Standard metoclopramide hydrochloride solutions (20 ml of 1.0×10^{-1} - 1.0×10^{-6} M) were transferred into a 50 ml beaker and the sensor with the reference electrode were immersed in the solution. The measured electromotive force (e.m.f.) values were plotted as a function of a logarithm of the drug concentrations. The electrode was periodically recalibrated over a period of nine weeks.

Selectivity of the electrode

Selectivity coefficients $K_{A,B}^{pot}$ were evaluated by the separate solution method [20] according to the following equation:

$$\log K_{A,B}^{pot} = (E_B - E_A)/S+(1-Z_A/Z_B) \log a_A$$

Where E_A , E_B ; Z_A , Z_B and a_A , a_B are the potentials, charge numbers and activities of the primary A and interfering B ions respectively at $a_A = a_B$.

Potentiometric determination of MCP in pure samples and pharmaceutical formulations

Pure sample: aqueous solutions of MCP hydrochloride equivalent to 1.0×10^{-2}, 1.0×10^{-3} M were prepared. Tablets: ten tablets (meclodin, 5 mg per tablet) were finely

powdered, well mixed and an accurate weight required to prepare 10^{-3} M MCP hydrochloride solution was dissolved in a minimum amount of double distilled water, filtered into a 25 ml volumetric flask and diluted to the mark. Injection ampoules (placeela), oral pediatric drops (meclodin) and syrup (clopram): an accurate volumes (12 ml, 7.5 ml, 30 ml) of each formulation respectively were quantitatively and separately transferred into 100 ml volumetric flasks and the volumes were completed to the mark with double distilled water to get solutions of 10^{-3} M MCP hydrochloride. As pure and pharmaceutical samples: a 20 ml aliquot of the drug solution was potentiometrically measured as described and the potential reading was compared with the calibration plot. Alternatively the standard addition method was applied by measuring the potentials of the drug test solution before and after the addition of small increments (0.2 ml) of a standard solution (10^{-1} M) of MCP hydrochloride. The change in the electrode potential (ΔE) at constant temperature of 25°C was recorded and used to calculate the concentration of the drug.[21] A potentiometric titration was also applied when 10 mL aliquot of the drug test solution were diluted to 100 ml with double distilled water. The resultant solution was titrated with (10^{-2} and 10^{-3} M) standard solution of PT using MCP membrane electrode as the sensor.

Results and Discussion

Membrane composition and electrode response

metoclopramide hydrochloride phosphotungstate is a stable water insoluble ion pair complex but readily soluble in organic solvents such as tetrahydrofuran. The complex was dispersed in a PVC membrane as an active material with the following plasticizers: tributyl phosphate (TBP), dioctyl phenyl phosphonate (DOPP), dibutyl phthalate (DBPH), dioctyl phthalate (DOP), dibutyl phosphate (DBP) and bis(2-ethyl-hexyl phosphate) (BEHP). The performance characteristics of the proposed sensors based on data collected over a period of nine weeks were evaluated according to IUAPC recommendations.[22] The results were summarized in Table 1. A typical calibration graph of MCP sensors is shown in Figure1. It is well known that the nature of the plasticizer significantly influence the sensitivity, linearity and life time of the polymeric membrane sensors. The plasticizers insured the mobility of the membrane constituents within the membrane phase by lowering the viscosity of the polymer matrix, set the dielectric constant of the membrane phase and provide a suitable mechanical properties of the membrane.[23,24] Non- Nernstian slopes were obtained with sensors depending on DBP and BEHP. Their slopes were (40.7 and 29.0) mV/decade with correlation coefficients of 0.9982 and 0.9979 respectively. The linear range of concentration were 1.0×10^{-4} - 1.0×10^{-2} M and 6.0×10^{-4} - 5.0×10^{-2} M with detection limits 4.0×10^{-5} M and 2.0×10^{-4} M respectively. The poor results for sensors using DBP and BEHP can be attributed to the low solubility or low distribution of MCP-PT ion pair in these plasticizers that have high viscosity (112.89 and 272.54) cST. On the other hand the membranes based on DOPP, DBPH and DOP gave a near Nernstian slopes of (57.7, 57.4 and 55.3) mV/decade with correlation coefficients of 0.9996, 0.9996 and 0.9986 respectively. The linear range of these membranes were 1.0×10^{-5} - 1.0×10^{-2} M for membranes using DOPP and DBPH, and 3.0×10^{-5} - 1.0×10^{-2} M for DOP with detection limits of 4.0×10^{-6} M, 4.0×10^{-6} M and 6.0×10^{-6} M respectively. A Nernstian slope of 59.9 mV/decade with correlation coefficient of 0.9998 was obtained for membrane based on TBP and a linear concentration range 1.0×10^{-5} - 1.0×10^{-2} M and detection limit 3.0×10^{-6} M. The stability of electrodes was monitored continuously by measuring the potential drift and evaluate it for a period of 15 days. The standard deviations of the potential drift obtained for these 15 days were ± 1, ± 1, ± 1, ± 4, ± 9 and ± 12 mV for membranes No. I, II, III, IV, V and VI respectively.

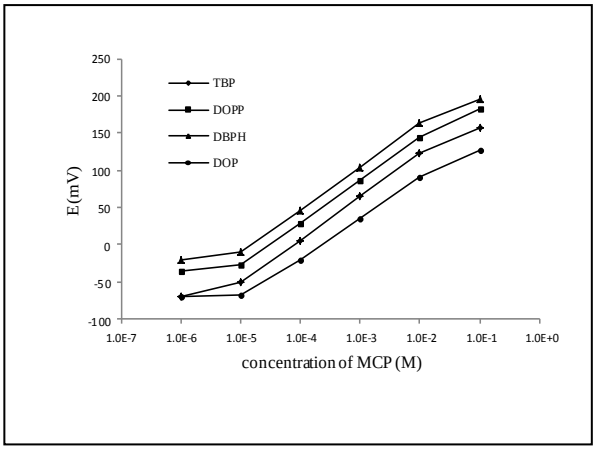

Figure 1: Calibration curves of metoclopramide hydrochloride electrode

Table 1: Parameters of metoclopramide hydrochloride selective electrodes

Parameters	Electrode number					
	I	II	III	IV	V	VI
plasticizer	TBP	DOPP	DBPH	DOP	DBP	BEHP
Slope mV/decade	59.9	57.7	57.4	55.3	40.7	29.0
Correlation coefficient	0.9998	0.9996	0.9996	0.9986	0.9982	0.9979
Linear range (M)	1.0×10^{-5} – 1.0×10^{-2}	1.0×10^{-5} – 1.0×10^{-2}	1.0×10^{-5} – 1.0×10^{-2}	3.0×10^{-5} – 1.0×10^{-2}	1.0×10^{-4} – 1.0×10^{-2}	6.0×10^{-4} – 5.0×10^{-2}
Detection limit (M)	3.0×10^{-6}	4.0×10^{-6}	4.0×10^{-6}	6.0×10^{-6}	4.0×10^{-5}	2.0×10^{-4}
Response time 1.0×10^{-1} – 1.0×10^{-5}	5 – 9	5 – 15	5 – 15	7 – 12	30 – 39	60 – 75
Life time (day)	52	52	50	64	28	4
Potential drift (mV/day)	1	1	1	4	9	12

Soaking effect

Membranes that are freshly prepared must be soaked in their standard solutions before using to form a thin surface gel layer for ion exchange process to occur.[25] Soaking require different times depending on the diffusion and equilibration at the electrode-test solution interface. A fast equilibrium establishment is a condition of a fast potential response.[26] It was observed that continuous soaking of the MCP electrodes in 1.0×10^{-2} M solution of MCP hydrochloride at room temperature negatively affects their response to MCP due to leaching out of the membrane components to the external solution. The optimal conditioning time for the proposed MCP membranes was found to be about 2-3 hours.

Life time

The life time of the sensors was studied by recalibrating the sensors periodically (every three days) over a period of nine weeks. The electrode depending on DOP was used successfully for 64 days and the electrodes depending on DOPP, TBP and DBPH were used for 52 and 50 days without significant changes in the electrode parameters. However, the life times of the electrodes depending on DBP and BEHP were 28 and 4 days due to leaching out of the membrane incompatible components.

Response time

The response time of an electrode is evaluated by measuring the average time required to achieve a potential within ±1 mV of the final steady state potential, upon successive immersion of a series of interested ions, each having a ten-folds difference in concentration. It is notable that the experimental conditions like the stirring or flow rate, the ionic concentration and composition of the test solution, any previous usage or preconditioning of the electrode, and the testing temperature have an effort on the experimental response time of a sensor.[27] The response times for the MCP proposed electrodes at different concentrations of MCP solutions ranging from 1.0×10^{-5} to 1.0×10^{-1} M were calculated and listed in Table 1. A plot of the electrode response with time for electrode no.I is shown in Figure 2. The response time for all electrodes ranged (5-7) sec. for 1.0×10^{-1} M solutions and (9-15) sec. for 1.0×10^{-5} M solutions except the electrodes depending on DBP and BEHP, where they showed longer response time (39 – 30) sec. and (75 – 60) sec. for 10^{-5} – 10^{-1} M respectively which could be attributed to the high viscosity of the plasticizers used which slow down the mobility of the ion pair within the membrane and cause the equilibrium process to take longer time.

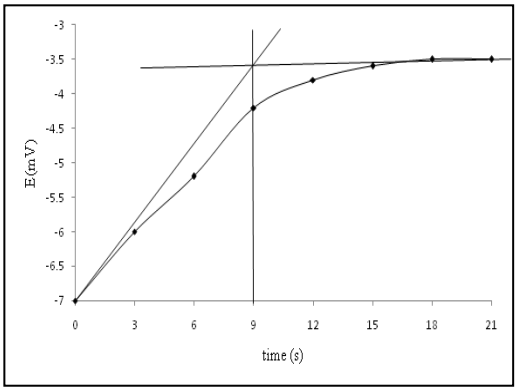

Figure 2. The response time of TBP electrode using 10^{-5}M metoclopramide hydrochloride

pH-effect

The influence of the pH on the response of MCP membrane sensors was checked using 10^{-2} M and 10^{-3} M MCP hydrochloride solutions and recording the e.m.f. at different pH values. The pH was adjusted by the addition of very small volumes of 0.1 M hydrochloric acid or sodium hydroxide solutions. As can be seen in Figure 3, the electrode potential is practically

independent of the pH range 2.0 – 6.0 for membrane depending on TBP. The considerable decrease of the potential observed at pH values higher than 6.0 is due to the MCP base was precipitated and this leads to the decrease in the concentration of the protonated species and lowers e.m.f. readings. This can be viewed from the consideration that the dissociation constant of MCP hydrochloride, pKa is 9 so, at pH values higher than 6 (decrease in the concentration of H^+) the dissociation of MCP hydrochloride will increase and more precipitate will form in the presence of sodium ions which leads to a decrease in the concentration of the protonated species. At pH below 2.0 a sharp increase of the e.m.f. was noticed indicating that the membrane sensor responds to hydrogen ions[14].

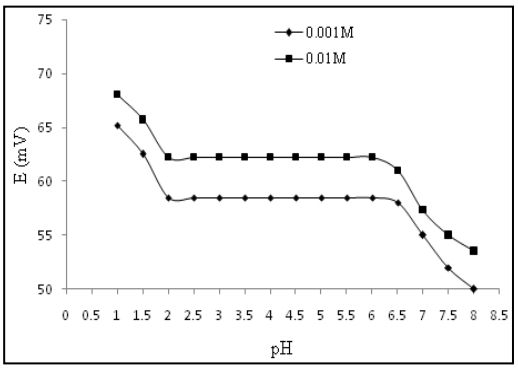

Figure 3:pH effect on electrode response using electrode based on TBP, 0.001M, 0.01M metoclopramide hydrochloride

Table 2 illustrates the working pH range for all the constructed MCP-PT the membrane sensors.The MCP electrode depending on TBP was selected for carrying out the remaining studies. It showed a good, fast and stable response over a period of 52 days with a wide linear range and low detection limit.

Table 2: Working pH range for metoclopramide electrodes

Electrode No.	Plasticizer	pH range
I	TBP	2.0 – 6.0
II	DOPP	3.9 – 6.4
III	DBPH	3.0 – 6.0
IV	DOP	3.2 – 5.5
V	DBP	6.0 – 9.2
VI	BEHP	5.0 – 8.0

Selectivity measurements

One of the important characteristic of any selective sensor is its response to the primary ion (MCP) in the presence of other ions (J) present in solutions which is expressed in term of the potentiometric selectivity coefficient $K^{pot}_{MCP^+,J^{Z+}}$. It is well known that the selectivity of ion-pair association based membrane sensors depends on the selectivity of the ion exchange process at the membrane-test solution interface, the mobility of the respective ions within the membrane and the hydrophobic interactions between the primary ion and the membrane. The influence of some inorganic cations, sugars and amino acids on the MCP electrode was determined by the separate solution method. Figure 4 illustrates a typical plot for the selectivity of MCP electrode to lactose. As can be seen from Table 3, none of the investigated species was found to interfere as shown by the very small values of $K^{pot}_{MCP^+,J^{Z+}}$ which means that the MCP-PT ion pair used in the sensor was completely dissociated in the organic phase of the membrane and reflects the high selectivity of the MCP-PT electrode towards MCP. The inorganic cations do not interfere owing to the differences in ionic size and consequently their mobility and permeability as compared with those of MCP^+. The selectivity in the case of sugars and amino acids is attributed to the differences in the polarity and lipophilic nature of these molecules relative to MCP.

Table 3: Selectivity coefficient values of various interfering compound for metoclopramide electrode I

Interfering ion	Concentrations of metoclopramide hydrochloride					
	10^{-1}M	10^{-2}M	10^{-3}M	10^{-4}M	10^{-5}M	10^{-6}M
	$K_{A,B}$	$K_{A,B}$	$K_{A,B}$	$K_{A,B}$	$K_{A,B}$	$K_{A,B}$
K^+	4.0×10^{-1}	4.2×10^{-1}	2.6×10^{-4}	4.3×10^{-3}	1.6×10^{-2}	6.0×10^{-2}
NH_4^+	7.7×10^{-3}	7.7×10^{-3}	8.0×10^{-2}	7.9×10^{-1}	1.9×10^{-1}	1.6×10^{-1}
Cu^{2+}	6.3×10^{-5}	5.8×10^{-5}	2.0×10^{-4}	5.4×10^{-4}	1.9×10^{-3}	1.2×10^{-2}
glucose	2.8×10^{-4}	9.3×10^{-4}	8.9×10^{-3}	8.9×10^{-2}	6.4×10^{-1}	6.3×10^{-1}
lactose	2.4×10^{-4}	6.7×10^{-4}	6.3×10^{-3}	5.8×10^{-2}	5.8×10^{-1}	8.7×10^{-1}
sucrose	1.2×10^{-4}	6.0×10^{-4}	3.7×10^{-3}	6.6×10^{-2}	3.6×10^{-1}	1.1×10^{-2}
Alanin	1.5×10^{-3}	4.3×10^{-3}	5.4×10^{-2}	5.1×10^{-1}	1.7×10^{-1}	1.5×10^{-1}
Glycine	2.3×10^{-3}	4.5×10^{-3}	8.0×10^{-3}	3.6×10^{-1}	2.1×10^{-1}	1.3×10^{-1}

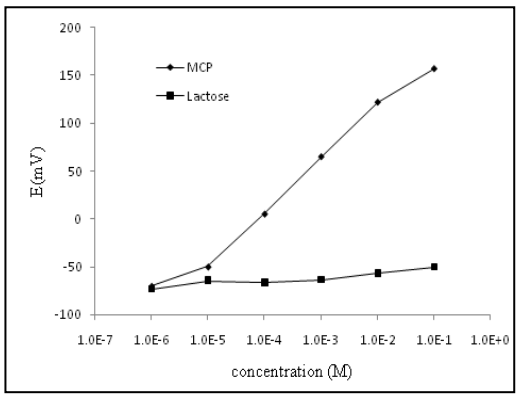

Figure 4: Selectivity of electrode using TBP to lactose interfering by seperate solution method

Analytical application

The usefulness of metoclopramide electrodes in the determination of MCP hydrochloride in pure solutions 10^{-2}, 10^{-3} M and in some pharmaceutical preparations was examined by direct, standard addition, multiple standard addition and potentiometric titration. The statistical analysis of the analytical results illustrated in Table 4 encouraged us to use the proposed electrode for the determination of MCP hydrochloride in some pharmaceutical preparations (tablets, ampoules, drops and syrup) the results are listed in Table 5 presented by recovery %R, relative standard deviation %RSD and relative error %RE. the relative recovery was calculated for 5 additions of 0.1 M MCP hydrochloride solutions.

Table 4: Metoclopramide hydrochloride pure samples analysis by potentiometric techniques using electrode I*

Sample (M)	Measurements by potentiometric methods			
	Direct	**S.A.**	**M.S.A.**	**Titration**
1×10^{-2}	1.001×10^{-2}	1.005×10^{-2}	0.992×10^{-2}	0.995×10^{-2}
%RSD	1.409	1.404	0.565	0.353
%RC	100.1	100.5	99.2	99.5
%RE	0.1	0.5	-0.8	-0.5
1×10^{-3}	1.002×10^{-3}	1.003×10^{-3}	0.991×10^{-3}	0.993×10^{-3}
%RSD	1.408	1.407	0.635	0.504
%RC	100.2	100.3	99.1	99.3
%RE	0.2	0.2	-0.9	-0.7

*Each value represents an average of 3 measurements.

Table 5: Determination of metoclopramide hydrochloride in some pharmaceutical formulations by potentiometric methods using electrode I*

Pharmaceutical formulation	Sample (M)	Direct	S.A.	M.S.A.
Tablets	1.000×10^{-3}	1.002×10^{-3}	1.018×10^{-3}	1.003×10^{-3}
	%RSD	1.411	1.386	1.407
	%RC	100.2	101.8	100.3
	%RE	0.1	1.8	0.3
Injection ampoules	1.000×10^{-3}	0.997×10^{-3}	0.995×10^{-3}	1.001×10^{-3}
	%RSD	1.418	2.125	1.400
	%RC	99.7	99.5	100.1
	%RE	-0.3	-0.5	+0.1
Oral pediatric drops	1.000×10^{-3}	0.992×10^{-3}	0.991×10^{-3}	1.002×10^{-3}
	%RSD	1.420	0.630	1.272
	%RC	99.2	99.1	100.2
	%RE	-0.8	-0.9	0.2
Syrup	1.000×10^{-3}	1.003×10^{-3}	1.001×10^{-3}	0.990×10^{-3}
	%RSD	2.100	0.700	1.331
	%RC	100.3	100.1	99.0
	%RE	0.3	0.1	-1.0

*Each value represents an average of 3 measurements.

A typical plot of antilog E/S versus the volume of the standard MCP together with the concentration of pure 10^{-3} M of MCP is shown in Figure 5. Gran's plot paper with 10% volume correction was used. For potentiometric titration of MCP hydrochloride, a typical titration plot of 10^{-3} M MCP with 10^{-3}M PT is shown in Figure 6. The values of standard deviation and recovery given in Table 4 and 5 prove that the electrode depending on TBP plasticizers is very successful for the determination of MCP either in pure or pharmaceutical formulations. The good agreement between data obtained by the proposed sensor and the standard pharmacopial method[28] and the spectrophotometric method[8] confirming the applicability of the sensor for the analysis of controlled drugs.

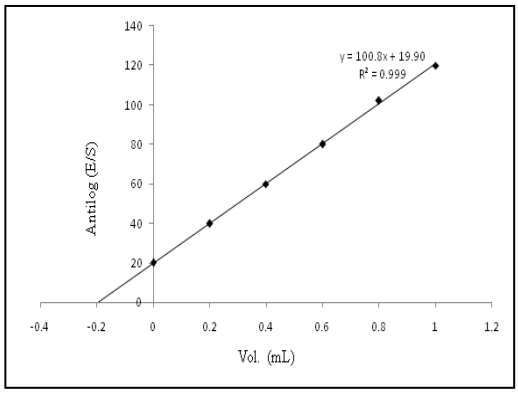

Figure 5: Plot of antilog (E/S) vs. the volume of 0.1M standard metoclopramide by MSA using TBP electrode

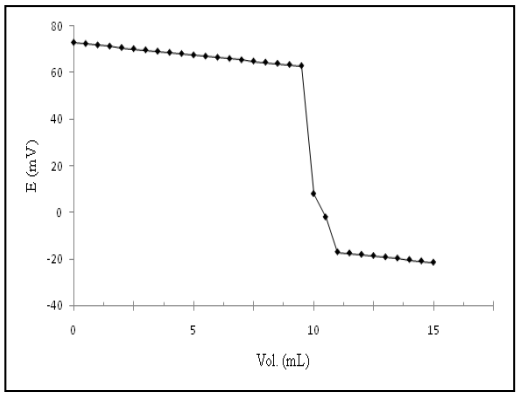

Figure 6: Titration curve of 10^{-3} M metoclopramide titrated with 10^{-3} M phosphotungstic acid using TBP electrode

Conclusion

MCP selective electrodes based on ion pair complex of MCP-PT incorporating different plasticizers were constructed. The best MCP electrode was based on TBP. It gave excellent electrode parameters and no interference with several cations, sugars and amino acids. This electrode was used for the drug determination in pharmaceutical preparations and offers a simple, rapid and cost effective with high precision and accuracy method.

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