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RESEARCH ARTICLE

Ion Selective Electrode for L- GlutamateA coated wire

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Abstract

Glutamate (MSG) ion selective electrode (ISE) was developed . Ag /$Ag^{+}Glu^{-}$ wire electrode is covered by an inert silicon rubber and contact with reference electrode .The concentration range for which the glutamate ion can be detected , generally 10-4-1 M, with the calibration slop 26.4 mV decade $^{-1}$ in 10 -2 M $NaNO_3$. The selectivity coefficient of (MSG) electrode were measured by separate solution method of some organic and inorganic compound . The electrode can be applied to determined MSG in milk by direct method . The temperature effect on (MSG) electrode behavior is described.

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1.Introduction

Glutamic acid {(2-Aminopentanedioic acid) (2-Aminoglutaric acid)} is one of the 20 – 22 proteinogenic amino acids. The carboxylate anions and salts of glutamic acid are known as glutamates. In neuroscience, glutamate is an important neurotransmitter that plays a key role in long-term potentiation and is important for learning and memory [1]. Glutamate is a key compound in cellular metabolism and plays an important role in the body's disposal of excess or waste nitrogen. Glutamate undergoes deamination, an oxidative reaction catalyzed glutamate dehydrogenation [2].A glutamic acid derivative, poly-y-benzyl-L-glutamate (PBLG),is often used as an alignment medium to control the scale of the dipolar interactions observed [3]. Prevalence of overweight was significantly higher in MSG1 user than in non-user.The compound B-citryl-L-glutamate(B-CG)was initially isolated from developing brains, though it's functional roles remain unclear[4]

2.Experimental

2.1.ApparatusA micro-computer pH meter model

6209 (JENCO electronics, LTD) and a microprocessor pH meter HANNA instruments (model HI 9321) were used to potentiometric measurements at 20 ± 2 °C. Glutamate electrode in conjunction with double junction Ag/AgCl reference electrode (Model 90 – 02 - ∞) which filled by 10%w/v KCl in the outer compartment were used for all potentiometric measurements as the sensor system.

Glutamic acid mono sodium salt and silver nitrate were purchased from LOBA Chemie . All other chemicals were of analytical reagent grade. Distilled water was used throughout the experiments . A stock solution of 1M of MSG was prepared by dissolving 18.713 g in 100 ml of distilled water,(10-1: 10-5 M) solution of MSG were freshly prepared by dilution. 10-2 M MSG was standardized potentiometricaly by a standard 10-2 M of $AgNO_3$ which prepared by dissolving 0.16987g in100ml DDW.

2.3. Electrode preparation

Glutamate electrode was prepared by cleaning silver wire with filter paper ,soaking in 30 ml of 10^{-1} M MSG, precipitate MSG ion on the electrode by using 9V battery along 30 min and cover the electrode by silicon rubber . This electrode was conditioned by soaking in distilled water for 30 min and 10-1 M MSG 10 min before used and stored dry.

2.4.Calibraton

The standard addition technique[5] for measuring the potential by adding aliquots (1ml) of 10-**4**: 1 M of MSG solution to 9ml of 10-2 M $NaNO_3$ in a beaker containing MSG electrode and reference electrode. Also separate technique for 20ml aliquots of 10-5:10-1 M of MSG solution was studied. Millivolt values were plotted on a semi logarithmic paper versus MSG concentration. Unknown MSG concentrations can be defined on the calibration graph[6].

Ag / Ag MSG /silicon rubber / MSG(test solution) //10% KCl / Ag/AgCl

3.Results and Discussion

3.1 Response Characteristics of Glutamate Ion Selective Electrode

L- Glutamic acid mono sodium salt gives 1:2 precipitate with silver nitrate . The structure of ion pair complex (Fig. 1) was elucidate .The performance potentiometric characteristics of MSG electrode is listed in (Table 1).The proposed electrode exhibit linear and stable potentiometric response in the concentration range 10-4:10-1 M. The reproducibility and stability of MSG valuated by constructing replicate calibration graphs (n=15) over a period of two weeks.

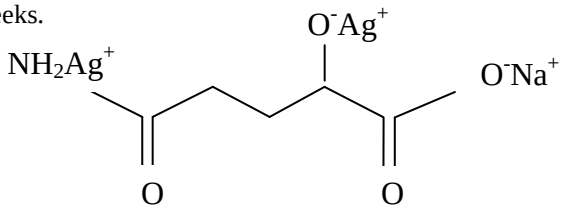

Fig. 1

In addition technique and in separate method , the slop of the calibrationgraphs is 26.4 and 28.5 ,the slop don't exceed ± 0.2mVdecade-1 of MSG concentration. MSG electrode reach to the final steady potentials after 30 s and 15 s . The lower limit of detection is 9×10-5 and 7.3×10-5 M obtained respectively.

The pH effect change using MSG test solutions 10-3,10-2,10-1M over a pH range 1.5-10.5 (Fig. 2). The potential readings are insensitive to pH changes over the range 4.5 : 6 and 8 : 10. Separate solutions method were used to determine the potentiometric selectivity coefficient $K^{pot}_{MSG^{-2},B}$ (Table . 2). potassium ferrocyanide has a higherinterfering effect than all deferent organic and inorganic compound

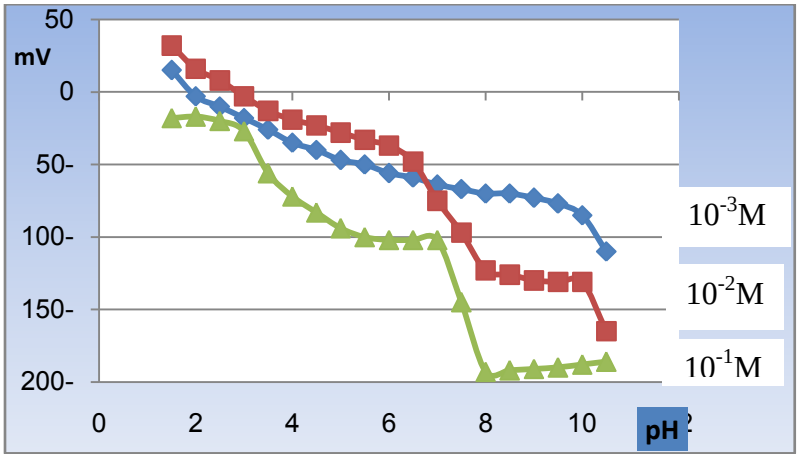

Fig.2, Effect of pH on the response of MSG electrode

Interferant,B	$K^{pot}_{MSG,B}$
(NH4)2SO4	5.01 × 10-3
NaCl	1.25 × 10-2
L-Aspartic acid	1.148 × 10-3
Sucrose	8.91 × 10-4
NaHCO3	3.55 × 10-3
D(+)Glucose	1.48 × 10-3
K4[Fe(CN)6]	2.38
Maltose	1.35 × 10-3
Pot.oxalate	1.55 × 10-2
Na2CrO4	3.68 × 10-4
Urea	9.18 × 10-5

(Table. 2)Potentiometric selectivity coefficient of MSG electrode

The characteristics of MSG electrode were examined at temperature range 10 - 45°C with 10-5 -10-1 MSG solutions using thermo stated cell . The isothermal coefficient of the electrode(dE°/dt) was amounting to nearly 0.37-2.9 V/°C which reveals very high thermal stability of the investigated electrode (Table, 3).

(Table, 3) Effect of temperature on the performance characteristics of MSG electrode

Temp,°C	Slope, (mV/ decade)	Linear range/M	Lower limit of detection /M	E^o,mV	(T- 25)°C
18	28	10-4-10-1	7.3 × 10-5	-53	-7
25	26.5	10-3-10-1	7 × 10-4	-61.5	0
45	33	10-5-10-1	8 × 10-6	-120	20

3.2. Analytical application

Glutamate electrode was used to determined available milk solutions as Almarai (Fresh Milk,100% pure ,cow's milk, full fate ,2L) ; Nadec(Fresh Milk, full fate, 1.75 L) and Saudia ,Whole Milk ,UNT-Treated, cow's milk powder,200 ml) by direct potentiometric. The displayed potentials were compare with the corresponding calibration graphs constructed at the same day to assess the accuracy and reproducibility, the mean standard deviation are 0.0501 ,0.0517 and 0.368 respectively

4. Conclusion

The proposed potentiometric electrode, provide an easy and a simple low cost method, which offers a direct selectivity determination of MSG in pure solution and in milk solutions without prior separation steps with high accuracy, precision and sensitivity.

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