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Green Alternative to Synthetic Indicator in Complexometric Titrations

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Abstract

The standard metallochromic indicators employed to locate the end point in complexometric titrations are synthetic organic dyes capable of forming weak complexes with metal cations. Studies by our group has shown that ethanolic and acetonic extracts of brightly coloured flower petals ,fruit peels and vegetable peels contain pigments capable of forming weak coloured complexes with metal cations. This complexing property of the pigments has been utilized to find suitable substitute for synthetic metallochromic indicators. The current study used the crude Ethanolic extract and Acetonic Extracts of Onion (*Allium cepa L.)* peels. Comparative studies with standard indicators reveal high degree of accuracy and sharp, intense colourchange at the end-point.

Key Words: Complexometric titrations , indicators, , extracts , pigments

Introduction

The onion plant (*Allium cepa*), also known as the bulb onion [1]or common onion [2] is the most widely cultivated species of the genus *Allium*[3,4]. Onion bulbs are believed to have been used as food since thousands of years. Though primarily a food plant, its pharmacological properties are extensively studied and documented [5, 6]. With increasing concerns about the harmful effects of synthetic dyes on the environment, the pigments from Onion peels have been used as textile and pulp dyes.[7,8] Studies by our group has indicated the pH sensitivity of the extract of onion peel , and established its applicability as an effective substitute for synthetic indicators in Acid –Base titrations[9]. Earlier studies by our group have indicated complex forming ability of natural pigments with metal cations. Hence the attempt was made to study the feasibility of using this weak complexing ability of natural pigments for end-point detection in routine complexometric titrations.

This study has put forward interesting possibilities of replacing synthetic mettalochromic indicators used in complexometric titrations with the natural pigments in onion peels , which is discarded as agricultural waste. The procedure is highly energy efficient and extremely environment friendly.

Experimental

Material:

The onion peels (Nasik Onion) were procured from the Kalyan wholesale market . All AR grade chemicals (Thomas Baker)

were obtained from Smt. CHM College , Ulhasnagar. Solutions of required Molarity were prepared as per standard procedures.

Calibrated glassware (Corning / Borosil) were used for all experimental procedures. Analytical Balance of 0.001gm sensitivity was used.

Extraction:

The Onion peels were thoroughly washed with distilled water , and air dried at room temperature. The peels were powdered and soaked in Acetone : water Mixture (80 :20) for 24Hrs. (10grams in 50 cm^3) . Extract in Ethanol was prepared by soaking in Absolute Alcohol. The extract was then filtered through ordinary filter paper and stored in stoppered Glass bottles.

Procedure:

Complexometric titrations of 0.02 M solutions of MgSO4, $CaCl_2$, $PbNO_3$, $ZnCl_2$ and $CuSO_4$ were conducted against 0.02M EDTA (Disodium salt) as per established procedures , using *Allium Cepa* (AC) extracts as indicator. The results were compared with those obtained using synthetic Mettalochromic indicators.

Control experiments were conducted, varying the concentration of salts and also of EDTA, to verify the accuracy and reproducibility of the results.

Result and Discussion

S. No.	**Titrand**	**Reagents**	**Standard Indicator Used**	**Volume of Titrant at Equivalence point (cm^3)**	
				Std .Indicator	**AC extract in Acetone**
1.	0.02 M $MgSO_4$	NH_4Cl + NH_4OH (Buffer pH 10)	Erychrome Black T (EBT)	9.8±0.1	(Eq. Pt. not detected as No colour change observed)
2.	0.02 M $CaCl_2$	8M KOH +1% KSCN + 1% Hydroxylamine Hydrochloride	Erychrome Black T	9.9±0.1	(Eq. Pt. not detected as No colour change observed)
3.	0.02 M $PbNO_3$	Hexamine powder	Xylenol Orange	9.8±0.1	9.9±0.1
4.	0.02 M $ZnCl_2$	Hexamine Powder	Xylenol Orange	9.9±0.1	9.9±0.1
5.	0.02 M $CuSO_4$	Liq. NH_3	Fast Sulphone Black	9.8±0.1	9.9±0.1

Table 1 : Volume of titrant (0.02M EDTA Di sodium Salt) at equivalence point

S. No.	Titrand	Synthetic indicator And Colour change		Colour change using AC Extract in Acetone
1.	0.02 M $MgSO_4$	EBT	Wine Red to Blue	No colour change
2.	0.02 M $CaCl_2$	EBT	Wine Red to Blue	No colour change
3.	0.02 M $PbNO_3$	Xylenol Orange	Wine Red to Yellow	Green to colourless
4.	0.02 M $ZnCl_2$	Xylenol Orange	Wine Red to Yellow	Green to colourless
5.	0.02 M $CuSO_4$	Fast Sulphone Black	Blue to Dark Green	Navy Blue to turquoise blue

Table 2 : Colour Change at Equivalence point

The results indicate that the Acetone extract of *Allium Cepa* peel can replace synthetic mettalochromic indicators for the Complexometric estimation of Inner Transition metals like Copper , Zinc and Lead. High degree of accuracy and sharp, intense colour change at the end-point was observed.

It is particularly beneficial as it can be locally extracted with no energy input is easily available and being a natural pigment is Environment friendly. It has colour stay Capacity of upto 4 weeks when stored in a glass container.

Results: Using Etanolic extract of *Allium Cepa* peel were found to be unreliable and inconsistent.

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