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Electro chemical studies of new schiff's base derivatives of vanillin

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Abstract
Kinetic and spectral parameters are most vital properties of any chemical compound to determine structure and reactivity. In this present study we are intended to report the kinetic and spectral parameters of the new schiffs base derivatives of Ortho vanillin (2-Hydroxy-3-methoxybenzaldehyde) and Meta vanillin (4-Hydroxy-3-methoxybenzaldehyde), synthesized by condensation with 2-amino-2 methyl-1-propanol. Characterized by UV and IR spectroscopy and melting points. Kinetic parameters were evaluated by DC polarography and Cyclic voltametry in 40% aqueous di methyl formamide KCl was supporting electrolyte. On applying milli coulometric method of analysis on polarograms it was clear that the schiffs bases undergone two electron reduction. The experimental results observed from the effect of concentration and mercury column height on the limiting current confirmed the diffusion-controlled nature of the limiting current. Cyclic voltametric results shows reversible nature of electron transfer.

Keywords: Kinetic parameters, schiffs bases, vanillin, cyclic voltametry and polarography

Introduction
Schiff's base derivatives have been found to be potent drug in pharmaceutical industries and possess a wide spectrum of biological activities. Azomethines are also known as Schiff's bases and they are well known intermediate for the preparation [1-11] of azetidinone, thiazolidinone, formazan, arylacetamide and many other derivatives. These are the compounds containing characteristic –C = N– group. Schiff's base derivatives are endowed with different therapeutic activities such as antibacterial [12-16], analgesic, antiviral [17], anti-inflammatory [18], antitubercular [19], etc. Schiff bases with aryl substituents are more stable and readily synthesized. Where as those containing alkyl substituent is relatively unstable. Schiff bases of aliphatic aldehydes are unstable and readily polymerizable while those with aromatic aldehyde Vanillin (4-hydroxy-3-methoxybenzaldehyde) is the main aromatic compound in natural vanilla and can be extracted from vanilla pods and beans. In the market, more than 99% of vanillin synthesized much more cheaply via chemical or biochemical processes [20, 21]. Vanillin is one of the most popular flavoring substances and it is widely used in confectionery, beverages, pharmaceuticals, foods and perfumery. However, Excessive ingestion of Vanillin can cause headaches, nausea and vomiting, and can affect potential damage to liver and kidney [22]. Hence, it is important and necessary to detect and control the content of vanillin in food products. Several methods have been reported for the determination of vanillin which include spectrophotometry [23], fluorescence [24], capillary electrophoresis [25, 26], HPLC [27, 28], LC- MS and GC-MS [29, 30]. These methods can be applied to the detection of vanillin in various samples, but they are generally time- consuming and/or complicated. Alkanolamines are chemical compounds that contain both hydroxyl (-OH) and amino (-NH₂, -NHR, and -NR₂) functional groups on an alkane backbone [31]. Literature Survey revealed that not much work has been carried out in establishing the Complexing ability of AMP towards metal ions. Metal-AMP complexes were found to wide range applications in biological fields. Metal complexes prepared by the reaction of tetrachloroaurate with AMP in aqueous media were recommended as anti-tumor agents [32]. In this present study we had prepared two new schiff's base derivatives of ortho and para isomers of vanillin condensing with 2-amino-2-methyl-1-propanol and then studied their spectral and electrochemical properties by voltametric methods.

Materials: All the chemicals used were analytical grade 1). 0.05M 2-Hydroxy-3-

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methoxybenzaldehyde (O-vanillin), 2) 0.05M 4-Hydroxy-3-methoxybenzaldehyde (P-Vanillin), 3) 0.05M 2-Amino-2-methyl-1-propanol, 4). Double distilled water 5). Soxhlet apparatus 6) methanol, 7) DMF, 8). magnetic stirrer, 9) cyclic voltametry setup, supplied by CH Instruments pvt limited. 10) Mercury, 11) Britton rabinson buffers, 12). Kcl, 13) Nitrogen gas, 14). Tries buffers 15).DC polarography, 16). pH meter model LI – 10 manufactured by M/s. ELICO Private Limited, Hyderabad, India. 17). 0.01M $CdSO_4$ solution 18).Visible spectrophotometer model 106 manufactured by M/s. Synstronics Instrument, Ahmedabad, 19).boiling point instrument 20). Recorder 21). Thermo nicolet nexus 670 IR spectrophotometer.

Synthesis schiff's bases
i). Synthesis of 2-((1-hydroxy-2- methyl propan-2-ylimino) methyl)-6-methoxyphenol (O-VAMP): 0.05M 2-Hydroxy-3-methoxybenzaldehyde (O-Vanillin) was added to a mixture of 50ml of methanol and 2-Amino-2-methyl-1-propanol (5ml; 0.05mole) and 50ml of distilled water. The reaction mixture was taken in a clean 250ml round bottom flask and stirred well with a magnetic stirrer. Then it was refluxed for 8 hours. A Bright yellow colored product was formed. It was separated by filtration and washed several times with hot water and methanol and dried in vacuum. The compound was recrystalized from methanol. The percentage of yield was 80% and melting point of the compound was160-162^{0}C. The structure of schiff's derivative was established by IR, UV.

ii) Synthesis of 4-((1-hydroxy-2- methyl propan-2-ylimino) methyl)-2-methoxyphenol (P-VAMP)
4-Hydroxy-3-methoxybenzaldehyde (P-Vanillin) (0.05moles) was added to a mixture of 50ml of methanol and 2-Amino-2-methyl-1-propanol (AMP) (5ml; 0.05mole) and 50ml of distilled water. The reaction mixture was taken in a clean 250ml round bottom flask and stirred well with a magnetic stirrer. Then it was refluxed for 8 hours. A Bright yellow colored product was formed. It was separated by filtration and washed several times with hot water and methanol and dried in vacuum. This compound was recrystalized from methanol. The percentage of yield was 75% and melting point of the compound was194-197^{0}C. The structure of derivative was established by IR, and UV.

Experiment
a). Polarographic method
Polarographic behaviour of the schiffs base derivatives at different pH values, Concentrations of the substrate, Heights of the mercury column, is studied adopting the procedures reported in litarature [33-38].

(i) Effect of pH: 8.0 ml of the buffer solution of desired pH (1.1 – 10.1), 2 ml of the stock solution of the substrate (1.0 x 10^{-2} M) in dimethylformamide (DMF), 6 ml of dimethylformamide (DMF) and 4.0 ml of distilled water are mixed thoroughly in the polarographic cell and the polarograms are recorded after removing the dissolved oxygen by passing pure and dry nitrogen gas through the solution for about fifteen minutes.

(ii) Effect of concentration: 8.0 ml of required buffer solution (pH 4.1) and a known aliquote of the substrate solution (1.0 x 10^{-2} M) and the requisite volume of dimethylformamide are mixed in the polarographic cell to make the total volume 20 ml and the polarogram is recorded after deprecation.

iii) Effect of mercury column height: 8.0 ml of the buffer solution (pH 4.1 and 8.1), 2.0 ml of the substrate (1.0x10^{-3} M) stock solution, 6.0 ml dimethylformamide (DMF) and 4.0 ml of distilled water are mixed in the polarographic cell and the polarogram is recorded at different heights (80, 70, 60, 50 and 40 cms) of mercury column.

b). Cyclic voltametric method of analysis
Cyclic voltametric set up supplied by CH electrochemical instruments company was used to record cyclic voltamograms. Calomel electrode as reference electrode, Ag electrode as counter electrode, platinum wire as working electrode, 1×10^{-3}M solution of Newly synthesized two Azo methines were prepared in 40% aqueous dimethyl formamide and taken in 1ml of solution in electrolytic cell. Rabinson – britton buffer solutions with pH 4.1 and 8.1 added. KCl used as supporting electrolyte, cylic voltamograms for each azomethine at pH 4.1 and 8.1 were recorded using recorder At various sweep rates (mV/sec), 0.010, 0.020, 0.050, 0.100, 0.200, 0.500.

Results and Discussion
Electronic spectras of newly synthesized Schiff base (O-VAMP) and P-VAMP were recorded in dimethyl formamide solvent in the range 200-400nm and the UV data establishes the nature of transitions in O-VAMP and P-VAMP. Schiff base O-VAMP in UV region show an intense band at 285 nm and weaker band at 288 nm which were assigned to the π $\rightarrow$ π* and n $\rightarrow$ π* Transitions respectively. Electronic spectra of the P-VAMP Schiff base in UV region show an intense band at 275 nm and weaker band at 280 nm which are assigned to the π $\rightarrow$π* and n $\rightarrow$ π* Transitions respectively.

The IR spectra of newly synthesized Schiff base (O-VAMP) was recorded in KBr Pellette in the IR range of 4000-400 cm^{-1} and IR data establishes the Molecular structure of O-VAMP. 3446 cm^{-1} (Intra molecular H- bonding), 3036 cm^{-1} (Ar-H, stretching), 2846 cm^{-1} (Aliphatic C-H stretching), 1686 cm^{-1} (>C=N stretching), 1235 cm^{-1} (C-O stretching vibrations of Alcohol / Phenol. The IR spectra of O-VAMP was shown in the Fig.1. IR of P-VAMP was 3427 cm^{-1} (intra molecular H-bonding), 3082 cm^{-1} (Ar-H, stretching), 2964 cm^{-1} (Aliphatic C-H stretching), 1680 cm^{-1} (>C=N stretching), 1218cm^{-1} (C-O stretching vibrations of Alcohol / Phenol. The IR spectra of P-VAMP was shown in the Fig.2. The Schiff bases in Briton-Robinson buffer solution exhibit one wave in the pH range 2.1-10.1. with limiting current values i$_L$(μA) 3.8-3.40 (μA) for O-VAMP, 4.0-3.6 (μA) for P-VAMP. On inspection of the structures of of derivatives reveals that the sites susceptible for reduction at the dropping mercury electrode were the exocyclic > C = N- in Schiff bases. The results presented in the Table-1& 2 suggest that in the present investigation both the half-wave potential and limiting current were pH dependent.
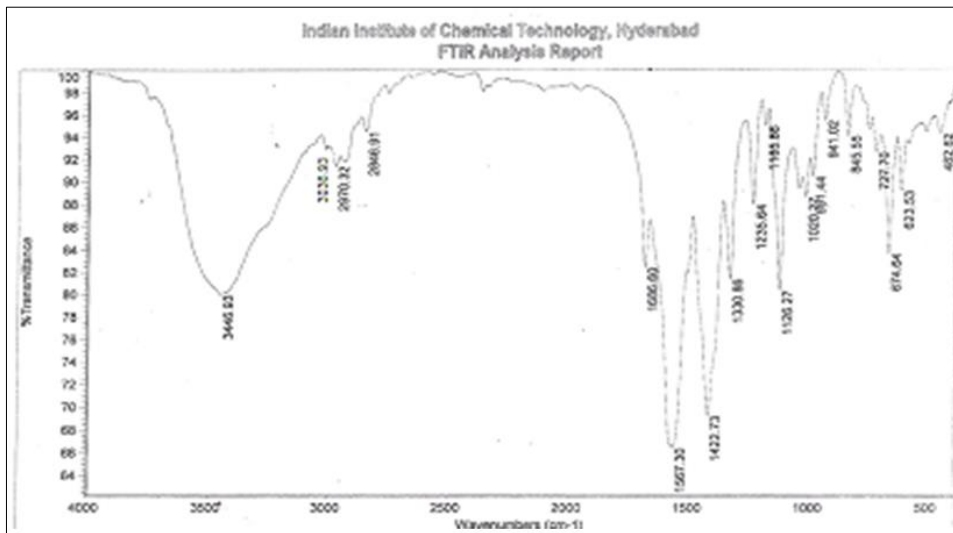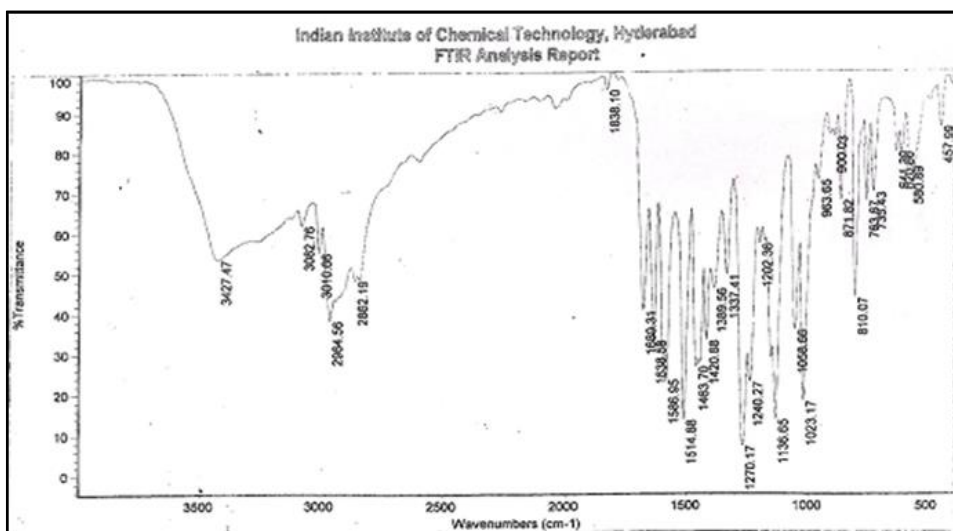
Fig 1: Vibrational spectra of O-VAMP

Fig 2: Vibrational specra of P-VAMP

Effect of pH on the half-wave potential

The results in the Tables 1 and 2 show that the half-wave potential increases with increase in pH in the acid range but it remains unaltered in the alkaline pH range. The plot of the half-wave potential and the pH was a straight line up to pH 8.1 and the slope lies between 80-110 mV. The p (number of protons) values (Tables 1) were low and non-integers. This suggests that the proton transfer in the reduction process was a heterogenous process. The shift in the half-wave potentials with pH of the solution can therefore be ascribed to the following reasons. Both protonated form and unprotonated form of the depolariser were electro active. There exist an equilibrium between protoneted form and unproteneted form. The unprotonated form is reduced at more negative potentials than protonated form of the azomethine group. The pH dependence of the half-wave potential was caused not only by the antecedent chemical acid-base reaction but also by the consumption of protons in the reduction process. The pH of the solution in bulk was different from pH values at the electrode surface. In the presence of electric field the inequality was observed $\Delta(pHs) < \Delta(pHo)$ as the equilibrium shifted towards the unprotonated form, the $E_{1/2}$ remains constant. It is seen from the Figs. 3, 4 that above pH 8.1, the shift in half-wave potential with pH was not so marked as in the acidic pH range. $E_{1/2}$ – pH of Polarographic wave was √

shaped in the pH range of study. The $E_{1/2}$ becomes practically constant in the alkaline pH range and this constancy in $E_{1/2}$ may be due to the fact that both acidic and basic forms of the depolariser were electroactive. But in the pH range where the protonation rate decreases, the half-wave potentials of both the protonated form (acidic) and the unprotonated form (basic) were so close to each other that the waves merge and a single wave was observed. $E_{1/2}$ vs pH graph consists of two linear segments intercepting each other and the point of interception of the two linear plots was approximately equal to pK_1.
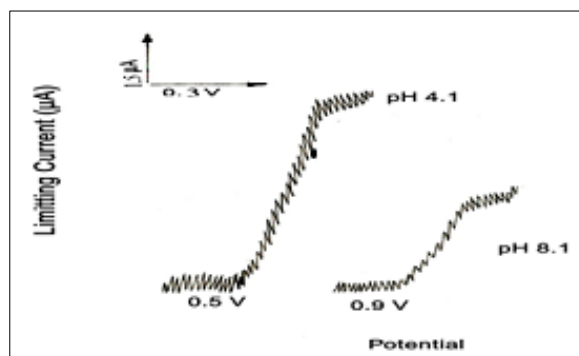

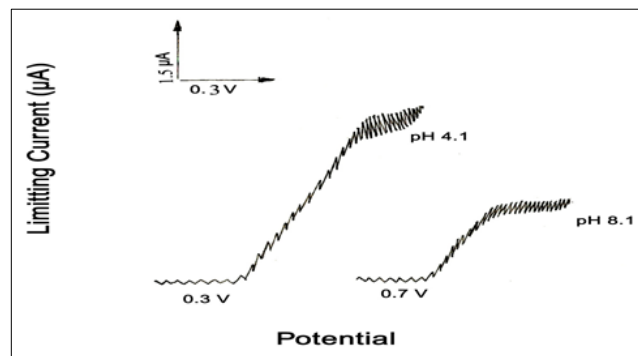**Fig 3:** Polarogram of O-VAMP (1×10^{-3} M) at pH 4.1 and 8.1

Fig 4: Polarogram of P-VAMP (1×10^{-3} M) at pH 4.1 and 8.1

Effect of the height of the mercury column head (h) on the limiting current (i_l)

The effect of mercury column height on the limiting current indicates the diffusion controlled nature of the polarographic wave. The i_l versus $h^{1/2}$ plots are linear and passing through the origin. The values of $i_l/h^{1/2}$ were constant as shown in the Tables 6-10. The three Polarographic reduction waves were found to be diffusion controlled wave.

Effect of concentration of the depolariser on the diffusion current

The effect of concentration of the depolarizer on the diffusion current of Schiff bases on the diffusion current in concentration range of 0.20 – 2.0 M has been studied at typical pH values 4.10. The i_l versus concentration graphs were linear as shown in the Figs. 6-10, and are passing through the origin. The constancy of i_l/C values serves not only as a test for the diffusion controlled nature of the wave but also indicates the applicability of the polarographic method for the quantitative determination of Schiff base derivatives. From the results it was concluded that the two Polarographic reduction waves noticed in the acidic pH 4.1 were diffusion controlled waves.

Nature of the electrode process

The experimental results observed from the effect of concentration and mercury column height on the limiting current confirmed the diffusion-controlled nature of the limiting current. The electrode processes was found to be irreversible at low acidic pH values unlike the reversible electrode process observed for azomethine compounds under comparable conditions. The irreversible nature of the process observed in the present investigations.This was also further confirmed by the slopes of (0.08-0.15) of the semi-logarithmic plots (Ede Vs $\log \frac{i}{id-i}$) do not confirm to the values expected for two or four electrons reversible reduction process respectively. $E_{1/2}$ shifts towards more negative potentials with increase in the depolariser concentration. The heterogenous rate constant ($k^\circ_{f,h}$) calculated from the Meites–Israel equation, the $K^0_{f,h}$ values in the present investigations were less than 10^{-4}. These observations suggest that the Polarographic reduction of azomethine (>C=N-) in derivative I and derivative II was found to be irreversible in nature. This may be due to the presence of bulky groups at the end of the >C=N- groups.

Effect of pH on the limiting current

It is observed from the Table 1&2, the height of the wave decreases with increase of pH and this suggests that both the protonated form (acidic) and the unprotonated form (basic) were transported to the electrode surface, and both of them may be electroactive.The limiting current depends on the nature of electro active species, concentration of the species pH of the solution and nature of the solvent present in the solution, the following factores plays an important role in deciding limiting current of the wave. The limiting current (i_l) of the Polarographic reduction process may be depends on one of these factors or some of these factors. (i) Acid-base reaction or (ii) A chemical reaction such as dehydration or ring opening hydrolysis or (iii) The difference in the number of electrons involved in the reduction of acidic and basic forms or all of them. (iv) All the mentioned factors

Electrode reaction

The plots of $-E_{dme}$ versus $\log i/i_d – i$ shown in the Figs. 6-10 at typical pH 4.1 were linear but the slopes are not in agreement with the theoretical values (0.030 V and 0.015 V for 2-electron and 4-electron reduction, respectively) expected for the reversible waves. This indicates that the electrode reaction is irreversible. The slopes further indicate that the tendency of the irreversibility increases with increase in the pH. Tome's criteria was also employed to determine the irreversible nature of the polarographic wave. The half-wave potential increases with pH and this suggests that the protons are involved in the reduction process. The number of protons involved in the reduction process is calculated from the equation (14). The half-wave potential remain constant in alkaline pH range 8.1 – 10.1.

Millicoulometric method

There is much interest in knowing the number of electrons (n), involved per molecule during the reaction at the dropping mercury electrode. A mercury pool cathode was used for determining the number of electrons (n) in the millicoulometer described by DeVris and Kroon [38]. The Millicoulometric experiment was performed on I in Briton-Robinson buffer solution of pH 4.1 containing 40% (V/V) aqueous dimethyl formamide. The schiffs bases in the experimetnal conditions exhibit one Polarographic reduction wave. The Polarographic reduction wave was ascribed to the electron reduction (I) of azomethine >C=N- group to amine stage.The Millicoulometric experiment was performed by with $CdSO_4$ as reference standard.

Peak potentials and peak currents change with change in the scan rates. The voltommograms of Schiff bases derived from AMP and Substituted benzaldehydes observed at typical pH values 4.1 and 8.1 at 100 mVS^{-1} scan rate were shown in the Figs.5-6.
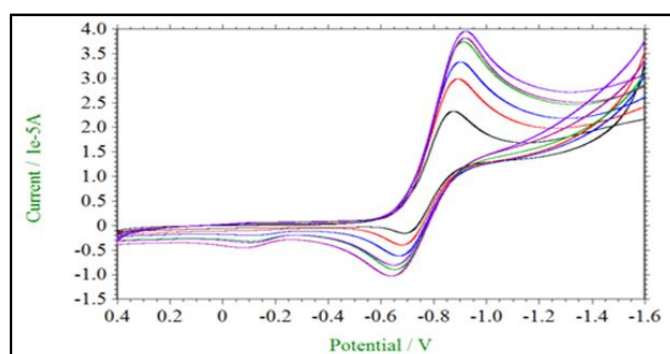

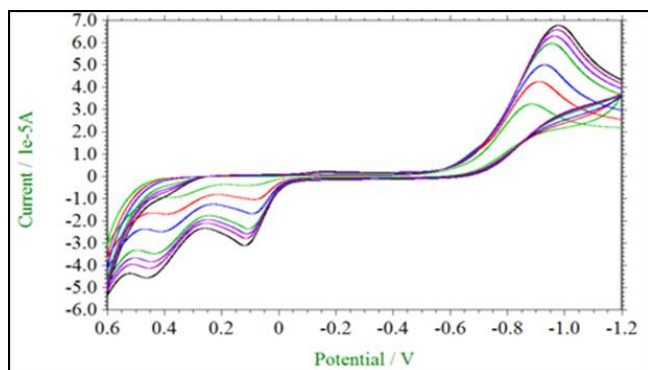**Fig 5:** Overlayed cyclic voltamogram of O-VAMP at various scan rates

Fig 6: Overlayed cyclic voltamogram of P-VAMP at various scan rates

Dependence of peak potential and peak current on scan rates

The cathodic peak potentials become more negative and the cathodic peak currents increase with the increase in the scan rate as shown in the Tables 7-10.

Effect of pH on peak potentials and peak current

The cathodic peak potentials shifted to more negative values and the peak currents decreased with the increase in the pH.The peak potential and the peak currents observed at different scan rates and at different pH values are given in the Tables 7-10.

In Briton-Robinson buffer solutins of pH 4.1 and 8.1 Schiff bases, exhibit two cathodic peak in all sweep rates. For a reversible charge transfer, O +ne → R, the peak potential is independent of scan rate and the separation of anodic peak and cathodic peak potentials (E_{pa} - E_{pc} = ΔE_p) is 60/n mV at 25°C and the ratio of anodic peak current to cathodic peak current must be unity. On the other hand, a plot of i_{pc} / $\upsilon^{1/2}$ versus sweep rate is a straight line parallel to sweep rate axis and it is contrary to the behaviour of a reversible system, the irreversible nature of the electrode process is characterized by dependence of peak potential on sweep rate, the absence of anodic peak in the reverse scan, in acidic pH solutions, The anodic peak and cathodic peak potentials (E pa –E pc =Δ Ep>60/n mV) at 25⁰ C The above mentioned facts clearly

rules out the possibility of a fast electron transfer which is characteristic of a reversible behaviour. The linear plot of ipc versus υ1/2 suggests the diffusion-nature of the electrode process. The Schiff bases (I&II) exibit one anodic peak in all sweep rates. The number of polarographic reduction waves in DC polarography and number of cathodic peaks in CVM studies are one and the same. However an additional anodic peak was noticed in Schiff bases (I-II) under experimental conditions. Based on experimental results in DC polarography and CVM studies the following mechanism has been proposed for Schiff bases (I&II)**.** The cathodoic peak was ascribed to two electron reduction of azomethine group to amine stage. The anodic peak was attributed to 2e ⁻oxidation of primary alcohol to aldehyde functional group.

Table 1: Polarographic results of O-VAMP in Britton Robinson buffer solutions ($1x10^{-3}$ mM) Medium: Aqueous DMF (40% v/v)

pH	E ½ vs SCE	Limiting Current $i_l(\mu A)$
2.1	0.72	3.8
3.1	0.78	3.8
4.1	0.84	3.8
5.1	0.90	3.7
6.1	0.96	3.6
7.1	1.02	3.5
8.1	1.08	3.4
9.1	1.08	3.4
10.1	1.08	3.4

Table 2: Polarographic results of P-VAMP Briton Robinson buffer solutions ($1x10^{-3}$ mM) Medium: Aqueous DMF (40% v/v)

pH	E ½ vs SCE	Limiting Current $i_l(\mu A)$
2.1	0.57	4.0
3.1	0.66	4.0
4.1	0.75	4.0
5.1	0.84	3.9
6.1	0.93	3.8
7.1	1.05	3.7
8.1	1.14	3.6
9.1	1.14	3.6
10.1	1.14	3.6

Table 3: Polarographic characteristics and kinetic parameters of O-VAMP ($1x 10^{-3}$ mM) Medium: Aqueous dimethyl farmamide (40% v/v)

pH	$-E_{1/2}$/pH (Mv)	α_{na}	No. of protons p	D X 10^{-6} cmsec^{-1}	I* X 10^3	K^0fh cm sec^{-1}	ΔG^* k cal mole^{-1}
2.1	0.084	0.42	0.62	2.87	4.0	$5.33x10^{-4}$	11.58
4.1	0.084	0.52	0.76	1.99	3.1	$3.62x10^{-4}$	12.01
6.1	0.084	0.59	1.06	1.22	2.0	$1.31x10^{-4}$	12.43
8.1	0.084	0.65	1.19	0.59	1.2	$6.70x10^{-5}$	12.89
10.1	0.084	0.65	1.19	0.59	1.2	$6.70x10^{-5}$	12.89

Table 4: Polarographic characteristics and kinetic parameters of P-VAMP ($1x 10-3$ mM) Medium :Aqueous dimethyl farmamide (40% v/v)

pH	$-E_{1/2}$/pH (Mv)	α_{na}	No. of protons p	D X 10^{-6} cmsec^{-1}	I* X 10^3	K^0fh cm sec^{-1}	ΔG^* k cal mole^{-1}
2.1	0.090	0.42	0.72	3.43	4.5	$3.31x10^{-4}$	11.87
4.1	0.090	0.50	0.87	2.47	3.8	$1.40x10^{-4}$	12.40
6.1	0.090	0.59	1.10	1.58	2.8	$6.40x10^{-5}$	12.98
8.1	0.090	0.68	0.97	0.57	1.8	$3.84x10^{-5}$	13.40
10.1	0.090	0.68	0.97	0.57	1.8	$3.84x10^{-5}$	13.40

Table 5: Effect of Mercury Column height (h) on the limiting current (i_l) of O-VAMP ($1x10^{-3}$ M) Medium: aqueous dimethyl foramamide (40%v/v)

Mercury column height (h)(cm)	pH=4.1		pH=8.1	
	First wave		First wave	
	i_l (µA)	$i_l/\sqrt{h}$	i_l (µA)	$i_l/\sqrt{h}$
80	3.6	0.40	3.0	0.34
70	3.30	0.40	2.80	0.34
60	3.00	0.38	2.40	0.30
50	2.70	0.38	2.20	0.30

Table 6: Effect of Mercury Column height (h) on the limiting current (i_l) of P-VAMP (1×10^{-3} M) Medium: aqueous dimethyl foramamide (40% v/v)

Mercury column height (h) (cm)	pH=4.1		pH=8.1	
	First wave		First wave	
	i_l (μA)	$i_l/\sqrt{h}$	i_l (μA)	$i_l/\sqrt{h}$
80	3.4	0.38	3.0	0.32
70	3.10	0.38	2.68	0.32
60	2.8	0.36	2.40	0.30
50	2.5	0.36	2.20	0.30

Table 7: Cyclic voltammetric results of Schiff bases (1×10^{-3}M) Medium: aqueous dimethyl foramamide (40% v/v): at pH=4.1

Schiff Base	Sweep rate (mv/sec)	Cathodic peak potentials (Epc)	Cathodic peak currents (ipc)	Anodic peak potentials (Epa)	Anodic peak currents (ipa)
		I	I	I	I
O-VAMP	0.010	0.66	0.78	0.46	0.33
	0.020	0.72	1.1	0.52	0.47
	0.050	0.78	1.74	0.58	0.75
	0.100	0.84	2.47	0.64	1.0
	0.200	0.90	3.49	0.7	1.5
	0.500	0.99	5.52	0.79	2.3

Table 8: Cyclic voltammetric results of Schiff bases (1×10^{-3}M) Medium: aqueous dimethyl foramamide (40% v/v): at pH=8.1

Schiff Base	Sweep rate (mv/sec)	Cathodic peak potentials (Epc)	Cathodic peak currents (ipc)	Anodic peak potentials (Epa)	Anodic peak currents (ipa)
		I	I	I	I
O-VAMP	0.010	0.96	0.6	0.76	0.2
	0.020	1.02	1.0	0.82	0.3
	0.050	1.08	1.5	0.88	0.4
	0.100	1.14	2.1	0.94	0.7
	0.200	1.20	3.0	1.0	0.9
	0.500	1.29	4.8	1.09	1.5

Table 9: Cyclic voltammetric results of Schiff bases (1×10^{-3}M) Medium: aqueous dimethyl foramamide (40% v/v): at pH=4.1

Schiff Base	Sweep rate (mv/sec)	Cathodic peak potentials (Epc)	Cathodic peak currents (ipc)	Anodic peak potentials (Epa)	Anodic peak currents (ipa)
		I	I	I	I
P-VAMP	0.010	0.68	0.671	0.36	0.4
	0.020	0.74	0.948	0.42	0.5
	0.050	0.8	1.49	0.48	0.8
	0.100	0.86	2.12	0.54	1.3
	0.200	0.92	3.0	0.60	1.8
	0.500	1.01	4.7	0.7	2.8

Table 10: Cyclic voltammetric results of Schiff bases (1×10^{-3}M) Medium: aqueous dimethyl foramamide (40% v/v): at pH=8.1

Schiff Base	Sweep rate (mv/sec)	Cathodic peak potentials (Epc)	Cathodic peak currents (ipc)	Anodic peak potentials (Epa)	Anodic peak currents (ipa)
		I	I	I	I
P-VAMP	0.010	0.98	0.5	0.66	0.5
	0.020	1.04	1.3	0.7	0.7
	0.050	1.1	1.4	0.78	1.1
	0.100	1.16	1.7	0.84	1.6
	0.200	1.22	2.4	0.9	2.2
	0.500	1.31	3.9	0.99	3.6

Conclusion

In this present study we have synthesized two new schiffs base derivatives of vanillin isomers by condensation with 2 amino 2 methyl 1 propanol and chareceised by spectral and electrochemical methods. Electrochemical methods of analysis reveals that these schiffs base derivatives under gone two electron transfer reactions with revesible electron transferring nature. These derivatives have shown strong reversible nature at pH 8.1 (basic conditions), this study may further useful to develope low cost electro chemical method development for qualitative and quantitative analysis of vanillin in commercial and biological samples. To electrochemical differenciation of ortho and para isomers of vanillin this study may also useful.

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