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# PROSIDING SEMINAR NASIONAL KIMIA V

UNIVERSITAS ISLAM INDONESIA

**PERANAN ILMU KIMIA  
DALAM  
MENINGKATKAN  
KEMANDIRIAN BANGSA**



*Auditorium Kahar Muzakkir  
Kampus Terpadu Universitas Islam Indonesia  
Jogjakarta  
Rabu, 6 Juli 2011*



Diterbitkan Oleh

**Program Studi Ilmu Kimia**

Fakultas Matematika dan Ilmu Pengetahuan Alam  
Universitas Islam Indonesia



## Kata Pengantar

Assalamu' alaikum Wr. Wb.

Syukur Alhamdulillah kami panjatkan ke hadirat Allah SWT yang melimpahkan nikmat dan kesempatan sehingga Prosiding Seminar Nasional Kimia V 2011 ini dapat tersusun dengan baik.

Seminar Nasional Kimia V kali ini merupakan salah satu dari rangkaian acara untuk memperingati Milad Program Studi Ilmu Kimia Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Islam Indonesia Jogjakarta ke 15 dan turut memeriahkan International Year of Chemistry 2011. Bersama dengan acara seminar ini, juga diselenggarakan Workshop Teknologi Minyak Atsiri dan Workshop Sertifikasi ISO 17025 pada tanggal 4 dan 5 Juli 2011.

Sesuai dengan tema, Seminar Nasional Kimia V UII 2011 berharap melalui forum ini, dapat menjadi momentum bersama bagi bangsa Indonesia untuk dapat mengangkat dan menggunakan potensi bangsa secara mandiri baik sumber daya alam, manusia, maupun teknologi dan ilmu kimia, sehingga tidak selalu tergantung kepada bangsa lain. Untuk itu perlu peran serta dan komitmen yang kuat dari seluruh pihak khususnya para kimiawan yang aktif sebagai peneliti, dosen, guru, praktisi dan pemerintah.

Seminar Nasional Kimia V UII 2011 dikelompokkan menjadi 6 bagian dengan total makalah sebanyak 58, terdiri dari:

- a. Biokimia berjumlah 11 makalah
- b. Kimia Anorganik berjumlah 6 makalah
- c. Kimia Fisika berjumlah 11 makalah
- d. Kimia Analitik berjumlah 8 makalah
- e. Kimia Organik berjumlah 11 makalah
- f. Kimia Pendidikan 11 makalah

Mudah-mudahan forum ini dapat menjadi ajang bertukar pikiran antar kimiawan dari berbagai disiplin dan bermanfaat untuk meningkatkan kemandirian bangsa Indonesia. Amin.

Wassalamu alaikum Wr. Wb.

Tim penyusun

## Daftar Isi

Kata Pengantar	i
Daftar Isi	ii
Sambutan Ketua Panitia	vi
Susunan Panitia	vii
Daftar Editor	viii
Manual Acara	ix
Abstrak Pemakalah Paralel	
<b><u>Biokimia :</u></b>	
Komposisi Kimia Dan Aktivitas Minyak Kemangi Sebagai <i>Repellent</i> Dan Larvisida Nyamuk Dan Larva <i>Anopheles</i> <b>Maximus M. Taek</b>	1-9
Uji Aktivitas Antibakteri Minyak Atsiri Daun Sirih ( <i>Piper betle, L.</i> ) Terhadap <i>Salmonella typhi</i> ATCC 14028 <b>Hadi Anshory T., Tatang Shabur Julianto, Eriqrachmad Charismawan</b>	10-21
Sulfonasi Senyawa Kalanon Dan Uji Sitotoksitasnya Terhadap Sel Leukemia L1210 <b>Mochamad Chasani, Ponco Iswanto, Eva Vaulina, Mirah Farfita</b>	22-33
Hepatotoksitas Ekstrak <i>Strychnos ligustrina</i> Sebagai Obat Tradisional Antimalaria Di Timor Terhadap Hewan Coba <b>Maximus M. Taek, Eufrasia R. A. Lengur</b>	34-41
Efficacy Test of Azadirachtin isolated from <i>Azadirachta indica</i> A. Juss. Against Subterranean Termite, <i>Coptotermes gestroi</i> <b>Khoirul Himmi Setiawan, Didi Tarmadi, Maya Ismayati, and Sulaeman Yusuf</b>	42-45
Modifikasi Bioavailabilitas Teofilin Akibat Pemberian Telur Rebus Pada Tikus Putih Jantan <b>Farida Hayati, Dimas Adhipradana dan Bekti Wulandari</b>	46-55
Pengendalian Hama Gudang <i>Sitophilus oryzae</i> menggunakan pestisida alami berbahan dasar Nimba, <i>Azadirachta indica</i> <b>Sulaeman Yusuf, Khoirul Himmi Setiawan, Didi Tarmadi dan Maya Ismayati</b>	56-64
Penghambatan HMG-CoA Reduktase Hepar Tikus Putih ( <i>Rattus norvegicus</i> ) Oleh Fraksi Diklorometan Batang Pasak Bumi ( <i>Eurycoma longifolia</i> Jack) <b>Ari Widiyantoro, Rika Setyarini, Siti Khotimah, dan Siti Ifadatin</b>	65-74
<b><u>Kimia Analitik :</u></b>	
Design And Application Of Gold Metal Electrode (gme) For Electroanalysis Ascorbic Acid In Fruit Samples <b>Riyanto</b>	75-84
Design And Application Of Metal Sheet Electrode (mse) For Electrochemistry Research <b>Riyanto</b>	85-95
Proses Sorpsi Logam Khrom Dari Lingkungan Ke Dalam Gagalan Genteng Kebumen Dan Godean <b>Ngasifudin</b>	96-108

Penentuan Kondisi Optimal Respon Percobaan Dengan Metodologi Permukaan Respon <b>Edy Widodo, Suryo Guritno dan Sri Haryatmi</b>	109-124
Validasi Metode CV-AAS untuk Analisis Total Merkuri pada Sampel Sedimen <b>Suheryanto</b>	125-134
Studi Ekstraksi Cr(VI) dari Limbah Elektrolisis dengan Teknik Ekstraksi Cair-Cair Dua Tahap Menggunakan Carrier Tributyl Posfat (TBP). <b>Imam Santoso</b>	135-144
Verifikasi Metode Uji Penetapan Kadar SiO <sub>2</sub> pada Slag Baja Secara Gravimetri <b>Dwi Muharani, Thorikul Huda</b>	145-157
<b><u>Kimia Anorganik :</u></b>	
Sintesis 1-fenil-3-metil-4-benzoil-5-pirazolon (HPMBP) dan Aplikasinya Dalam Ekstraksi Ion La(III) <b>Rusnadi , Buchari, M. Bachri A, Deana W</b>	158-165
Optimasi Proses Chelating Menggunakan EDTA dan H <sub>2</sub> SO <sub>4</sub> terhadap Pelepasan Metal Ions dari Pulp Kayu Akasia <b>Vifi Fitriwati dan Ahmad M. Fuadi</b>	166-178
Pengaruh Penambahan Aluminat dan TMAOH terhadap Stabilitas Material Mesopori MCM 41 <b>Mustofa Ahda, Sutarno, Eko Sri Kunarti</b>	179-189
Adsorpsi-Reduktif Au (III) dengan Menggunakan Asam Humat <b>Thorikul Huda, Sri Juara Santosa, Dwi Siswanta</b>	190-196
Sintesis dan Karakterisasi Senyawa Kompleks Tembaga (II) dengan Ligan 2,6 Piridin Dikarboksilat <b>Ayu Wardani K, Mahbub Alwathoni, Fahimah Martak</b>	197-204
<b><u>Kimia Fisika :</u></b>	
Peningkatan Mutu Bata Rakyat dengan Memanfaatkan Abu Terbang (AT) dan Limbah Karbid (LK) <b>Dasli Noerdin</b>	205-219
Oksidasi Fenol Menggunakan Katalis Cu(II)-Biomassa Azolla microphylla-silikat <b>Sri wardhani, Danar Purwonuggho, M. Andi Sulaiman</b>	220-227
Karakterisasi Fisikomekanik Amilum Sorgum (Sorghum bicolor L.) sebagai Eksipien dalam Formulasi Sediaan Tablet <b>Oktavia Indrati, Ikhsan Kurniawan, Yandi Syukri</b>	228-242
Sintesis Nanokomposit Alofan/TiO <sub>2</sub> dan Uji Fotodegradasi pada Zat Pewarna Biru Metilena <b>Sri Sugiarti</b>	243-252
Tantangan Pengembangan Katalis Hidrogenasi Fatty Acid Methyl Ester untuk Produksi Fatty Alcohol <b>Haris Puspito Buwono</b>	253-258
Catalytic Activity of Chromium and Nickel Impregnated Natural Zeolite Catalysts in The Cracking of Palm Oil Methyl Esters <b>Totok E. Suharto and Agus Sundaryono</b>	259-268

Katalisis Homogen Asam Basa Pada Pembuatan Biodisel Dari Minyak Jelantah <b>Muhammad Ali</b>	269-275
Kinetika Reaksi Asidolisis Trigliserida Minyak Sawit dalam Medium Asam Propanoat <b>Muhammad Ali</b>	276-285
Kajian Adsorpsi-Desorpsi Cu(II) dalam Kolom SPE dengan Adsorben Kitin Terimobilisasi Ditizon <b>Y. Rohyami, Mudasir, N.H. Aprilita, E.Sugiharto</b>	286-293
Hidrocracking Tir Batubara Menggunakan Katalis Ni-mo-s/zaa Untuk Menghasilkan Fraksi Bensin Dan Fraksi Kerosin <b>Zainal Fanani</b>	294-301
<b><u>Kimia Organik :</u></b> Studi Pendahuluan Pengaruh Jenis Pelarut (Solvent) Terhadap Daya Tahan Parfum Racikan <b>Hernandi Sujono</b>	302-307
Optimasi Pembuatan Selulosa Dari Ampas Tebu Sebagai Bahan Dasar Pembuatan Polimer Superabsorben <b>Ngasifudin dan Wiwien Andriyanti</b>	308-316
Produksi Bioplastik Polihidroksi Alkanoat (PHA) oleh Bakteri Pseudomonas putida dengan Sumber Karbon Minyak Jelantah <b>Darti Nurani dan Sidik Marsudi</b>	317-328
Fraksinasi dan Identifikasi Senyawa Bioaktif dalam Ekstrak Etil Asetat Kulit Batang Kamboja (Plumeria alba) <b>Santi Nur Handayani, Moch. Chasani dan Faisal Assegaf</b>	329-339
Sintesis dan Karakterisasi Polimer Hibrid Berbasis Monomer (3-Glycidylxypropyl) trimethoxysilane untuk Aplikasi Coating Baja Karbon <b>H. A. Melati, R. Hidayat, N. Syakir, dan F. Fitrilawati</b>	340-346
Bioplastik Dari Limbah Rumah Tangga Sebagai Bahan Edible Film Ramah Lingkungan <b>Eli Rohaeti</b>	347-360
Tipe Kimia Lengkap Minyak Kemangi (Ocimum citriodorum) Dari Dua Wilayah yang Berbeda di Jogjakarta <b>Dwiarso Rubiyanto, Tatang S. Julianto, Pramytha S. Hapsari, Hardjono Sastrohamidjojo dan Chairil Anwar</b>	361-368
Supercritical Carbon Dioxide Extraction: Application of Semi Empirical Models on Virgin Coconut (Cocos nucifera) Oil Solubility and Its Medium Chain Triglycerides Selectivity <b>Wahyu B. Setianto</b>	369-380
Studi Perbandingan Perlakuan Bahan dan Metode Distilasi Terhadap Rendemen dan Kualitas Minyak Atsiri Jahe Emprit (Zingiber officinale) <b>Tatang Shabur Julianto, Hardjono Sastrohamidjojo, Martsiano Wija Dirgantara</b>	381-395

**Kimia Pendidikan :**

Peran Asam Sialat Dan Sfingomielin Kuning Telur Dalam Meningkatkan Kemampuan Belajar Siti Suryaningsih	396-403
Remediasi Miskonsepsi dengan Menggunakan Metode Pembelajaran Perubahan Konseptual Pada Subkonsep Hukum Kekekalan Massa (Penelitian di Kelas XI IPA SMAN Kota Bandung ) Cucu Zenab Subarkah	404-431
Pembelajaran Berbasis Web Untuk Pengembangan Kemampuan Interkoneksi Multiple Level Representasi Mahasiswa Pada Topik Kesetimbangan Asam-Basa Ida Farida dan Liliasari	432-444
Model Mental Mahasiswa Tahun Pertama dalam Mengenal Konsep Stoikiometri (Studi pada Mahasiswa PS. Pendidikan Kimia FKIP Universitas Lampung) Sunyono, Leny Yuanita dan Muslimin Ibrahim	445-458
Penggunaan Media Booklet Dengan Setting Kooperatif Pada Materi Reaksi Redoks di Kelas X SMA Islam Bawari Pontianak Jamilah, Hairida, H. A. Melati	459-469
Konsep Pendidikan Kimia Integratif : (Telaah Pemikiran Pendidikan Jabir Bin Hayyan) Edy Chandra	470-500
Miskonsepsi Perhitungan Kimia Tingkat Sekolah Menengah Atas Asih Widi Wisudawati, Ashadi, Haryono	501-512
Model Evaluasi Praktikum Kimia Untuk Menilai Tujuan Praktikum yang Telah Dicapai oleh Mahasiswa Endang Susilaningsih	513-519
Analisis Pemahaman Konseptual Hukum Dasar Kimia Dan Hubungannya Dengan Kemampuan Berpikir Formal Mahasiswa Prodi Pendidikan Kimia Universitas Tanjungpura Erlina	520-535
Penerapan Model Pembelajaran Siklus Belajar (Learning Cycle) untuk Meningkatkan Prestasi Belajar Kimia Kelas X di SMK Piri 1 Yogyakarta Hadiyanto Sahputra	536-550

**SAMBUTAN  
KETUA PANITIA  
SEMINAR NASIONAL KIMIA V UII 2011**

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2. Harian Kedaulatan Rakyat
3. Koran Merapi
4. Radio Unisi
5. Orizho
6. Djamo Cookies

Suatu kebanggaan bagi kami dapat menyelenggarakan **acara ini** dengan mengundang para peneliti di negeri ini, yang menghadirkan 58 pemakalah dari 25 perguruan tinggi dan 3 Lembaga Penelitian di hampir seluruh wilayah **Indonesia**.

Seminar ini merupakan rangkaian acara dalam rangka memperingati Milad Prodi Ilmu Kimia Universitas Islam Indonesia ke 15 dan untuk memeriahkan **International Year of Chemistry 2011**. Sebelumnya kami juga telah menyelenggarakan 2 acara yang cukup menarik yaitu **Workshop Teknologi Minyak Atsiri**, bidang yang menjadi kompetensi Prodi Ilmu Kimia UII untuk mengangkat kearifan lokal khususnya di Daerah Istimewa Yogyakarta, dan untuk **Indonesia** pada umumnya. Selain itu juga telah dilaksanakan **Workshop Sertifikasi ISO/IEC 17025** yang merupakan bentuk pengabdian kami untuk berbagi pengalaman sebagai penerima **ISO 17025** pertama untuk perguruan tinggi swasta di **Indonesia**. Mudah-mudahan kegiatan ini dapat memberikan semangat bagi bangsa ini untuk dapat mengembangkan potensi alam dan sumber daya manusianya menuju kemandirian bangsa dalam arti yang sebenarnya.

Salam Kimia.

*Wassalamu alaikum wr. Wb.*

Ketua Panitia

**Tatang Shabur Julianto, M.Si.**

# **Susunan Panitia**

## **Seminar Nasional Kimia V 2011**

“Peranan Ilmu Kimia dan Pendidikan Kimia untuk Meningkatkan Kemandirian Bangsa”  
Jogjakarta, 6 Juli 2011

Pelindung	: Dekan Fakultas MIPA UII
Pengarah	: Ketua Program Studi Ilmu Kimia FMIPA UII
Ketua Panitia	: Tatang Shabur Julianto, M.Si.
Sekretaris	: Thorikul Huda, M.Sc.
Bendahara	: Yuni Ari Rahmawati, S.Ag.
Seksi Konsumsi	: Reni Banowati Istiningrum, S.Si.
Seksi Publikasi dan Dokumentasi	: Dwiarso Rubiyanto, M.Si.
Seksi Abstrak dan Proceeding	: Dr. Is Fatimah
Tim Supporting	: Dr. Noor Fitri, M.Si. Cecep Sa'bana Rahmatillah, S.Si. Dedy Sugiarto, S.Si. Sigit Mujiarto Jamalul Lail, S.Si. Yuli Rohyami, M.Sc. Dwi Mahmudi, BA. Slamet Haryanto Nandang Kurniawan Yusuf Ratih Dyah Puspitasari Yuyun Yunani M. Miqdam Musawwa Fachri Cahyana Ahmad Safarudin Restu Ayu Mumpuni Afifah Hidayatullah Muhammad Mahfudz, S.Ag



## Daftar Editor

### Seminar Nasional Kimia V 2011

“Peranan Ilmu Kimia dan Pendidikan Kimia untuk Meningkatkan Kemandirian Bangsa”

Jogjakarta, 6 Juli 2011

Ketua : **Prof. Dr. Hardjono Sastrohamidjojo**  
Anggota : **Dr. Noor Fitri, M.Si.**  
**Riyanto, M.Si., Ph.D.**  
**Dr. Is Fatimah**  
**Dwiarso Rubiyanto, M.Si.**  
**Tatang Shabur Julianto, M.Si.**  
**Thorikul Huda, M.Sc.**

## DESIGN AND APPLICATION OF GOLD METAL ELECTRODE (GME) FOR ELECTROANALYSIS ASCORBIC ACID IN FRUIT SAMPLES

Riyanto\*

\* *Chemistry Study Program, Faculty of Mathematic and Natural Science  
Islamic University of Indonesia  
Jl. Kaliurang KM 14.5 Yogyakarta 55584; e-mail: riyanto@fmipa.uui.ac.id*

### ABSTRACT

*Design and application of gold metal electrode for electroanalysis ascorbic acid in fruit samples have been done. GME electrode was prepared by cutting its metal foil into 1cm x 1cm size. Universal Pulse Dynamic EIS, Voltammetry, Voltalab potentiostat (Model PGZ 402) was used for the electrochemical measurements while data acquisition was accomplished using the Voltmaster 4 software. Voltammetric experiments were carried out in a three electrodes system using GME as a working electrode (anode), an Ag/AgCl (saturated KCl) or SCE as reference electrode and platinum wire as the counter electrode. All potentials given are with respect to the SCE reference electrode. The measurements were made in a potential range of 0 mV to 1200 mV in relation to reference electrode using a scan rate of 100 mV/s. The anodic peak currents for the electrochemical oxidation of ascorbic acid to dehydroascorbic acid were recorded at 880 mV. Fruits found to have high levels of ascorbic acid include orange 61.56 mg/100g, apple 42.51 mg/100g, mango 51.23 mg/100g, pine apple 53.33 mg/100g, and guava 50.44 mg/100g.*

*Keywords: gold metal electrode (GME), electroanalysis, ascorbic acid, fruit samples.*

### Introduction

Ascorbic acid (Vitamin C) is a strong reducing substance. The oxidation of Vitamin C leads over a radical intermediate to dehydroascorbic acid, in vivo. The three forms mentioned constitute a reversible redox-system. Ascorbic acid plays an important role in hydroxylation reactions, i.e. in the synthesis of collagen. So it is rather important for the de novo synthesis of bone, cartilage and tooth and for the healing of wounds. Vitamin C is needed for the production of noradrenalin. Another important role of Vitamin C is that of an antioxidants, that means it protects other substances from the oxidizing effects of oxygen. Ascorbic acid promotes the resorption of iron in the intestine. It reduces the production of nitrosamines which might cause cancer.

Ascorbic acid (vitamin C) is a water-soluble vitamin which can be found in many biological systems and foodstuffs (fresh vegetables and fruits, namely, citrus). Ascorbic acid plays an important role in collagen biosynthesis, iron absorption, and immune response activation and is involved in wound healing and osteogenesis. It also acts as a powerful antioxidant which fights against free-radical induced diseases.

The only way humans uptake ascorbic acid is via food (Englard and Seifter 1986), but the daily needs of vitamin C for a human are not clear yet. Linus Pauling postulated that people's needs for vitamins and other nutrients vary markedly and that to maintain good health, many people need amounts of nutrients much greater than the recommended doses. According to his suggestions, daily uptake of vitamin C has to be within units of grams of AA to reduce the

incidence of colds and other diseases. These “huge” amounts of AA have not been ever proved as the reason for large reducing of the incidence of illnesses. AA can be mostly found in fruits and vegetables. The main sources of AA are citrus fruits, hips, strawberries, peppers, tomatoes, cabbage, spinach and others (Davey et al. 2000). If one wants to uptake AA from animal sources, liver and kidney are the tissues with highest contents of this molecule, but in comparison with plant sources the amount of AA is very low (Deicher and Horl 2003). The content of AA in food can be affected by many factors such as climate, method of harvest, storing and processing. Thus, there is a need of analytical procedures able to not only monitor AA content in agricultural and food products, but also in body liquids and tissues (Ogiri et al. 2002). Authors also paid their attention at detection of AA in blood serum (Prasad et al. 2008; Karlsen et al. 2007; Yao et al. 2007; Koide et al. 2006).

Numerous analytical techniques have been reported in the literature for the determination of vitamin C in different matrices. These include titrimetric (Kleszczewska 2000), fluorometric (Meister 1994), complexometric methods (Englard and Seifter 1986), liquid chromatography (Levine 1999), high-performance liquid chromatography (Gomez-Romero 2007), spectrophotometric (Ogiri et al. 2002; Prasad et al. 2008), amperometric (Karlsen et al. 2007) and enzymatic (Yao et al. 2007). Most of these methods overestimate the levels of vitamin C in different matrices due to the presence of oxidizable species other than vitamin C. The drawbacks in these methods have been reviewed previously (Koide et al. 2006). The vitamin C levels in some tropical food samples have been reported by several investigators. The methods commonly employed in these determinations were titrimetric (Cofan and Radovan 2008; Wang et al. 2008; Yogeswaran and Chen 2008) or spectrophotometric (Chen and Fang 2007). Although titrimetric methods are simple to use in the determination of vitamin C, difficulties are encountered with commonly used titrants and interferences often occur with coloured samples. Direct spectrophotometric determination of ascorbic acid in the UV region is prone to matrix effect since many organic compounds in complex samples may also exhibit ultraviolet absorbance. Thus there is a need to adopt a procedure that will accurately determine the levels of vitamin C in tropical food samples. Electrochemical methods can be useful in the determination of vitamin C levels in foods because ascorbic acid is easily oxidized to dehydroascorbic acid. Electrochemical methods traditionally have found important applications in sample analysis and in organic and inorganic synthesis. The electrode surface employed in such determinations can be a powerful tool in such applications (Shaidarova et al. 2006).

Electrochemical detection is an attractive alternative method for detection of electroactive species, because of its inherent advantages of simplicity, ease of miniaturization, high sensitivity and relatively low cost. Electrochemical detection typically worked in amperometric or coulometric mode can be coupled with liquid chromatography to provide high

sensitivity to electroactive species. The more sensitive technique is further applied on analysis of real samples (pharmaceutical preparation, oranges and apples fruits, and human blood serum). In this investigation we report on the use of cyclic voltammetry in the determination of ascorbic acid levels of fifty tropical fruit samples. This method is fast, sensitive, selective and gives linear response at low concentration range.

## **Experiment**

### ***Preparation of solutions***

All solutions were prepared by dissolving their analytical grade reagent (Merck) in deionised distilled water.  $\text{KNO}_3$  was used as the supporting electrolyte. Nitrogen was used to deaerate the solutions and to keep an inert atmosphere over the reaction solution during the oxidation process. Ascorbic acid solutions were prepared by dilution of absolute ascorbic acid (BDH laboratory supplies) with deionised distilled water.  $15 \text{ cm}^3$  each of the standard ascorbic acid solutions prepared in  $1.0 \text{ M KNO}_3$  was transferred to the electrochemical cell and purged with nitrogen for 10 minutes. The potential of each solution was scanned between  $0 \text{ mV}$  and  $1200 \text{ mV}$  using a scan rate of  $100 \text{ mV/s}$  to obtain the cyclic voltammogram. All measurements were carried out at room temperature. The anodic peak currents for the electrochemical oxidation of ascorbic acid were recorded at  $880 \text{ mV}$ . Calibration curves were prepared from plots of the anodic peak currents against ascorbic acid concentrations with addition method. For real sample measurements, the juice from each juicy fruit was squeezed out and filtered with glass wool. Suitable aliquots ( $1\text{-}2 \text{ cm}^3$ ) were immediately added to the  $1.0 \text{ M KNO}_3$  in the cell to make a final volume of  $15 \text{ cm}^3$ . The potential of the solution was scanned as described for the standard ascorbic acid solutions. For the non-juicy fruits, a weighed amount ( $5\text{-}6 \text{ g}$ ) of the edible portion of the fruit was minced and blended with  $1.0 \text{ M KNO}_3$  for approximately one minute. The homogenized sample was then filtered through a glass wool.  $15 \text{ cm}^3$  of this solution was transferred to the electrochemical cell, purged with nitrogen for 10 minutes before scanning the potential between  $0 \text{ mV}$  and  $1200 \text{ mV}$ . The results of the anodic peak current obtained at  $880 \text{ mV}$  were used to extrapolate the concentration of the ascorbic acid in the sample. For the voltammetric studies,  $5 \text{ mM}$  ascorbic acid stock solution was prepared by dissolving  $0.088 \text{ g}$  of ascorbic acid in  $100 \text{ cm}^3$  of  $1.0 \text{ M KNO}_3$ .

### ***Preparation of a gold electrode***

Solid metal foil ( $99.98\%$  purity, Aldrich Chemical Company) was used to prepare solid electrode. A  $0.5 \text{ mm}$  thick gold foil was cut into approximately  $1 \text{ cm} \times 1 \text{ cm}$  piece and connected to silver wire with silver conducting paint prior covered with epoxy gum.



**Experimental procedure**

Universal Pulsa Dynamic EIS, Voltammetry, Voltalab potentiostat (Model PGZ 402) was used for electrochemical stability measurements, data acquisition was accomplished using the Voltmaster 4 software. Cyclic voltammetry experiments were performed in a three electrodes system using solid electrode Au as a working electrode (anode), SCE as reference electrode and platinum wire as the counter electrode. All potentials given are with respect to the SCE reference electrode.

**Result and discussion****Cyclic voltammetry**

The voltammograms of the 0.05 M ascorbic acid in 1.0 M  $\text{KNO}_3$  are shown as in figure 1 and 2 with different scan rate. Figure 3 shown voltammogram 1.0 M  $\text{KNO}_3$  (without ascorbic acid), no anodic peak current was observed in the voltammogram. At figure 1 and 2, no cathodic peak current was found indicating an irreversible heterogenous charge transfer in this system. At figure 5, these results show that ascorbic acid concentration can be measured quantitatively by cyclic voltammetry. The anodic peak currents at 880 mV were found to vary linearly with ascorbic acid concentration. The voltammogram for the determination of ascorbic acid content of orange is shown in figure 5. The anodic peak current was found to increase with the addition of ascorbic acid thus confirming that the current obtained for the juice sample alone was that of ascorbic acid.

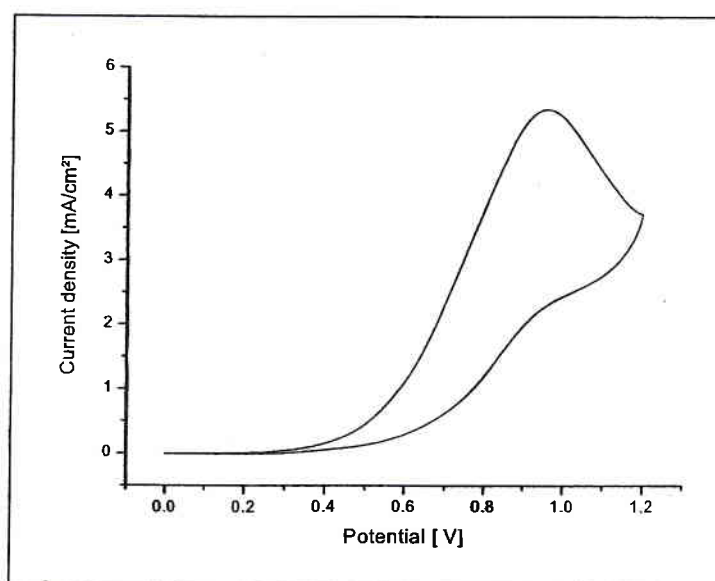


Figure 1. Cyclic voltammograms for Au solid electrode in 1.0 M  $\text{KNO}_3$  + 0.05 M ascorbic acid.

Anodic sweep from 0 mV to +1200 mV (vs. SCE). Scan rate  $50 \text{ mVs}^{-1}$

The oxidation peak for the oxidation of ascorbic acid to dehydroascorbic acid were represents by anodic peak in Figure 1. Based on the cyclic voltammety, the reaction mechanism for the oxidation processes occurred on the Au based electrode surface were as follows:

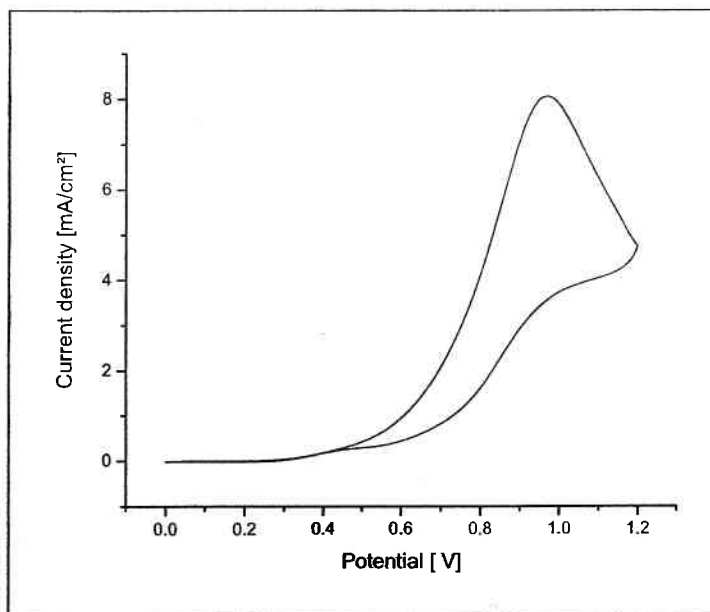
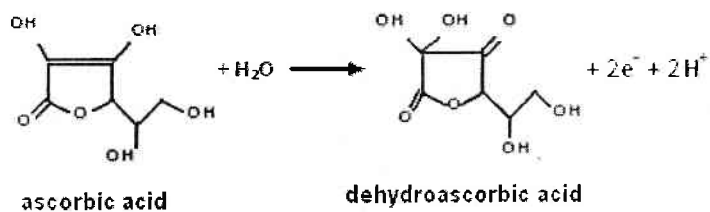


Figure 2. Cyclic voltammograms for Au solid electrode in 1.0 M KNO<sub>3</sub> + 0.05 M ascorbic acid. Anodic sweep from 0 mV to +1200 mV (vs. SCE). Scan rate 100 mVs<sup>-1</sup>

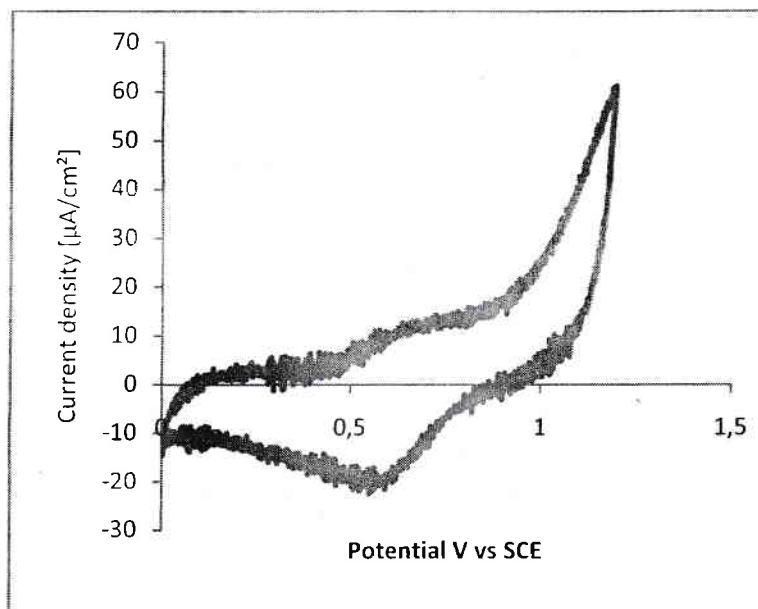


Figure 3. Cyclic voltammograms for Au solid electrode in 1.0 M  $\text{KNO}_3$  (without ascorbic acid). Anodic sweep from 0 mV to +1200 mV (vs. SCE). Scan rate  $100 \text{ mVs}^{-1}$

Figure 3 shows the cyclic voltammogram using the Au electrode in 1.0 M  $\text{KNO}_3$  (without ascorbic acid). When 0.05 M ascorbic acid was added (Figure 1 and 2), a new peak was observed, which represents the electrochemical oxidation of ascorbic acid peak ( $E_p$  anodic). Cyclic voltammogram of the electrochemical oxidation of ascorbic acid was found to be a irreversible process. The cyclic voltammogram obtained in Figure 1 and 2 shows that Au electrode is very stable in sampel solution.

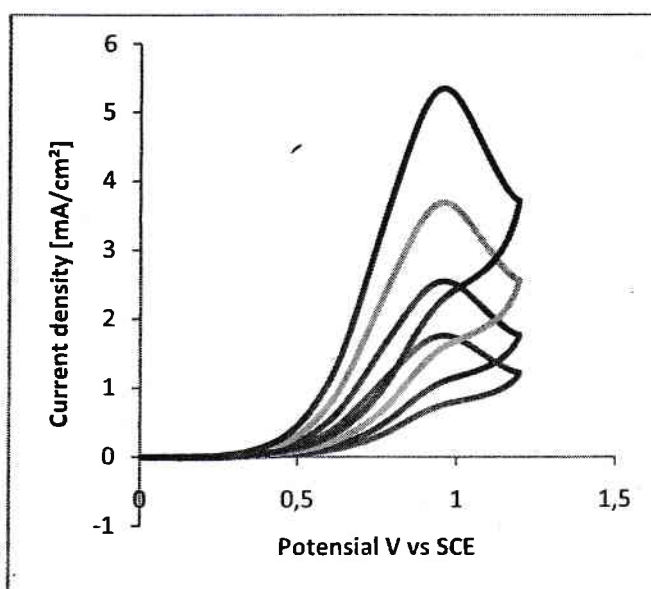


Figure 4. Cyclic voltammograms for Au solid electrode in 1.0 M  $\text{KNO}_3$  + 0.05 M ascorbic acid. Anodic sweep from 0 mV to +1200 mV (vs. SCE). Scan rate 50, 100, 150 and  $200 \text{ mVs}^{-1}$

One of the ways to clarify the oxidation area can be done by changing the scan rate. The peak current densities increased remarkably with increasing scan rates, but the ratio of the anodic to cathodic peak current ( $I_a/I_c$ ) lies above unity (Figure 4).

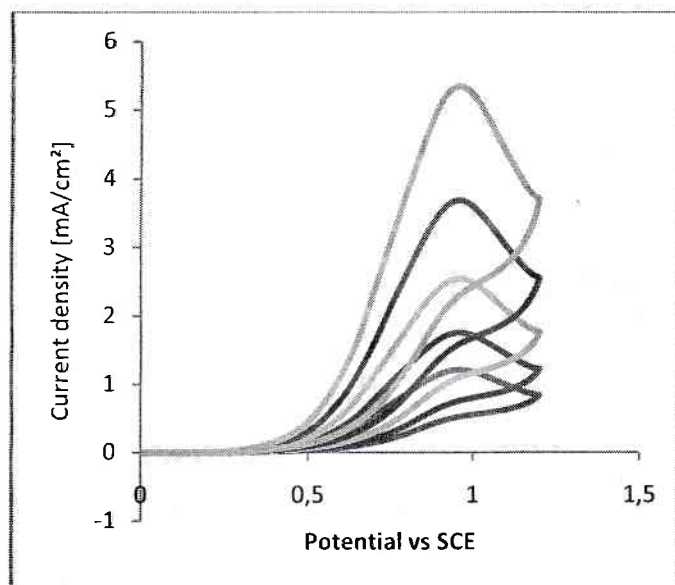


Figure 5. Cyclic voltammograms for Au solid electrode in 1.0 M  $\text{KNO}_3$  + 0.05 M ascorbic acid. Anodic sweep from 0 mV to +1200 mV (vs. SCE). Scan rate  $100 \text{ mVs}^{-1}$

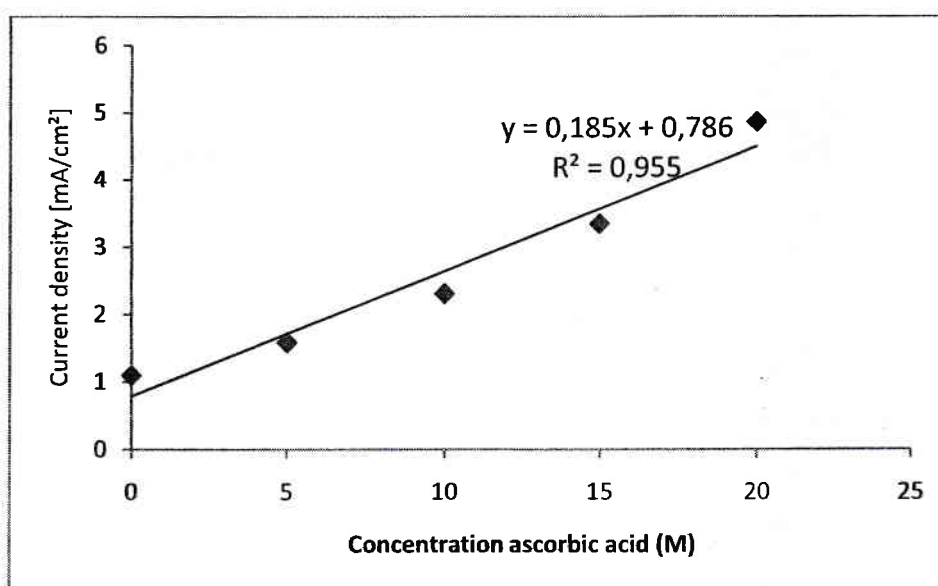


Figure 6. Application of the standard addition method for determination of ascorbic acid in orange using Au electrode at 0.88 V

Figure 6 shows the calibration curve for the concentration of ascorbic acid in orange with current density for Au electrode. From the calibration curve obtained using Au electrode, the



correlation coefficient ( $r$ ) recorded was 0.955. For the purpose of analysis, the slope and limit of detection were also determined, where the sensitivity of the technique is correctly defined as the slope of the calibration curve. The slope for the calibration curve using Au electrode was 0.185 (Table 1). From this single parameter, it could be concluded that Au electrode was for the analysis of ascorbic acid using CV method. Limit of detection for Au electrodes were approximately about 1.2 mg/100g.

Table 1. Analytical parameters of *ascorbic acid* using cyclic voltammetry method

Parameters	Au electrode at 0.88 V
Peak potential ( $E_p$ anodic)	0.88 V
Equation regression linear	$y=0.185x+0.786$
Slope	0.185
Intercept	0.786
Coefficient of determination ( $R^2$ )	0.955
Limit of detection	1.2 mg/100g

Table 2. The results of the determination of ascorbic acid contents of fruits by the voltammetric method

Samples	Concentration ascorbic acid (mg/100g)
Orange	61.56
Apple	42.51
Mango	51.23
Pine apple	53.33
Guava	50.44

The anodic peak currents for the electrochemical oxidation of ascorbic acid to dehydroascorbic acid were recorded at 880 mV. The results of the determination of ascorbic acid contents of tropical fruits by the voltammetric method are shown in Table 2. Fruits found to have high levels of ascorbic acid include orange 61.56 mg/100g, apple 42.51 mg/100g, mango 51.23 mg/100g, pine apple 53.33 mg/100g, and guava 50.44 mg/100g. The results obtained in this study show that cyclic voltammetry can be successfully used as part of quality management in food industry, for assessing the vitamin C content in natural fruit juice and soft drinks.

## Conclusions

Au electrode was found to be a good working electrode (anode) for the analysis of ascorbic acid using CV method. Based on the calibration curve obtained (current density vs. concentration), Au electrode was found very sensitive for analysis of ascorbic acid using CV

method. Cyclic voltammetry can be successfully used as part of quality management in food industry, for assessing the ascorbic acid content in natural fruit juice and soft drinks

### References

- Chen, J. and Fang, Y.J., 2007, Flow injection technique for biochemical analysis with chemiluminescence detection in acidic media. *Sensors*, 7, 448-458.
- Cofan, C. and Radovan, C., 2008, Simultaneous chronoamperometric sensing of ascorbic acid and acetaminophen at a boron-doped diamond electrode. *Sensors*, 8, 3952-3969.
- Davey, M.W., Van Montagu, M., Inze, D., Sanmartin, M., Kanellis, A., Smirnoff, N., Benzie, I.J.J., Strain, J.J., Favell, D. and Fletcher, J. 2000, Plant L-ascorbic acid: chemistry, function, metabolism, bioavailability and effects of processing. *J. Sci. Food Agric.*, 80, 825-860.
- Deicher, R. and Horl, W.H., 2003, Vitamin C in chronic kidney disease and hemodialysis patients. *Kidney Blood Pressure Res.*, 26, 100-106.
- Englard, S. and Seifter, S., 1986, The Biochemical Functions of Ascorbic-Acid. *Annu. Rev. Nutr.* 6, 365-406.
- Gomez-Romero, M., Arraez-Roman, D., Segura-Carretero, A. and Fernandez-Gutierrez, A., 2007, Analytical determination of antioxidants in tomato: Typical components of the Mediterranean diet. *J. Sep. Sci.*, 30, 452-461.
- Karlsen, A., Blomhoff, R. and Gundersen, T.E., 2007, Stability of whole blood and plasma ascorbic acid. *Eur. J. Clin. Nutr.*, 61, 1233-1236.
- Kleszczewska, E., 2000, L-Ascorbic acid-clinical use, toxicity, properties, methods of determination and application in chemical analysis. *Pharmazie*, 55, 640-644.
- Koide, K., Zhang, X.M., Ohishi, K., Usami, Y., Hotta, Y. and Hiramitsu, T., 2006, Ascorbic acid concentration in rabbit vitreous measured by microdialysis with HPLC-electrochemical detection before and after vitreous surgery. *Exp. Eye Res.*, 82, 868-873.
- Levine, M., Rumsey, S.C., Daruwala, R., Park, J.B. and Wang, Y.H., 1999, Criteria and recommendations for vitamin C intake. *JAMA-J. Am. Med. Assoc.*, 281, 1415-1423.
- Meister, A., 1994, Glutathione Ascorbic-Acid Antioxidant System in Animals. *J. Biol. Chem.*, 269, 9397-9400.
- Ogiri, Y., Sun, F., Hayami, S., Fujimura, A., Yamamoto, K., Yaita, M. and Kojo, S., 2002, Very low vitamin C activity of orally administered L-dehydroascorbic acid. *J. Agric. Food Chem.*, 50, 227-229.

- Prasad, B.B., Tiwari, K., Singh, M., Sharma, P.S., Patel, A.K. and Srivastava, S., 2008, Molecularly imprinted polymer-based solid-phase microextraction fiber coupled with molecularly imprinted polymer-based sensor for ultratrace analysis of ascorbic acid. *J. Chromatogr. A*, *1198*, 59-66.
- Shaidarova, L.G., Gedmina, A.V., Chelnokova, I.A. and Budnikov, G.K., 2006, Electrocatalytic oxidation and flow-injection determination of ascorbic acid at a graphite electrode modified with a polyaniline film containing electrodeposited palladium. *J. Anal. Chem.*, *61*, 601-608.
- Wang, Y., Xu, H. Zhang, J.M. and Li, G., 2008, Electrochemical sensors for clinic analysis. *Sensors*, *8*, 2043-2081.
- Yao, X., Wang, Y.T., and Chen, G., 2007, Simultaneous determination of am aminothiols, ascorbic acid and uric acid in biological samples by capillary electrophoresis with electrochemical detection. *Biomed. Chromatogr.*, *21*, 520-526.
- Yogeswaran, U. and Chen, S.M., 2008, A review on the electrochemical sensors and biosensors composed of nanowires as sensing material. *Sensors*, *8*, 290-313.