**BORANG PENGESAHAN STATUS TESIS**

**JUDUL:** Chemistry Of Breathalyzer : Analysis Of Ethanol Via Redox Reaction

**Ijazat:** The Degree Of The Bachelor of Science With Honours (Industrial Chemi)

**SESI PENGAJIAN:** 2004/2005

**Saya:** LAI YUEN LU

(HURUF BESAR)

mengakui membenarkan tesis (LBS/Sarjana/Doktor Falsafah) ini disimpan di Perpustakaan Universiti Malaysia Sabah dengan syarat-syarat kegunaan seperti berikut:

1. Tesis adalah hakmilik Universiti Malaysia Sabah.
2. Perpustakaan Universiti Malaysia Sabah dibenarkan membuat salinan untuk tujuan pengajian sabaja.
3. Perpustakaan dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan ( / )

   [ ] SULIT
   [ ] TERHAD
   [ ] TIDAK TERHAD

(Mengandungi maklumat yang berdaulat keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)

(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)

Disahkan oleh

(TANDATANGAN PUSTAKAWAN)

Alamat Tetap: P.O.Box 2383, 90727 Sandakan, Sabah.

Tarikh: 11 April 2007

**CATATAN:**

* Potong yang tidak berkenaan.
** Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu dikedakan sebagai SULIT dan TERHAD.
@ Tesis dimaksudkan sebagai tesis bagi Ijazah Doktor Falsafah dan Sarjana secara penyelidikan, atau disortasi bagi pengajian secara kerja kursus dan penyelidikan, atau Laporan Projek Sarjana Muda (LPSM).
CHEMISTRY OF BREATHTALYZER: ANALYSIS OF ETHANOL VIA REDOX REACTION

LAI YUEN LU

PERPUSTAKAAN
UNIVERSITI MALAYSIA SABAH

DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF BACHELOR OF SCIENCE WITH HONOURS

INDUSTRIAL CHEMISTRY PROGRAMME
SCHOOL OF SCIENCE AND TECHNOLOGY
UNIVERSITI MALAYSIA SABAH

APRIL, 2007
DECLARATION

I hereby declare that this dissertation is based on my original work, except for quotations and summaries each of which have been fully acknowledged.

[Signature]

LAI YUEN LU
HS2004-3472

APRIL, 2007
CERTIFIED BY

1. SUPERVISOR
   (Prof. Madya Dr. Marcus Jopony)

2. EXAMINER 1
   (Dr. Noumie Surugau)

3. EXAMINER 2
   (Dr. Md. Lutfur Rahman)

4. DEAN
   (SUPT/KS Prof. Madya Dr. Shariff A.K Omang)

Signature

[Signatures]
ACKNOWLEDGMENTS

I have done this dissertation. I would like to express my deep appreciation to my supervisor, Professor Madya Dr. Marcus Jopony for his guidance, advise, encouragement and patient throughout the period of this project.

Big thanks also to Industrial Chemistry Laboratory assistants Mr. Sani Gorudin, Mr. Samudi and Mrs. Zainab for teaching, helpful for providing chemicals and lending glassware.

I also want to thank my family for their patience, encouragement and support during the period of studying at University Malaysia Sabah. I am especially grateful for the support of my brother, Lai Yeong Jee; a student of University Tunku Abdul Rahman to accompany me visited the libraries around the Kuala Lumpur.

Lastly, I wish to thank to my friends for their many helping and support, and also anyone who involve in this project.
The ethanol content of aqueous solutions and four beverage samples (Anglia Shandy, Jolly Shandy, Anchor beer and Sherry) were determined by back titration method and colorimetric method. Both methods are based on redox reaction between ethanol and acid dichromate. The analytical results showed that the ethanol contents of the aqueous solutions according back titration method was 0.14, 0.22, 0.33, 0.42 and 0.53% v/v, respectively, while for the beverages samples (Anglia Shandy, Jolly Shandy, Anchor beer and Sherry) was 6.6, 6.6, 5.0 and 31.0% v/v, respectively. Meanwhile, according to the colorimetric method, the ethanol content of aqueous solutions was 0.13, 0.22, 0.33, 0.56 and 0.62% v/v, respectively and beverages samples was 6.4, 6.4, 6.5 and 29.0% v/v, respectively. The concentrations obtained for the aqueous solution were relatively close to the actual values. By contrast, the concentrations obtained for the beverage samples were higher compared to the actual values.
PENENTUAN ETANOL DENGAN TINDAK BALAS REDOKS

ABSTRAK

Kandungan etanol dalam larutan akues etanol dan dalam sampel minuman beralkohol (Anglia Shandy, Jolly Shandy, Anchor beer dan Sherry) telah ditentukan melalui kaedah tritratan berbalik dan kaedah metriwarna. Kedua-dua kaedah adalah berdasarkan tindak balas redoks antara etanol dengan asid dikromat. Bagi kaedah titratan berbalik, keputusan analisis menunjukkan bahawa kandungan etanol dalam larutan akues ialah 0.14, 0.22, 0.33, 0.42 dan 0.53% v/v, dan dalam sampel minuman beralkohol masing-masing ialah 6.6, 6.6, 5.0 dan 31.0% v/v. Bagi kaedah metriwarna pula, kandungan etanol dalam larutan akues ialah 0.13, 0.22, 0.33, 0.56 dan 0.62% v/v, dan dalam sampel minuman beralkohol masing-masing ialah 6.4, 6.4, 6.5 dan 29.0% v/v. Kepekatan yang diperolehi bagi larutan akues adalah menghampiri nilai sebenar dalam sampel. Sebaliknya, kepekatan yang diperolehi bagi sampel minuman beralkohol adalah lebih tinggi daripada nilai sebenar itu.
# CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>DECLARATION</td>
<td>ii</td>
</tr>
<tr>
<td>VERIFICATION</td>
<td>iii</td>
</tr>
<tr>
<td>ACKNOWLEDGE</td>
<td>iv</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>v</td>
</tr>
<tr>
<td>ABSTRAK</td>
<td>vi</td>
</tr>
<tr>
<td>TABLE OF CONTENTS</td>
<td>vii</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>x</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>xi</td>
</tr>
<tr>
<td>CHAPTER 1  INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>1.1 Alcohol (Ethanol) and its Negatives Influences</td>
<td>1</td>
</tr>
<tr>
<td>1.2 Objectives of Study</td>
<td>5</td>
</tr>
<tr>
<td>1.3 Scope of Study</td>
<td>5</td>
</tr>
<tr>
<td>CHAPTER 2  LITERATURE REVIEW</td>
<td>6</td>
</tr>
<tr>
<td>2.1 Alcoholic Beverages</td>
<td>6</td>
</tr>
<tr>
<td>2.1.1 Alcohol content</td>
<td>6</td>
</tr>
<tr>
<td>2.1.2 Types of alcoholic beverages</td>
<td>9</td>
</tr>
<tr>
<td>2.1.2.1 Beer</td>
<td>9</td>
</tr>
<tr>
<td>2.1.2.2 Wines and Spirits</td>
<td>9</td>
</tr>
<tr>
<td>2.2 Ethanol in Body Fluids</td>
<td>10</td>
</tr>
<tr>
<td>2.3 Ethanol in the Human Body</td>
<td>11</td>
</tr>
<tr>
<td>2.4 Analytical Methods for Determination of Ethanol in Body Fluids/</td>
<td>13</td>
</tr>
<tr>
<td>Alcohol Beverages</td>
<td></td>
</tr>
</tbody>
</table>
2.4.1 Chemical Methods

2.4.1.1 Back titration method

2.4.1.2 Colorimetric method

2.4.2 Enzymatic Method

2.4.3 Gas Chromatography

2.4.4 Infrared Spectroscopy

2.5 Breathalyzer

2.5.1 History of Breathalyzer

2.5.2 Basic concepts of ethanol measurement by Breathalyzer

2.5.3 Chemistry of Breathalyzer

CHAPTER 3 METHODOLOGY

3.1 Ethanol-containing Samples

3.1.1 Aqueous Ethanol Solutions

3.1.2 Alcoholic Beverage Samples

3.2 Back Titration Method

3.2.1 Preparation of solutions

3.2.2 Determination of Ethanol in Samples

3.2.3 Calculation of Ethanol Concentration

3.3 Colorimetric Methods

3.3.1 Preparation of Acid Dichromate Solutions (0.01 M)

3.3.2 Reaction between Acid Dichromate and Ethanol

3.3.3 Preparation of Standard Curve for Acid Dichromate

3.3.3.1 Preparation of standard acid dichromate solutions

3.3.3.2 Determination of the Absorbance of Standard Acid Dichromate Solutions
3.3.4 Determination of the Absorbance of Aqueous Samples and Beverage Samples
3.3.5 Calculations of Ethanol Concentration

CHAPTER 4 RESULTS AND DISCUSSION

4.1 Back Titration Method
4.1.1 Concentration of the Sodium Thiosulfate
4.1.2 Redox Titration
4.1.3 Concentration of ethanol in aqueous solutions and beverage samples

4.2 Colorimetric Method
4.2.1 Colour Changes
4.2.2 Standard Curve of acid dichromate
4.2.3 Effect of the volume of samples on ethanol analysis
4.2.4 Concentration of ethanol in aqueous solutions and beverage samples

4.3 Comparison between Back Titration Method and Colorimetric Method for the Determination of Aqueous Ethanol Samples
4.4 Comparison between Back Titration Method and Colorimetric Method for the Determination of Beverage Samples

CHAPTER 5 CONCLUSION
REFERENCES
APPENDIX A
APPENDIX B
APPENDIX C
LIST OF TABLES

Table 2.1  Major kinds of Alcoholic Beverages and their alcohol content .......................... 8
Table 2.2  Blood ethanol concentrations and clinical signs/ symptoms .............................. 13
Table 2.3  Analytical methods used to determine ethanol in body fluids/ alcoholic beverages ............................................. 14
Table 2.4  The visible spectrum .............................................................................................. 17
Table 3.1  Experimental design for determination of ethanol in aqueous ethanol samples .......... 28
Table 3.2  Dilution of alcoholic beverage samples for back titration ....................................... 29
Table 3.3  The different volume of 0.1% v/v ethanol sample in each of the beaker ................. 32
Table 3.4  Different volume of ethanol sample in beaker E1-E5 ............................................. 33
Table 3.5  Different volume of ethanol sample in beaker S1-S4 ............................................. 34
Table 3.6  Dilution of alcoholic beverage samples for colorimetric method ......................... 34
Table 4.1  Absorbance readings of acid dichromate-ethanol mixtures at different volume of ethanol sample ..................................................................................................................... 44
## LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1.1</td>
<td>Alcohawk ABI Digital Breathalyzer</td>
<td>4</td>
</tr>
<tr>
<td>Figure 1.2</td>
<td>A roadside breath screening test being administered</td>
<td>4</td>
</tr>
<tr>
<td>Figure 4.1</td>
<td>Colour changes during the back titration</td>
<td>37</td>
</tr>
<tr>
<td>Figure 4.2</td>
<td>Ethanol content of aqueous samples</td>
<td>39</td>
</tr>
<tr>
<td>Figure 4.3</td>
<td>Ethanol content of beverage samples</td>
<td>39</td>
</tr>
<tr>
<td>Figure 4.4</td>
<td>Variation in colour of acid dichromate-ethanol solution mixtures at low initial amount of ethanol</td>
<td>41</td>
</tr>
<tr>
<td>Figure 4.5</td>
<td>The reduction of colour intensity acid dichromate by ethanol in beakers 6-10</td>
<td>41</td>
</tr>
<tr>
<td>Figure 4.6</td>
<td>UV-VIS Spectra of acid dichromate-ethanol solution mixtures</td>
<td>42</td>
</tr>
<tr>
<td>Figure 4.7</td>
<td>A plot of absorbance versus the molarity of acid dichromate Solutions</td>
<td>43</td>
</tr>
<tr>
<td>Figure 4.8</td>
<td>Ethanol content of aqueous samples (colorimetric method)</td>
<td>45</td>
</tr>
<tr>
<td>Figure 4.9</td>
<td>Ethanol content of beverage samples (colorimetric method)</td>
<td>46</td>
</tr>
<tr>
<td>Figure 5.1</td>
<td>The actual and experimented ethanol content (% v/v) in aqueous samples</td>
<td>47</td>
</tr>
<tr>
<td>Figure 5.2</td>
<td>The actual and experimented ethanol content (% v/v) in beverage samples</td>
<td>48</td>
</tr>
</tbody>
</table>
CHAPTER 1

INTRODUCTION

1.1 Alcohol (Ethanol) and its Negative Influences

To most of people, alcohol refers to the intoxicating ingredient in beer, wine and spirits. But to a chemist, alcohol refers to a class of organic compounds containing hydroxyl (OH) groups. The chemist’s name for this particular alcohol is ethanol or ethyl alcohol (CH$_3$CH$_2$OH) (Rolfes et al., 1998). The molecular structure of ethanol can be represented as follows:

\[
\begin{align*}
\text{H} & \text{H} \\
\text{H$_3$C} & \text{C} & \text{OH} \\
\text{H} &
\end{align*}
\]

Since ancient times, alcoholic beverages having been known to the Pharaohs of ancient Egypt and has been produced by fermentation. The name ‘alcohol’ was derived from the Arabic words ‘al’ and ‘kohl’ (Criddle, 1995). Ethanol has been known to humans in the form of alcoholic drinks for many thousand of years. Fermentation of the sugar in the fruit will soon commence when ripe fruits are harvested, producing ethanol and other compounds. Fermentation involves yeasts, which occur naturally on the skins.
of many ripening fruits. It is quite probable that early humans, as hunters and gatherers, ate the partially fermented fruits to consume alcohol (Ratcliff, 2000). So that, a short step to get alcoholic liquor, is to allow fruit (or partially germinated grain) to ferment in a container. Such liquors would have a wide range of compounds present. It would probably have given people who drinking them very sore head.

Ethanol is by far the most important of the alcohols. It has been described as one of the most versatile of compounds. It widely used as a germicide, a solvent, an antifreeze, a beverage, a fuel and most importantly used as an intermediate for synthesis and production of other organic compounds (Criddle, 1995).

Ethanol is a clear, colourless liquid. Its physical properties are derived mainly from the presence of hydroxyl group (OH). Infrared (IR) studies indicate that ethanol exists in the liquid state mainly in a dimeric form. Some of physical properties of ethanol are important in the analytical chemistry of ethanol. The hydroxyl group is an important component in the structure of ethanol because the chemical properties of ethanol are derived essentially from this group. From analytical viewpoint, the most important property is the relative ease by which the molecule can be oxidized to give acetaldehyde (etbanal) and, in some cases, acetic acid (ethanoic acid) (Criddle, 1995).

Alcohol (ethanol) consumption can cause death, both directly and indirectly. Drinking too much too soon alcohol can cause death directly (Kaye, 1974). Ethanol is sufficient to cause death in its own right. Alcohol intoxication can lead to loss of alertness, stupor, coma and death. Alcohol intoxication in pregnant women can result in birth defects (Schroeder, 1984).
Alcohol is responsible for most accidental deaths, especially automobile fatalities. Many road accidents caused by drivers who operate cars under the influence of alcohol. Traffic accidents associated with alcohol consumption are a serious social problem. More than one million driver's licenses per year have been revoked worldwide because of inebriation. About 50,000 fatal auto accidents occur in the United States each year, of which more than half involve drivers who had recently been drinking alcohol (Kaye, 1980). In the European Union, annual fatalities associated with alcohol consumption involve more than 15,000 people (Moriya, 2005). About 8000 to 9000 people in Japan are involved in fatal traffic accidents annually and almost 15 percent of them were victims of drunken driving (Moriya, 2005).

To decrease accidental deaths, a simple screening test using breathalyzer has been developed (Figure 1.1). The device is used by the police to calculate a suspect's breath-alcohol level (Criddle, 1995). This measurement of alcohol (ethanol) by the device is based on oxidation-reduction reaction (Criddle, 1995). In general, the suspect is advised to blow to the device (Figure 1.2), which contains some sort of science. The resultant reactions change the color of solution from yellow to green if the suspect is too drunk to drive.
Figure 1.1 Alcohawk ABI Digital Breathalyzer.

(Source: http://www.breathalyzer.com)

Figure 1.2 A roadside breath screening test being administered.

(Source: http://www.bookrags.com/)

---

**Figure 1.1** Alcohawk ABI Digital Breathalyzer.

(Source: http://www.breathalyzer.com)

**Figure 1.2** A roadside breath screening test being administered.

(Source: http://www.bookrags.com/)
1.2 Objectives of Study

The objectives of this study are:

a) To determine the concentration of ethanol using back titration method.

b) To determine the concentration of ethanol using spectrophotometric method.

c) To compare the results of these two methods.

1.3 Scope of Study

In this study, the concentration of alcohol (ethanol) will be determined using two different methods. Both methods, however, are based on redox reaction between ethanol and acid dichromate. The test samples to be investigated are aqueous ethanol solutions and alcoholic beverages.
2.1 Alcoholic Beverages

Beer, wine, China rice wine, and distilled spirits are examples of alcoholic beverages that are produced on an industrial scale. Examples of distilled spirits include brandy, whisky, rum, gin, cognac, vodka, tequila, pisco, and China distilled spirit (Cacho and Lopez, 2005). The manufacture of all beverages depends on the fermentation, but distilled spirits require further distillation. The kind of beverage resulting from fermentation depends on what sugar-containing substance is used. When grains are used, fermentation produces beer, while when grapes are used, the product is wine (Connors et al., 2004).

2.1.1 Alcohol content

Alcoholic beverages contain varying amounts of alcohol (ethanol). In the United States, the alcohol percentage is denoted by volume. This calculation is straightforward: 16 ounce of a beverage that is 50% ethanol contains 8 ounces of alcohol. In Britain, alcohol content is expressed by weight (sometimes abbreviated w/w for weight for weight) (Connors et al., 2004).
The alcohol content of a beverage is also designated by proof. Proof is used primarily for distilled spirits and equals to twice the percentage of ethanol by volume. Accordingly, a beverage that is 43% alcohol by volume is 86 proofs. This somewhat indirect way of expressing alcohol content comes from 17th-century England, where it was determined that a mixture that was 57% alcohol by volume, if poured over gunpowder, would cause its ignition in an open flame. The English still refer to their beverages as “over proof” (more than 57% alcohol by volume) or “under proof” (less than 57% alcohol by volume) (Becker et al., 1975).

During the fermentation, the percentage of ethanol can be as high as 10 to 15%. Thus, fermented beverages like wine and beer do not have alcohol content higher than 15% (Connors et al., 2004). The percentage of alcohol in a beverage can be increased by distillation. Distillation is a procedure in which a solution containing alcohol is boiled (Connors et al., 2004). Alcohol has a lower boiling point than water (Goldberg, 2003). Therefore, during the heating process, alcohol will separate from the solution in the form of steam. The vapour then is condensed through cooling. Finally, the resulting liquid has higher alcohol content than the original fermented mixture. By repeating this cycle, it is possible to raise the alcohol content in the beverage to progressively higher levels (Connors et al., 2004).

Table 2.1 summarizes the major types of alcoholic beverages commercially available. Varying the substances that form the base of the beverage and varying the alcohol concentration produce different alcoholic beverages.
Table 2.1 Major kinds of Alcoholic Beverages and their alcohol content.

<table>
<thead>
<tr>
<th>Beverage</th>
<th>Production</th>
<th>% Alcohol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beer (includes lager, ale, malt, stout)</td>
<td>Fermentation of carbohydrate: Extracted from barley malt (or rice or corn) by cooling with hops, cooled, and fermented. Types of beer vary in malt, hops and alcohol content.</td>
<td>Lager 3-6, Other 4-8</td>
</tr>
<tr>
<td>Wine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red (table wine)</td>
<td>Fermentation of red grapes in skins</td>
<td>Average 12</td>
</tr>
<tr>
<td>White (table wine)</td>
<td>Fermentation of skinless grapes</td>
<td></td>
</tr>
<tr>
<td>Champagne</td>
<td>Same as white wine, with carbon dioxide</td>
<td></td>
</tr>
<tr>
<td>Fortified (dessert) wines</td>
<td>Ordinary table wines with alcohol content raised</td>
<td>Up to 20</td>
</tr>
<tr>
<td>Distilled spirits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brandy</td>
<td>Distilled from any sugar-containing fruit. Probably first to be produced commercially.</td>
<td>About 40</td>
</tr>
<tr>
<td>Whiskey</td>
<td>Grains brewed with water to form a beer of 5%-10% alcohol. Beer is distilled and aged in new or used charred oak barrels for two to eight years before blending.</td>
<td>40-50</td>
</tr>
<tr>
<td>Bourbon</td>
<td>Corn with rye and malted barley</td>
<td></td>
</tr>
<tr>
<td>Scotch</td>
<td>Malted barley and corn</td>
<td></td>
</tr>
<tr>
<td>Irish whiskey</td>
<td>Corn and malted and malted barley</td>
<td></td>
</tr>
<tr>
<td>Rye whisky</td>
<td>Rye and malted barley</td>
<td></td>
</tr>
<tr>
<td>Other spirits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rum</td>
<td>Distilled from fermented molasses; aged about three years</td>
<td>40-75</td>
</tr>
<tr>
<td>Gin</td>
<td>Distilled from fermentable carbohydrate (barley, potato, corn, wheat, rye); flavoured by second distillation with juniper berries</td>
<td>35-50</td>
</tr>
<tr>
<td>Vodka</td>
<td>Distilled from potato or almost any other carbohydrate source; kept free of flavours</td>
<td>35-50</td>
</tr>
</tbody>
</table>

(Source: Becker et al., 1975)
2.1.2 Types of alcoholic beverages

2.1.2.1 Beer

Beer is a low potency alcoholic beverage made by fermenting grains and then extracting the liquid from the mash. Beer involves a relatively short (incomplete) fermentation process and an equally short aging process (a week or two) resulting in an alcohol content generally between 3-8% (Becker et al., 1975).

Most of beer is initially brewed to an alcoholic strength up to three times the required level. The high gravity beer is diluted with water to give the required strength and this dilution is controlled by ethanol content, which must be monitored regularly during the dilution process (Criddle, 1995). To brew beer, sprouted barley is added to cereal grains like corn, wheat or rye, to change the carbohydrates in the grains into sugar, while yeast changes the sugar into alcohol (Goldberg, 2003).

The level of ethanol in beer (including high-gravity beer) is 2.5-12.0% (v/v). In some other beverages like 'shandy' and 'alcohol-free' types of beer and all soft drinks, the ethanol levels fall in the range 0-1.5% (v/v) (Criddle, 1995).

2.1.2.2 Wines and Spirits

Wine is a relatively low potency alcoholic beverage made by fermenting fruit juices. Fruit juices, particularly those with high sugar content, are suitable to make wine. The alcohol content of wine ranges from 8% to 14% generally. Wines, first introduced in
the early 80s, are about 4% alcohol by volume. Wines are a mixture of wine with various carbonated beverages (Connors et al., 2004).

Fortified wines are produced by adding alcohol to slightly sweetened wines. Sherry and port are the examples of fortified wines, and they have higher alcohol content (Connors et al., 2004). Distilled spirits are high potency alcoholic beverages that are made by fermenting grains or fruit juices and then distilling the resulting liquid to reduce its water content and to concentrate its alcohol (Becker et al., 1975). Distilled spirits also called hard liquor.

European Community (EC) regulations require that the ethanol concentration in wines and spirits should be displayed on bottles labels. The Exercise Duty payable on wine and fortified wine depends on the ethanol concentration range, the range being less than 15% (v/v), 15-18% (v/v), 18-22% (v/v) and more than 22% (v/v). Similarly, rules apply to distilled spirits where the range system applies up to 96% (v/v). Even though, most of spirits contain between 35 and 50% (v/v) (Criddle, 1995).

2.2 Ethanol in Body Fluids

Ethanol has a low molecular weight, is highly soluble in water, and does not bind to plasma proteins. All these properties make it suitable for analysis in body fluids, i.e. blood, urine, saliva and sweat (Bendtsen et al., 1999).

Blood is the best specimen for detecting ethanol because blood is the standard unit which other specimens are usually equated. For example, urine analysis is
converted by an “average conversion factor” to a “supposed” blood concentration and is reported as a “blood”-ethanol concentration (Kaye and Cardona, 1969). The urine-to-blood ethanol concentration ratios averages 1.3 with considerable intra- and inter-individual variation. The urine ethanol test has become the preferred drug of abuse screening test in modern clinical laboratories (Bendtsen et al., 1999).

Actually, urine is also a good specimen for detecting ethanol concentration because it is easy to obtain and handle. Ethanol is stable in urine, but it is preferable to transfer urine to a container which containing sodium fluoride at a final concentration of 1 to 2 percent, and store at 4°C prior to analysis (Moriya, 2005).

Saliva is an alternative specimen for ethanol determination in the human body (Gubala and Zuba, 2002). Saliva is used for on-site ethanol testing using commercially available testing devices. Saliva is absorbed in a pad on the test strip under the tongue until it is saturated. A small volume of saliva needed for the current commercial tests (Moriya, 2005).

2.3 Ethanol in the Human Body

After a person drinks an alcoholic beverage, his or her blood ethanol concentration rises rapidly. Ethanol is absorbed into the blood from all parts of the gastrointestinal tract. It is advisable not to drink on an empty stomach because ethanol absorption depends partly on the rate of stomach emptying. Food slows the stomach’s emptying rate (Wardlaw, 1999).
The effects of ethanol on a person’s mental and physical condition are correlated with its blood ethanol concentrations. Thus intoxication is based on blood ethanol concentrations (Moriya, 2005). Table 2.2 show the blood ethanol concentrations and its associated clinical signs/symptoms. However, some population are very sensitive to ethanol. For example, Orientals like Japanese, Chinese, Koreans, Malaysians, Thais and Filipinos have a poor ability to metabolize acetaldehyde, which is the first metabolite of ethanol. Acetaldehyde accumulates in their blood. So even they consume small amount of ethanol, they will experience an intense flushing of their face that can spread to their neck and upper arms (Moriya, 2005).

Another example, when a man and woman take the same amount of ethanol, woman retains more ethanol in her blood streams. Women cannot metabolize as much ethanol in their stomach cells because they have lower amounts of alcohol dehydrogenase (Wardlaw, 1999).

According to Wardlaw (1999), ethanol goes on to affect the brain more than any other organ. Ethanol tends to relieve the drinker’s anxiety, cause slurred speech, reduce coordination in walking, and impair judgement and encouraged uninhibited behaviour. As William Shakespeare wrote, “It stirs up desire, but takes away the performance.” Because it reduces secretion of the body’s antidiuretic hormone, ethanol increases urination. It also causes the blood vessels to dilate, releasing body heat.
REFERENCES


