



UNIVERSITI PUTRA MALAYSIA

***HEALTH RISK ASSESMENT OF EXPOSURE TO RESIDUAL ALUMINIUM
(Al) IN DRINKING WATER OF RESIDENTS IN KAMUNTING PERAK***

**BY
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ABSTRACT

HEALTH RISK ASSESMENT OF EXPOSURE TO RESIDUAL ALUMINIUM (Al) IN DRINKING WATER OF RESIDENTS IN KAMUNTING PERAK**MOHD AIZUDDIN BIN AHMAD**

Introduction: Al sulphate ($Al_2(SO_4)_3$) has been used as treatment of surface water for a long time all over the world and applied to form floc through the reaction of a coagulant with solids suspended in the water. However, residual Al is still in the water and it is one of the contributing factors to cause Alzheimer disease if consumed by humans. The main aim of this study was to determine health risk assessment of exposure to residual Al levels in drinking water in Kamunting, Perak. **Methodology:** This cross-sectional study was conducted in three residential areas in Kamunting Perak. A total of 100 respondents were selected to participate in this study. Two replicates of water samples were collected from each respondent house and were filled into 250ml HDPE bottles and the pH reading was immediately taken using a pH meter. The water samples were preserved using 69% nitric acid and analysed using a Graphite Furnace Atomic Absorption Spectrophotometer (GFAAS) in determining the aluminium levels in each water sample. Respondent's information such as body weight, water daily intake, socio-demographic background and status of water quality supply was also collected using questionnaires. The health risk was then calculated for each respondent. **Results:** Results showed that 79% of water samples exceeded the NSDWQ Al limit value of 0.2mg/l. The mean residual Al concentration was 0.345 ± 0.123 mg/l and all respondents HI were below 1 and indicated safe level and risk was acceptable. **Conclusion:** There was significant difference of residual Al concentration between the three residential areas in Kamunting Perak. There was also significant relationship between residential areas residual Al concentration with distance from treatment plant and also significant relationship between pH and residual Al concentration. Risk was acceptable since there is no respondent with HI above 1.

Key words: Aluminium sulphate, Kamunting, Health Risk Assessment, Drinking Water, Cross Sectional Study

ABSTRAK

PENILAIAN RISIKO KESIHATAN OLEH PENDEDAHAN BAKI ALUMINIUM (AL) DALAM AIR MINUM TERHADAP PENDUDUK PERUMAHAN DI KAMUNTING PERAK

MOHD AIZUDDIN BIN AHMAD

Pengenalan: Al sulphate ($Al_2(SO_4)_3$) telah digunakan dalam rawatan air sejak dahulu lagi diserata dunia dan diaplikasi bagi membentuk gumpalan melalui hasil tindakbalas kogulan dengan pepejal terampai dalam air. Bagaimanapun, baki Al masih berada dalam air dan menjadi salah satu punca kepada penyebab penyakit Alzheimer jika diminum. Tujuan utama kajian ini adalah bagi menilai risiko kesihatan responden terhadap pendedahan Al dalam air minum di Kamunting Perak. **Metodologi:** Kajian keratan rentas ini dijalankan di tiga kawasan perumahan di Kamunting, Perak. Seramai 100 responden telah dipilih untuk menyertai kajian ini. Sebanyak 2 replika sampel air diambil dari setiap rumah dan diisi ke dalam botol HDPE 250ml. Bacaan pH segera diambil menggunakan pengukur pH dan kemudian diawet dengan menggunakan asid nitric 69% dan dianalisis menggunakan mesin Graphite Furnace Atomic Absorption Spectrophotometer (GFAAS) bagi menentukan paras baki Al dalam setiap sampel air. Maklumat responden diambil seperti berat badan, pengambilan air seharian, sosio-demografi dan juga status kualiti air yang diterima. Kemudian, risiko kesihatan bagi setiap responden dikira. **Keputusan:** Hasil menunjukkan 79% sampel air melebihi kadar paras Al yang ditetapkan oleh NSDWQ iaitu 0.2mg/l. Purata kepekatan baki Al adalah 0.345 ± 0.123 mg/l dan kesemua Indeks Hazad adalah dibawah 1 dan menandakan risiko yang selamat dan boleh diterima. **Kesimpulan:** Terdapat perbezaan signifikan antara kepekatan baki Al diantara satu kawasan perumahan dengan yang lain di Kamunting Perak. Terdapat perhubungan yang signifikan diantara jarak loji rawatan air dengan setiap kawasan perumahan. Terdapat juga perhubungan signifikan diantara nilai pH dan juga bacaan kepekatan baki Al. Risiko adalah diterima dan selamat kerana tiada responden dengan indeks hazad melebihi nilai 1.

Kata kunci: Aluminium sulfat, Kamunting, Penilaian Risiko Kesihatan, Air Minum, Kajian Keratan Rentas

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LIST OF ABBREVIATIONS

IWA	International Water Association
WHO	World Health Organization
Al	Aluminium
AD	Alzheimer Disease
CDI	Chronic Daily Intake
HI	Hazard Index
IUPAC	International Union of Pure and Applied Chemistry
MSDS	Material Safety Data Sheet
NSDWQ	National Standard for Drinking Water Quality
MOH	Ministry of Health
RfD	Reference Dose

CHAPTER 1

INTRODUCTION

1.1 Background

Access for all citizens to high quality, safe drinking water at an affordable price is fundamental to their quality of life (IWA, 2004; WHO, 2006).

Due to its polarity and hydrogen bond, water has unique chemical properties which means it is able to dissolve, absorb, adsorb or suspend many different compounds (WHO, 2007). In nature water is not really pure as it attracts contaminants from the surrounding and those originate from humans and animals as well as other biological activities (Mendie, 2005).

The third most abundant element on Earth is the aluminium (Al) and it is still considered to be safe for human health. This metal and its derivatives are globally used in human life, including in food and pharmaceuticals (Barton, 2008).

The commonly used Al and iron salts utilised as coagulants are Al sulphate or alum, Al chloride, ferric sulphate and ferric chloride (Niquette, Monette, Azzouz & Hausler, 2004).

In addition, Al salts such as alum or polyaluminium chloride (PACl) are used extensively as coagulants in drinking water treatment to enhance the removal of particulate, colloidal and dissolved substances (Rubinos, Manuel, Carlos, & Fierros, 2005).

Alum has been used as treatment of surface water for over a hundred years all over the world (Nasir, Pauzi, & Farina, 2010)

The alum is applied to form floc through the reaction of a coagulant with solids suspended in the water (Wang, Li, Wang, & Liu, 2010). However, the alum residual is still in the water.

1.2 Problem Statement

Regulatory agencies have established the guidelines/standards for the control of alum present in drinking water. These values vary and give different opinions on the hazard posed by alum in drinking water (Yang, Gao, Wang, Wang, & Yue, 2011), and the regulation only refers to the total Al only.

Although most of human intake of Al comes from food, Al in food tends to be bound to other substances and it tends to be in a form that cannot be absorbed into the bloodstream. In contrast, research has proved that Al from drinking water can be absorbed to some extent both by animals and humans.

Natural raw water itself contains some amount of Al, and the addition of alum in treated water increases the concentration. Alum is used in water treatment processes to remove dissolved and suspended matter from raw water, and only a small amount of the hydrolysed salt remains in solution (Ver'issimo & Gomes, 2008).

Water treatment residuals are the byproducts from a water purification procedure, and may contain high amounts of Al, Fe and Ca (Alstyne, McDowell, Davis, Wilkinson, & O'Connor, 2007).

Al issues seem to be increase in recent years, due to the information and also knowledge on the potential toxic effects of this element. Although there are no reported cases of acute Al poisoning of healthy individuals exposed to normal levels of Al, several studies have been published relating Al exposure and age related neurological disorders, such as Alzheimer's disease (AD) (Campbell, Becaria, Lahiri, Sharman, Bondy, & Neurosci, 2004).

Accumulation of Al is observed if this equilibrium is disturbed. For example, kidney diseases and dialyses, excess dietary intake or occupational exposure. Moreover, some dietary factors enhance Al absorption. For example citric acid and other fruit acids or lactose, as opposed to the phosphates and silica (Barton, 2008).

Table 1.1: Epidemiological studies of aluminium in drinking water and Alzheimer disease, dementia or cognitive impairment

Study no.	Country of origin	Results	References
1	Norway	+	(Flaten, 1986)
2	United Kingdom	-	(Wood, Cooper, Stevens, & Edwardson, 1988)
3	United Kingdom	+	(Martyn, Osmond, Edwardson, Barker, Harris, & Lacey, 1989)
4	Canada, Ontario	+	(Neri & Hewitt, 1991)
5	Canada, Newfoundland	+	(Frecker, 1991)
6	Switzerland	-	(Wettstein, Aeppli, & Gautschi, & Peters, 1991)
7	Canada, Ontario	+	(Forbes, 1997)
8	France	+	(Jacqmin, Commenges, Letenneur, & Dartigues, 1996)
9	United Kingdom	-	(Forster, Newens, Kay, & Edwardson, 1995)
10	Canada, Ontario	+	(Forbes & Lessard, 1995)
11	Canada, Ontario	+	(McLachlan, Bergeron, Smith, Boomer, & Rifat, 1996)
12	United Kingdom	-	(Martyn, Coggon, Inskip, Lacey, & Young, 1997)
13	Canada, Quebec	+	(Gauthier, Fortier, Courchesne, Pepin, Mortimer, & Gauvreau, 2000)

Source: (Flaten, 2001)

Flaten (2001) summarizes the studies of Al in drinking water and relationship with Alzheimer Disease, dementia, or cognitive impairment. Table 1.1 showed from 13 studies, 9 showed positive association.

1.3 Study Justification

The design of this study was cross sectional. This study is believed to be the first in Kamunting, Perak for the residual Al exposure in drinking water. Therefore, this study is to provide the overview of the water quality for the Al in drinking water.

It can be review by the responsible bodies to solve any problem arise and thus improve the health and wellbeing of the residents. Besides that, this study can be a guide for any intervention or improvement to be done in terms of health. For the residents themselves, they may know roughly about the drinking water quality and the safety of the drinking water.

Finally this study encourage for another researcher to conduct similar research at other places to assess the drinking water quality in Malaysia.

1.4 Study Objectives

1.4.1 General Objectives

1. To determine the health risk of the residents in three residential areas in Kamunting, Perak for the residual Al exposure.

1.4.2 Specific Objectives

1. To collect socio demographic data of the respondents in Kamunting, Perak.
2. To determine the concentration of residual Al in drinking water.
3. To compare residual Al concentration in drinking water between three different housing areas in Kamunting.
4. To determine the relationship between residual Al concentration and also distance of the residential areas from the treatment plant.
5. To determine the relationship between residual Al concentration and the physical properties such as pH.
6. To compare the concentration of residual Al in drinking water with the Al limit of National Standard of Drinking Water Quality (NSDWQ).
7. To calculate the chronic daily intake (CDI) and hazard index (HI) of the respondents.

1.5 Study Hypotheses

Hypothesis 1

There is no difference of residual Al concentration in drinking water between different residential areas in Kamunting.

Hypothesis 2

There is a significant relationship between residual Al concentration and also the distance of the residential areas from the treatment plant.

Hypothesis 3

There is a significant relationship between residual Al concentration and pH.

Hypothesis 4

There is a significance difference between residual Al concentrations in drinking water for residential area with (NSDWQ) standards.

Hypothesis 5

HI of the residents is less than 1.



1.6 Conceptual Framework

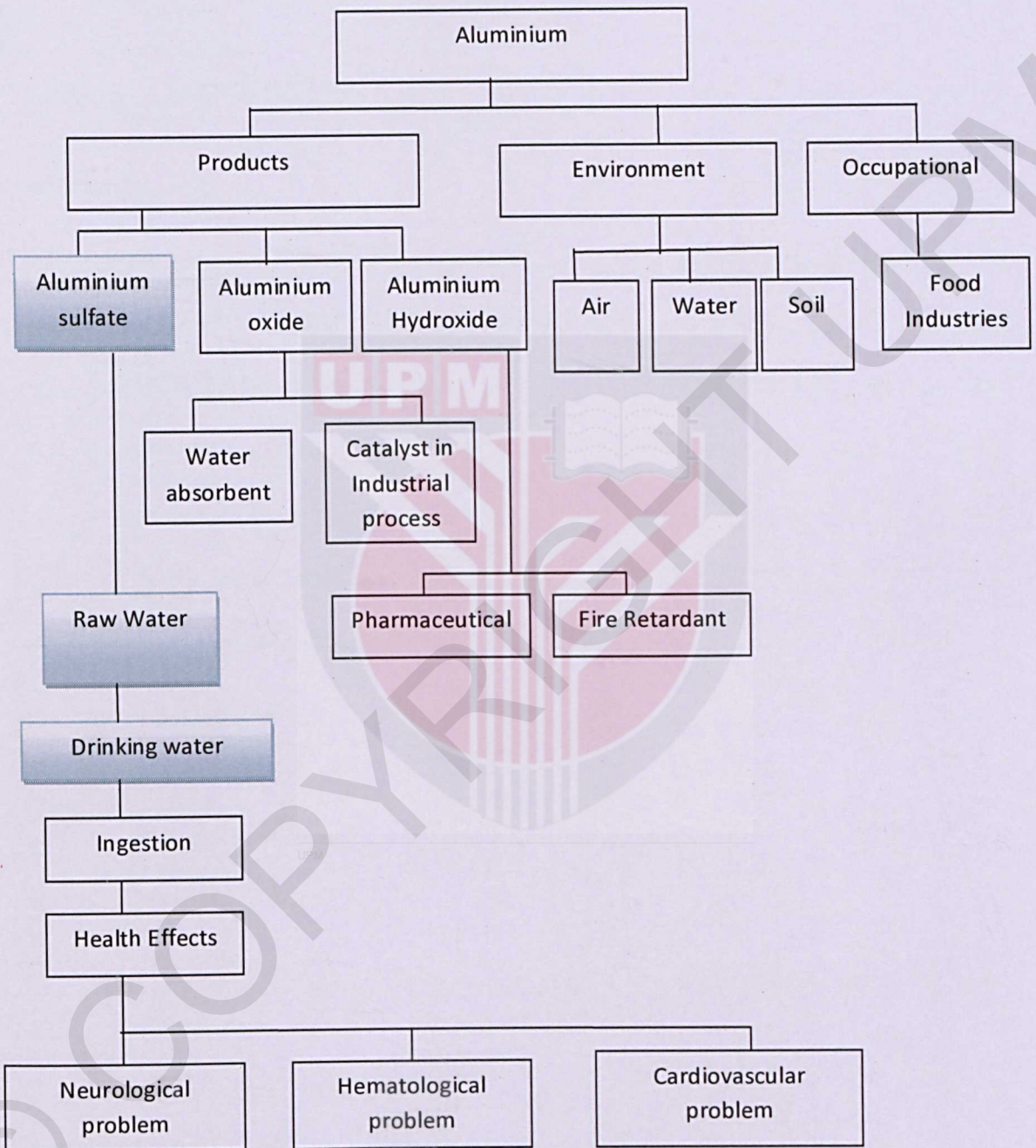


Figure 1.1: Conceptual framework

1.7 Definition of Term

1.7.1 Conceptual Definition

Al

Al is one of the most abundant elements in the earth crust and consists for 8% totally. Al have many uses and used widely in for example in medicine to produce vaccine, food industry for food packaging and food containers and also in consumer products such as antiperspirant. Al may occur in water mainly from two sources. One is due to naturally leaching from rocks and soils and the other source is anthropogenically added in raw water for treatment and known as alum. It is used as coagulant to reduce organic matter, colour and also the turbidity of the water.

CDI

Conceptual

Chronic daily intake is the daily dose for and individual average over a lifetime.

1.7.2 Operational Definition

Al

The Graphite Furnace Atomic Absorption Spectrophotometer (GFAAS) was used to determine the Al concentration in drinking water.

CDI

Chronic daily intake (CDI) was first calculated using the following equation

$$CDI (I) = (C_1 R_1 F E D t) / (W B T_{AVG})$$

Where CDI (I) is the chronic daily intake (mg/kg/d),

C_1 = level of aluminum concentration in drinking water (mg/L),

R_1 = ingestion rate (L/day),

FE = exposure frequency (day/year),

Dt = exposure duration (year),

WB = body weight (kg)

T_{AVG} = the average of exposure duration ($D \times 365$ days/year).

Source: (Risk Assessment Information System RAIS, 2009)

CHAPTER 2

LITERATURE REVIEW

2.1 Water Issues

Malaysia is blessed with an abundant of water resources and adequate rainfall. But there are still water shortage and water quality issues (Shaharuddin, Kidahus, Sumarlan, Kamil & Ismail, 2010).

Public health protection must be the principal goal of a drinking water utility, delivered through supplying safe drinking water (Jalba *et al.*, 2009).

2.2 Physicochemical Properties

2.2.1 Al

IUPAC Periodic Table of the Elements

1 H Hydrogen 1.008	2 He Helium 4.0026											10 Ne Neon 20.180	11 Na Sodium 22.990	12 Mg Magnesium 24.305	13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.06	17 Cl Chlorine 35.453	18 Ar Argon 39.948	19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.88	23 V Vanadium 50.942	24 Cr Chromium 52.004	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.63	33 As Arsenic 74.922	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.80	37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.94	43 Tc Technetium 98	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.91	46 Pd Palladium 106.42	47 Ag Silver 107.87	48 Cd Cadmium 112.41	49 In Indium 114.82	50 Sn Tin 118.71	51 Sb Antimony 121.76	52 Te Tellurium 127.6	53 I Iodine 126.91	54 Xe Xenon 131.29	55 Cs Cesium 132.91	56 Ba Barium 137.33	57 La Lanthanum 138.91	58 Ce Cerium 140.12	59 Pr Praseodymium 140.91	60 Nd Neodymium 144.24	61 Pm Promethium 145	62 Sm Samarium 150.36	63 Eu Europium 151.96	64 Gd Gadolinium 157.25	65 Tb Terbium 158.93	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93	68 Er Erbium 167.26	69 Tm Thulium 168.93	70 Yb Ytterbium 173.05	71 Lu Lutetium 174.97	72 Hf Hafnium 178.49	73 Ta Tantalum 180.95	74 W Tungsten 183.84	75 Re Rhenium 186.21	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.97	80 Hg Mercury 200.59	81 Tl Thallium 204.38	82 Pb Lead 207.2	83 Bi Bismuth 208.98	84 Po Polonium 209	85 At Astatine 210	86 Rn Radon 222	87 Fr Francium 223	88 Ra Radium 226	89-103 Actinides	104 Rf Rutherfordium 261	105 Db Dubnium 262	106 Sg Seaborgium 263	107 Bh Bohrium 264	108 Hs Hassium 265	109 Mt Meitnerium 266	110 Ds Darmstadtium 267	111 Rg Roentgenium 268	112 Cn Copernicium 269
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Figure 2.1: Periodic table

Source: (IUPAC, 2011)

Al is situated in the main sub group III in the periodic table (Figure 2.1). It is silvery white in colour, light metal and also good conductor for electricity. Al has nine isotopes, whose mass number range from 23 to 30. Only ^{27}Al (stable isotope) and ^{26}Al (radioactive isotope, $t_{1/2} = 7.2 \times 10^5 \text{ y}$) occur naturally, however ^{27}Al has a natural abundance of 99.9+ %. ^{26}Al is produced from argon in the atmosphere by spallation caused by cosmic-ray protons (Gong, 2009).

Table 2.1: Aluminium Sulphate

Source :(MSDS, 2009)

Appearance	Granulated material
Physical state	Solid
Colour	White
Odour	Odourless
Solubility	Soluble in weak acids, slightly soluble in ethyl alcohol, alkalies
Water solubility	Soluble in cold and hot water: 31,2 g/100 g (at 0°C); 36,2 g / 100 g (20°C); 89,0 g/100 g (100°C)
pH	Octadecahydrate – 2,5-4,0 (for concentration 50 000 mg/l at 20°C) anhydrous form - 2,9 (for concentration 1 g/ml of water); 3-3,5 (for concentration 10 g/l of water)

2.3 Major Uses

Al is used widely nowadays in modern world. One of the common end uses of Al was packaging, include drink cans, foil wrapping, bottle top and foil container. Due to its strength properties and corrosion resistance, it was also used in transportation especially for the planes body part. In addition Al was also low in density and fully utilizes in electrical uses as pylon and high voltage conductors and due to its lightweight, it was utilised in cladding, windows, skylight, gutters, door frames, and roofing. Alum was extensively used as flocculating agent in water treatment and also in paper manufacturing.

2.3.1 Al in Drinking Water

Al salts are extensively used as coagulating agent in drinking water treatment process. The coagulating agents used to form floc through the interaction of a coagulant with solids suspended in the water. Although they were effective in removing turbidity of the water, Al based coagulants may result in increase and high concentration of residue in the treated water (Wang et al., 2009).

The extensively used of alum as coagulants often leads to higher concentrations of Al in the treated water than in the raw water itself (Srinivasan et al., 1999 and Srinivasan and Viraraghvan, 2002).

It was reported that Al salts, used in coagulation process, could increase residual Al concentration notably (Van Alstyne et al., 2007)

The levels of Al in drinking water are highly variable, from the concentration in raw water total Al concentrations to the method used to clarify treated water. The use of Al-based coagulants in water utilities may trigger to the increased concentration of the metal in treated water, and results in water quality problems (Schintu, Meloni, & Contu, 1998).

2.4 Sources in the Environment

2.4.1 Natural Sources

Al is one of the most abundant metallic elements in the Earth's crust, comprising about 7% of its mass, and it occurs in soil solution as well as in aquatic systems (Weng, Temminghott, & Riemsdijk, 2002).

2.4.2 Anthropogenic Sources

Recently, several factors of natural or anthropic origins such as acid rains and atmosphere deposits have produced a decrease in pH and have been identified as being responsible for the large amount of Al dissolving to natural waters which may increase the concentration of residual Al in drinking waters (Drabek, Boruvka, Mladkova, & Kocarek, 2003). Moreover, the use of Al-based coagulants may lead to increased content of the metal in treated water notably, resulting in problems relating to water quality and supply (Yang et al., 2011).

2.5 Permissible Limit of Al in Drinking Water

Natural water untreated with Al salts contains Al at a concentration significantly below the recommended upper limit in treated drinking water of 0.2 mg/l (WHO, 1993) and rarely exhibits higher concentrations.

The maximum concentration of Al that permitted in drinking water by the European Economic Community is 0.2 mg/l. The World Health Organization (WHO) has also set a guideline value of 0.2 mg/l, not based on any assessment of risks to health, but as an acceptable value between limit the use of Al salts in water treatment, and the effective discoloration of distributed water (Ver'issimo & Gomes, 2008)

Limit of Al concentration was 0.2 mg/l in drinking water (NSDWQ, 2009).

2.6 Human Exposure

Human may be exposed to Al from the environment through the diet or drinking water or consumption of certain medications. Al content in food and water, and Al inhalation as fine particles, are the most relevant ways of exposure (Go'mez, Esparza, Cabre, Garcia, & Domingo, 2008).

Human are expose to Al via air, food and water and they are naturally present in the human body at approximately 35 mg (Al-Kindy, Al-Ghamari, & Suliman, 2007).

Intake from food is much lower, approximately 6 mg/day for adults (Allen & Cumming, 1998), and intake for Al from cooking utensil is a growing concern (Jagannatha & Murthy, 1990).

In healthy adults, the availability of Al from the gastrointestinal tract is as low as 0.1% and it is excreted quickly to reduce the level of Al. Accumulation of Al is observed in patient if they have kidney diseases, excess dietary intake and occupational exposure (Barton, 2007).

2.7 Substances in Drinking Water

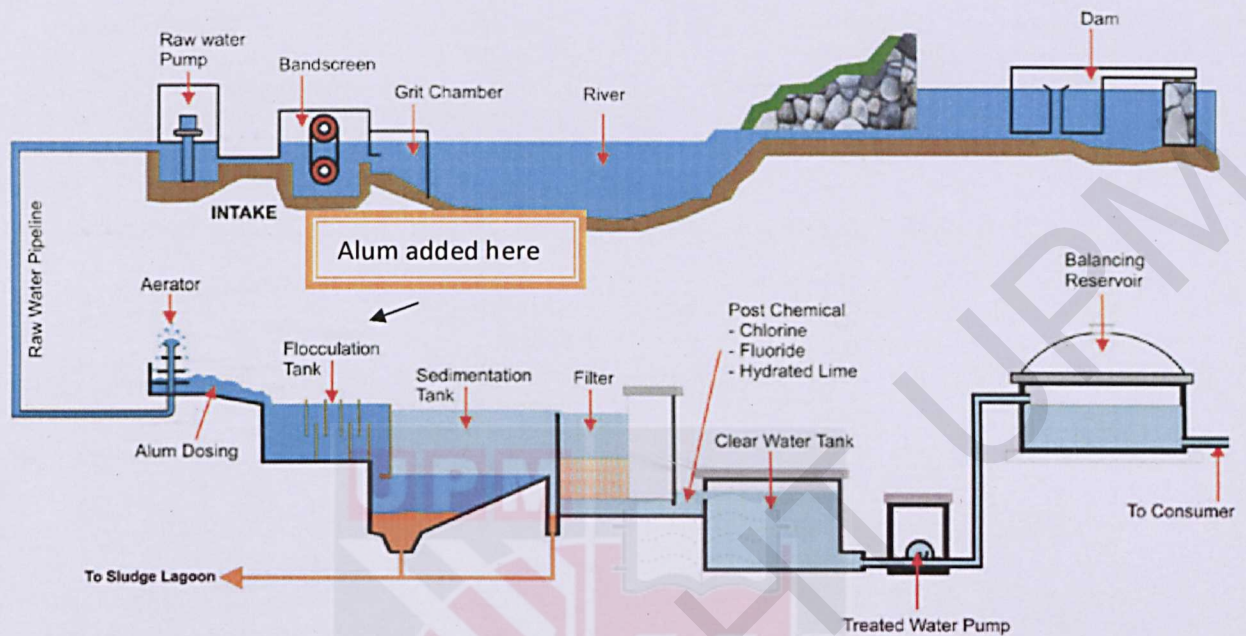


Figure 2.2: Water treatment process

Source : (Puncak Niaga (M) Sdn Bhd, 2009)

Coagulation and Flocculation

Chemical coagulants are added to interact with the remaining particles in the water to form particles large enough to settle out. Rapid mixing distributes the coagulants uniformly throughout the water. While, flocculation basin mix the water with large submerged paddle, and small particle collide to become large particles called floc.

2.8 Health Effects of Al

2.8.1 Neurological Effects

Al can produce an encephalopathy in renal-impaired humans (dialysis encephalopathy), cognitive deficits in young children, a low-turnover bone disease, and a microcytic hypochromic anemia (Yokel & Florence, 2008).

Most experts agree that high levels of Al in dialysis fluids and in medication are responsible for dementia, and that controlling these levels of Al can significantly reduce the incidence of this disease (Ver'issimo & Gomes, 2008)

When it enters the brain, it may cause AD and other neurodegenerative disease. Al is also associated with the mobilization of bone phosphate and increase the toxicity in the hemapoietic systems in human (Gupta, 2005).

A comprehensive literature survey has found 13 reports regarding a significant association between residing in area where aluminium concentration in the municipal drinking water are quite high an increase in the incidence of AD, and a meta analysis, integrating results from plenty sources, prove that this association was significant (Flaten, 2001).

2.8.2 Haematological

Al may cause direct effect on hematopoiesis (the development of blood cells), and for inducing microcytic anaemia (resulting of hemoglobin synthesis failure or insufficiency), among other diseases (Ver'issimo & Gomes, 2008).

Al is also associated with the mobilization of bone phosphate and increase the toxicity in the hemapoietic systems in human (Gupta, 2005).

Increased erythrocyte protoporphyrin in blood is reported to be the most sensitive indicator of exposure (Nasiadek & Chmielnicka, 2000).

The study of Varma et al. (1999) highlights the high prevalence of hypochromic anaemia in patients with adequate dietary intake and Al overload in chronic renal failure. Even in the absence of signs of anaemia, ingested Al may depress hematopoiesis by affecting RBC production and cell destruction (Garbossa et al., 1996).

2.8.3 Cardiovascular System

Accumulation of Al in the heart also happened. It has been suggested that observed cardiac hypertrophy in haemodialysis patients may be caused in part of Al (Birchall, 1991). According to Levine et al. (1990), Al exposure potentiates the adverse effects of diabetes mellitus by decreasing sarcoplasmic reticulum calcium uptake.

2.9 Exposure and Risk Assessment

2.9.1 Hazard Identification

Fatal Al encephalopathy happened following the chronic use of high dose of antacids and exposure to Al-contaminated dialysis solutions in patients with reduced or absent renal function (dialysis encephalopathy/dementia), following short term exposure to large amounts of alum instilled into the urinary bladder in patients with reduced renal function (Nakamura et al., 2000; Phelps et al., 1999).

Mental retardation and death (at nine years of age) following *in-utero* exposure to Al associated with maternal use of antacids at extremely high dose during pregnancy (Gilbert-Barnes et al., 1998).

2.9.2 Dose Response Assessment

Rondeau et al. (2000) reported an elevated risk of AD among individual consuming water with Al concentration exceeding 0.1mg/l.

Osteomalacia occurred following used of high doses of antacids (Kassem et al., 1991; Woodson, 1998) and exposure to Al contaminated dialysis solution.

2.9.3 Exposure Assessment

The largest exposures are associated with the use of antacids (7,200 mg/day) and aspirin (1,000 mg/day). The smallest exposures are associated with inhalation of ambient air and consumption of drinking water. The values in this table indicate that intake of Al from food dominates that from drinking water. Even inhalation contributes more Al than does consumption of drinking water. However, consumption of medications containing Al makes the greatest potential contribution to internal Al exposure (Krewski, 2006).

2.9.4 Risk Characterization

For oral exposure, we identified two health effects. For reproductive toxicity, there is a margin of exposure of nearly 3000. On the other hand, for neurological effects (in particular, an increased risk for the development of AD), exposure to Al in drinking water (0.1 mg/l) may be similar to the level of concern we identified. This level of 0.1 mg/L is less than the recommended limits established by the WHO.

Secondary drinking water regulations in the U.S. establish a limit of 0.05 to 0.2 mg/l for Al as pointed out by Nieboer et al. (1995), the epidemiological evidence for a possible association between Al in drinking water and AD must be viewed in the context that this disease has a complex genetic trait. It is considered multifactorial, involving multiple genes that interact with multiple environmental (including life-style) factors.

CHAPTER 3

METHODOLOGY

3.1 Study Design

A cross sectional study was conducted in Kamunting, Perak to determine the health risk of residual Al exposure in drinking water. A cross sectional study measures the prevalence of health outcomes or determinants of health, or both, in a population at a certain point in time or over a short period of time. The study also used questionnaires to gather information on important health related aspects such as people's knowledge, attitudes and practices (Abramson & Abramson, 2000).

3.2 Study Location

This study was conducted in Kamunting, Perak. Specifically, it was conducted in Taman Mewah, Taman Yayasan and Taman Kamunting Bakti. All areas are under Majlis Perbandaran Taiping (MPT) and receive the same water source from Gunung Semanggol Water Treatment Plant.

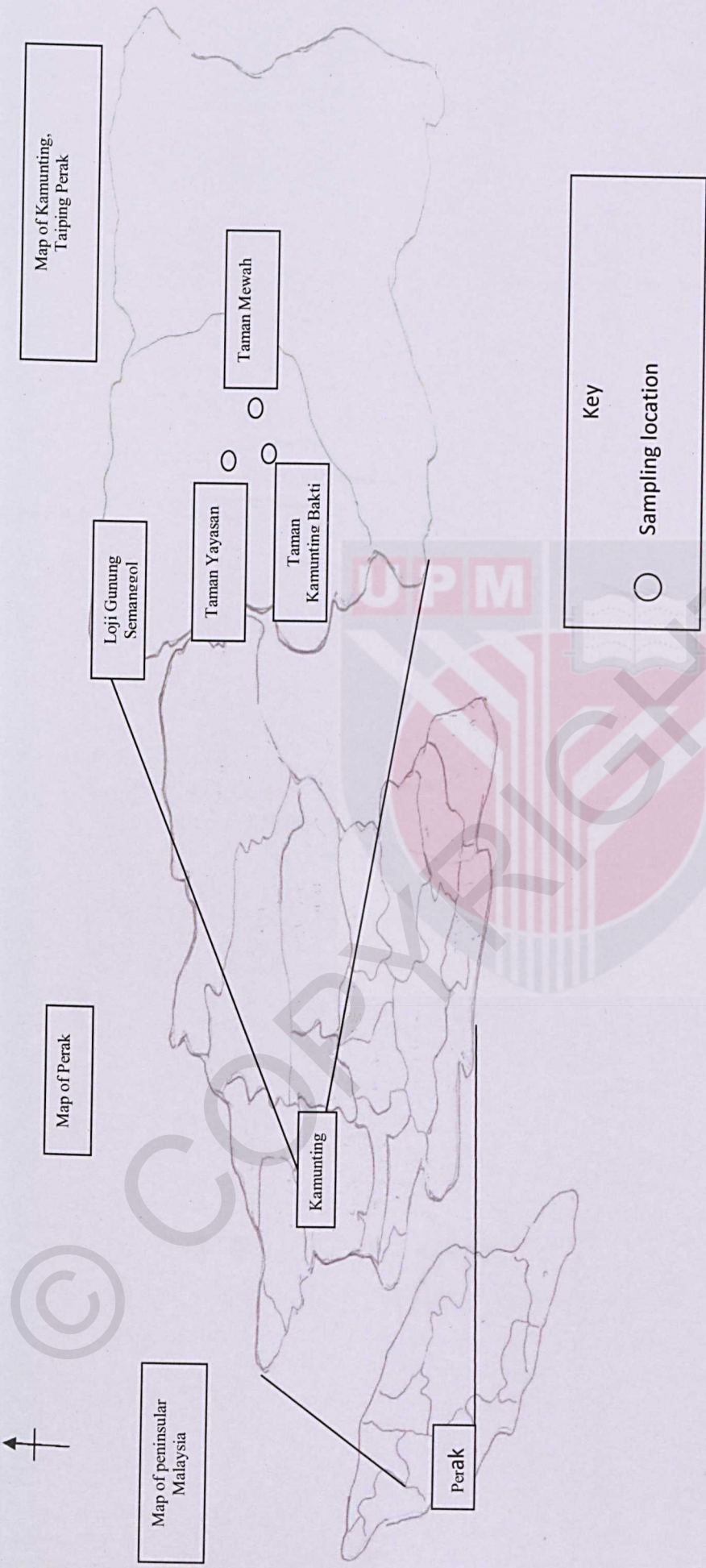


Figure 3.1: Sampling locations

3.3 Study Population

The study population consisted of residents from the three residential areas in Kamunting, Perak.

3.4 Sampling Unit

The sampling unit consisted of male and female residents in Taman Mewah, Taman Yayasan and Taman Kamunting Bakti who met the inclusive criteria. The inclusive criterias were Malaysian adult aged 18 years old and above. Besides that, they also must only use the tap water as their source of drinking water. All the three residential area were divided representatively for each race. According to census in Taiping for the year 2000, the total Malay population was 176,353 people, Chinese was 71649 people and Indian was 32393 people. Others were 645 people and foreigner was 3202 people. Therefore Malay races consist of 62%, Chinese was 25% and Indian was 11%.

For the exclusion criteria, residents who used other than tap water as their source of drinking water and also the usage of filter were automatically excluded.

3.5 Sample Size Calculation

Sample size was calculated using Kirkwood and Sterne (2009) formula, with the equation:

$$N = \frac{P(1-P)}{e^2}$$

Where,

N= sample size

P= prevalence

e= probability error

According to Dzulfakar, Shaharuddin, Muhaimin & Syazwan (2011), the prevalence rate of urban AI violation in Bukit Ubi is 8% or 0.08.

For 95% level of confidence, the margin error ± 2 time the standard errors. Therefore the error, $e=0.05$.

$$N = \frac{0.08(1-0.08)}{(0.05)^2}$$

=30 respondent. The sample was added to become 100 sample to support the study.

Besides that, it was also as a precautionary step in case of sample contamination or damage. The increment was also to support the limitation of the study since not all houses were sampled and also due to time constraint.

3.6 Sampling Method

The population was chosen purposively in this study. This study focus on choosing residents who fulfilled the inclusive criteria.

3.7 Study Instrument and Data Collection

3.7.1 Questionnaire

A set of structured questionnaires was used in this study which comprised of two sections. The first section contains questions regarding respondents' background data such as age, household income, duration of residence and education level. The second section contains questions regarding exposure duration, chronic daily intake and water consumption during living period in the selected villages. The second section of the questionnaire was modified from the Baseline, Descriptive and Time-Activity Questionnaires used in the National Human Exposure assessment Survey (NHEXAS)-Arizona study.

3.7.2 Graphite Furnace Atomic Absorption Spectrophotometer (GFAAS)

A PerkinElmer AAnalyst™ 600 Graphite Furnace Atomic Absorption Spectrophotometer equipped with the intuitive WinLab 32™ for AA (Version 6.5) software, was used to determine Al concentration in daily water samples.

3.7.3 Water Sampling and Preservation

A 250 milliliter (ml) non-acidified high-density polyethylene (HDPE) bottle was used for water sample collection. Two replicate of water sample were collected from each of the kitchen's pipe. The pipe was turned on for 3 minutes to provide a steady, medium strength flow, the bottles were not rinsed (Kavcar et al., 2009). Water was filled until it was up to the marked line and pH reading was taken. The bottle was then closed tightly after the acidification process. Throughout the process, gloves were worn to prevent any contamination of water samples. The sample was preserved with 0.5 ml 69% pure concentrated nitric acid before analysing process to ensure the sample is free from bacteria and to lengthen the storage time of the samples (MOH, 2004).

3.7.4 Water Sample Analysis

Equipment used to measure pH was LAMOTTE TRACER ORP PockeTester. The measurement of Al in drinking water sample was performed using a PerkinElmer AAnalyst™ 600 Graphite Furnace Atomic Absorption Spectrophotometer



3.7.5 Instruments



PerkinElmer A Analyst™ 600 Graphite Furnace Atomic Absorption Spectrophotometer

Source: (PerkinElmer Inc., 2011)



LAMOTTE TRACER ORP PockeTester

Source: (LaMotte Company, 2011)

Figure 3.2: Instrument for determination on residual Al concentration and pH reading

3.8 Quality Control

3.8.1 Standard Operating Procedure

All the procedure and step for PerkinElmer AAnalyst™ 600 Graphite Furnace Atomic Absorption Spectrophotometer, the pH meter (LAMOTTE TRACER ORP PockeTester), strictly followed using the standard operating procedure of the equipments in order to minimise analytical errors.

3.8.2 Calibration

All the equipments such as PerkinElmer AAnalyst™ 600 Graphite Furnace Atomic Absorption Spectrophotometer, the pH meter (LAMOTTE TRACER ORP PockeTester), and weighing machine was calibrated before used.

3.8.3 Pre-Test

Pretesting was done to ensure the respondent were able to understand the questionnaire question that were asked. Total of 10 respondents were asked regarding the questions and all of them understood with the questions.

3.9 Exposure and Risk Assessment

The exposure of residual Al among the respondents was first estimated by using the chronic daily intake formula

$$\text{CDI (I)} = (\text{C}_1\text{R}_1\text{FEDt}) / (\text{WBT}_{\text{AVG}}).$$

Where CDI (I) is the chronic daily intake (mg/kg/d)

C_1 = the level of residual Al concentration in drinking water (mg/l)

R_1 = ingestion rate (l/day),

FE = exposure frequency (day/year),

Dt = exposure duration (year),

WB = body weight (kg)

T_{AVG} = the average of exposure duration ($\text{D} \times 365$ days/year).

To conclude the significant exposure and overall potential for non-carcinogenic health effects posed by Al in drinking water, the Hazard Index (HI) was calculated using the following equation:

$$\text{Hazard Index (HI)} = (\text{CDI}) / (\text{RfD})$$

RfD is reference dose. RfD for Al is 7 mg/kg/day (WHO, 1989) In cases where the non-cancer HI does not exceed unity ($\text{HI} < 1$), it is assumed that no chronic risks are likely to occur at the study site.

3.10 Statistical Method

All the data of the questionnaire, body weight, Al concentration, hazard index and chronic daily intake analysed by using the SPSS version 19.

Univariate analysis was used to produce the raw and basic statistical data of respondent background information (descriptive analysis), like age, gender and education level. The data presented in the form of mean, maximum and minimum value. The specific objectives determined by analyzing the collected data using bivariate analysis.

For the first specific objectives, the sociodemographic data was presented by mean and standard deviation. For the variables (race, gender, and education level) data presented for the frequencies. Second objectives which was to determine residual Al concentration. Data such as rage, mean and standard deviation were used. Third objective was to compare between the three residential areas and Kruskal Wallis test was used. The fourth objective was to determine relationship between residual Al concentration with distance factor from treatment plant. Spearman Correlation test was used. The fifth objective also to observe relationship between residual Al concentration and pH and was analyzed by using Spearman Correlation test. The sixth objective was analyzed using Wilcoxon Signed Rank Test to compare residual Al concentration with

limit of NSDWQ Al limit. Final objective which were CDI and HI data presented for the mean, standard deviation, minimum and maximum readings.

3.11 Ethical Consideration

Ethical clearance was approved by the Medical Researcher Ethics Committee of the Faculty of Medicine and Health Sciences of UPM.

3.12 Resource Requirement

All equipment such as PerkinElmer AAnalyst™ 600 Graphite Furnace Atomic Absorption Spectrophotometer, body weight scale, and pH meter used in this research were obtained from the Faculty of Medicine and Health Sciences UPM.

3.13 Supervision

This study was under the guidance and supervision of Dr. Shaharuddin Mohd Sham from Environment and Occupational Health Department, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia.

3.14 Study Limitations

1. There were too many possible confounders such as from the environment (skin contact with Al in soil) and occupational (inhalation of Al).
2. No biological samples such as blood or urine were taken to determine the concentration of Al in the body.
3. Hard to conclude relationship between residual Al concentration in drinking water with the health of the residents since sampling is conducted only once for each house.
4. Recall bias from questionnaire regarding to water drinking frequencies.

CHAPTER 4

RESULTS

4.1 Results of Socio-Demographic Data of Respondents

The total number of respondents involved in this study was a hundred (100) residents from three (3) different residential areas which were Taman Mewah, Taman Yayasan and Taman Kamunting Bakti in Kamunting, Perak Darul Ridzuan. The results of the socio demographic data are shown in Table 4.1 and Table 4.2.

There were eighty-five (85) respondents (85%) which were Malay and the other fifteen (15) respondents (15%) were Indian. There was no Chinese respondent in this study since their population was too small in these study areas.

The mean age for these three residential areas were 40. Taman Yayasan have the highest mean which was forty two (42) compared to residents of Taman Mewah and Taman Kamunting Bakti.

For income level, the mean was $RM1647.32 \pm 1346.50$ and ranged from RM 100- RM 10000 per month. For weight, the mean was 65.99 ± 14.39 kg and ranged from 40- 125 kg. The mean for all three residential areas was almost the same. For the duration of residence, the mean was 7.81 ± 6.53 years. Respondents from Taman Mewah and Taman Yayasan recorded almost 10 years of residencies, but Taman Kamunting Bakti showed only about a year. This was because this residential area was still new.

There were (56%) male respondents and (44%) female respondents recruited for this study. For the education level, there was none (0%) of the respondents with no education. For UPSR level, there were twelve (12) respondents (12%) followed by PMR (25%), SPM (55%), IPT (6%) and lastly others was 2%.

Table 4.1: Socio-demographic data

Variable	Overall		Taman Mewah		Taman Yayasan		Taman Kamunting Bakti	
	Range	Mean±s.d.	Range	Mean±s.d.	Range	Mean±s.d.	Range	Mean±s.d.
Age	21-64	39.51±11.10	21-64	39.35±11.07	21-63	42.29±10.26	21-60	35.52±11.55
Income (RM)	100-10000	1647.32±1346.50	500-5000	1629.5135±861.92	600-10000	1972.36±1866.94	100-3000	1179.6±771.65
Weight	40-125	65.99±14.39	41-90	62.14±11.92	44-90	66.71±11.56	40-125	70.6±19.72
Duration of Residence	1-30	7.81±6.53	1-20	10±5.47	1-30	9.65±7.18	1-4	1.78±0.96

Table 4.2: Socio-demographic data

Variable	Taman Mewah (n=37) Frequency (%)	Taman Yayasan (n=38) Frequency (%)	Taman Kamunting Bakti (n=25) Frequency (%)
Race			
Malay	33(89.2)	31(81.6)	21(84)
Indian	4(10.8)	7(18.4)	4(16)
Gender			
Male	15(40.5)	25(65.8)	16(64)
Female	22(59.5)	13(34.2)	9(36)
Education Level			
No education	0(0)	0(0)	0(0)
UPSR	3(8.1)	7(18.4)	2(8)
PMR	9(24.3)	10(26.3)	6(24)
SPM	21(56.8)	19(50)	15(60)
IPT	2(5.4)	2(5.3)	2(8)
Others	2(5.4)	0(0)	0(0)

4.2 The Concentration of Residual Al in Drinking Water

Table 4.3 showed concentration of residual Al in drinking water ranged from 0.01-0.86 Total number of houses exceeded the guideline by NSDWQ (0.2mg/l) was 79 houses (79%). Meanwhile the mean residual Al in drinking water 0.33 ± 0.18 mg/l. The data was not normal, and log10 been done on the data but still the data was not normal in terms of normality test.

Table 4.3: The concentration of Residual Al in drinking water

Variable	N	Range	Mean \pm s.d.	Median
Concentration of residual Al in drinking water	100	0.01-0.86	0.33 ± 0.18	0.29

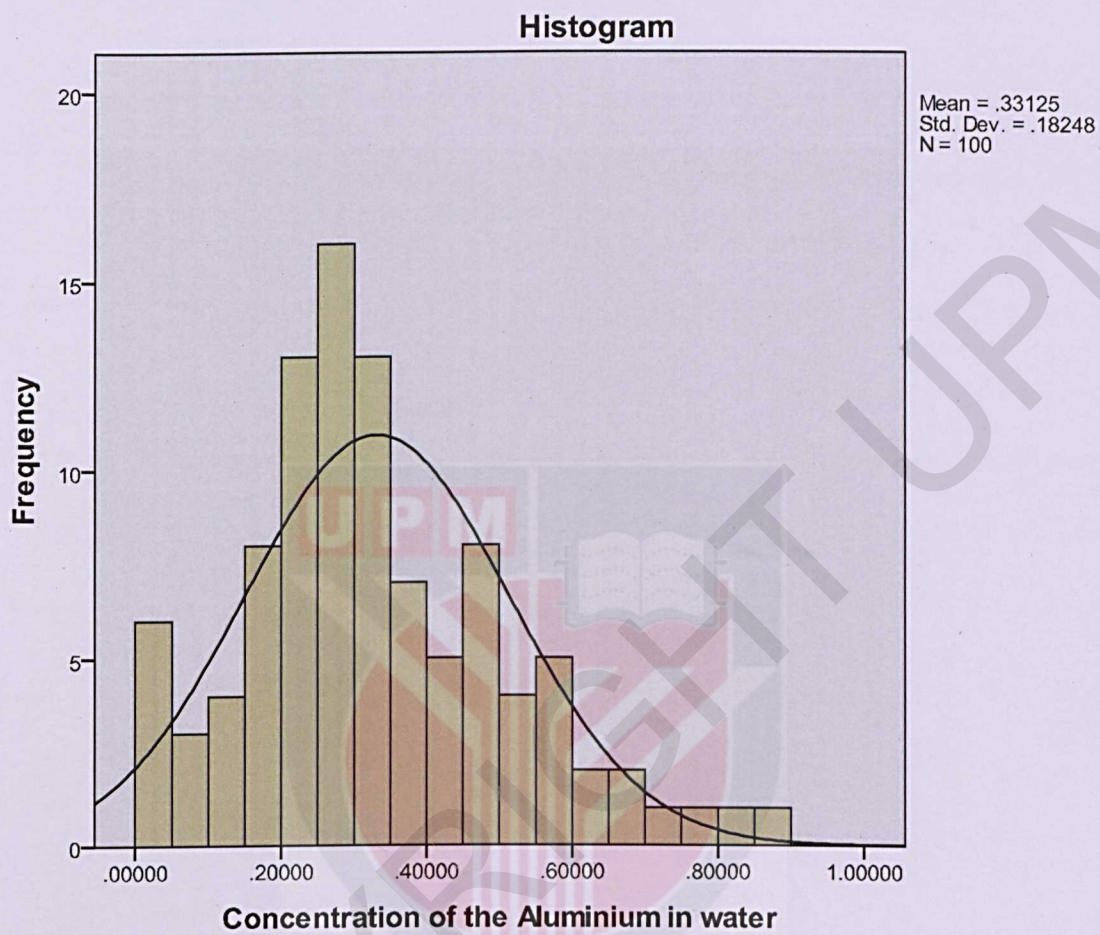


Figure 4.1: Concentration of residual Al in drinking water

4.3 Comparison of Residual Al Concentration across Three Residential Areas

Among all the three residential areas, Taman Yayasan had the highest mean (0.40 ± 0.15) followed by Taman Kamunting Bakti (0.34 ± 0.21) and lastly Taman Mewah (0.24 ± 0.15). There was a house with highest Al concentration which was 0.87 and it was from this Taman Kamunting Bakti. Kruskal Wallis test was conducted to compare the residual Al concentration between the three (3) residential areas. This test was used for non-parametric test since it was not normal. The p values ($p=0.000$) indicated that the results was statistically significant, meaning that the observed association is unlikely to have occurred by chance (Table 4.4).

Table 4.4: Comparison of residual Al concentration in all three residential areas

Variable	N	Mean Rank	X ²	p
Taman Mewah	37	33.39	22.17	<0.001
Taman Yayasan	38	64.47		
Taman Kamunting Bakti	25	54.58		

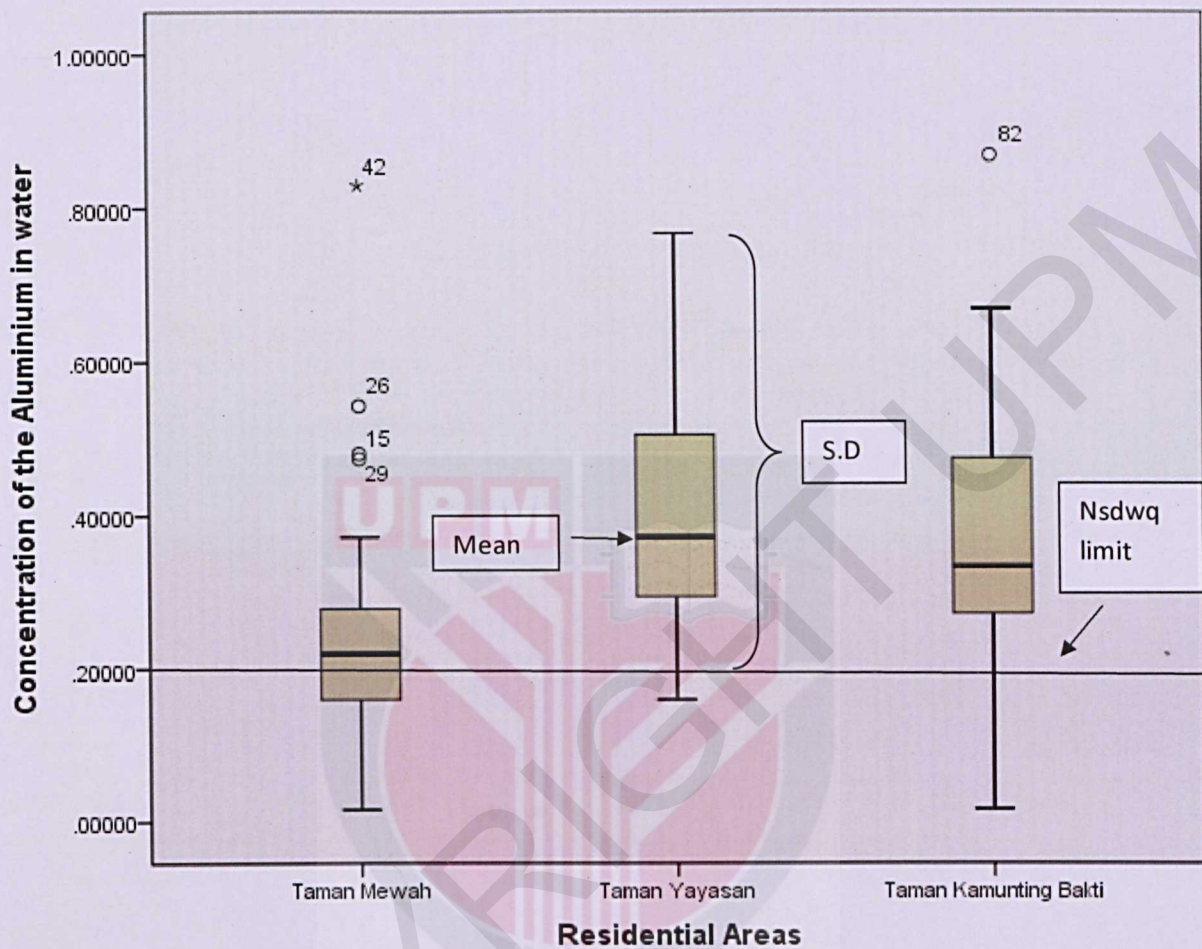


Figure 4.2: Comparison of residual Al concentration among three residential areas

4.4 Relationship of Residual Al Concentration with Distance from Water Treatment Plant

Table 4.5 shows the distance between each residential area and the treatment plant in Gunung, Semangol, Perak. The farthest distance was Taman Mewah which was 18.0 km followed by Taman Kamunting Bakti which was 16.2 km and lastly, Taman Yayasan which was 14.9 km. Results from Spearman Rank Correlation Coefficient test showed that $r = 0.345$ indicating low relationship between the two variables.

Table 4.5: Table of relationship between residual Al concentration and distance from treatment plant

Variable	Residual Al concentration	Distance from treatment plant (Loji Gunung Semangol)(km)	R	p
Taman Mewah	0.24±0.15	18.0		
Taman Yayasan	0.40±0.15	14.9	0.345	<0.001
Taman Kamunting Bakti	0.34±0.21	16.2		

4.5 Relationship between Residual Al Concentration and pH in Drinking Water

pH readings ranged from 6.25-7.62. Mean from Taman Mewah was 6.83 ± 0.34 ; Taman Yayasan was 7.23 ± 0.25 and Taman Kamunting Bakti which was 7.39 ± 0.19 (Table 4.6). All houses were below acceptable value of NSDWQ which was 9.

To observe the correlation between the two variables (pH and Al), Spearman Correlation test was conducted since both the data was not normal. Guilford Rule of Thumb stated that <0.2 =negligible relationship, $0.2-0.4$ =low relationship, $0.41-0.70$ moderate relationship, $0.71-0.9$ = high relationship, >0.91 = very high relationship. According to the results in Table 4.7, it shows low relationship between them. ($R=0.349$).

Table 4.6: Residual Al concentration and water pH data

Variables	Taman Mewah		Taman Yayasan		Taman Kamunting Bakti	
	Range	Mean \pm s.d.	Range	Mean \pm s.d.	Range	Mean \pm s.d.
Residual Al concentration	0.015-0.83	0.24 ± 0.15	0.16-0.76	0.40 ± 0.15	0.01-0.86	0.34 ± 0.21
pH	6.25-7.59	6.83 ± 0.34	6.49-7.59	7.23 ± 0.25	6.75-7.62	7.39 ± 0.19

Table 4.7: Table of relationship between residual Al concentration and water pH

Variable	N	R	p
Residual Aluminium concentration and pH	100	0.35	<0.001

4.6 To Compare the Concentration of Residual Al in Drinking Water with the Al Limit of National Standard of Drinking Water Quality (NSDWQ)

The Wilcoxon test, which evaluated comparison between NSDWQ standards with residual Al concentration in drinking water was found to be significant ($z = -6.10$, $p < .01$). That is, the results indicated significant difference between NSDWQ Al limit and residual Al concentration. Please refer to Table 4.8.

Table 4.8: Data of comparison between NSDWQ standards with residual Al concentration

Variables	Z	p
Comparison between MOH standard with residual Al concentration in drinking water	-6.10	<0.001

4.7 To Calculate the Chronic Daily Intake (CDI) and Hazard Index (HI)

Based on the results, the mean of the CDI was 0.00640 ± 0.00446 . CDI means the daily dose for individual average over a lifetime. It ranged from 0.00031 to 0.02190. For HI, the mean was 0.00091 ± 0.00063 . It ranges from 0.00004 to 0.00312. HI will determine whether the residents are at risk or not. All the results were below HI and considered safe (Table 4.9).

Table 4.9: Data of the CDI and HI

Variable	Mean	s.d.	Minimum	Maximum
CDI	0.00640	0.00446	0.0003	0.0219
HI	0.00091	0.00063	0.00004	0.0031

CHAPTER 5

DISCUSSION, CONCLUSION & RECOMMENDATIONS

5.1 Discussion

5.1.1 Socio-Demographic Data of Respondents

Respondents from this study consisted of (85%) Malay respondents and fifteen (15%) Indian respondents from three different residential areas. There was no Chinese respondent from this study. Based on the census done on the population of Taiping, Perak, Malay residents consists of 62%, Chinese residents consist of 25% and Indian consist of 11% residents. According to Lembaga Air Perak (LAP), only these three residential areas received treated water supply from Gunung Semanggol Water Treatment Plant. Unfortunately, there was no Chinese respondent to represent the census done in previous years.

The mean age of residents these three residential areas was 39.51 ± 11.10 years old. Taman Yayasan mean age of residents was 42.29 ± 10.26 years old which were the highest, followed by Taman Mewah which was 39.35 ± 11.07 years old and lastly Taman Kamunting Bakti which was 35.52 ± 11.55 years old.

For income level, the mean was $\text{RM}1647.32 \pm 1346.50$ and ranged from $\text{RM} 100$ to $\text{RM} 10000$ per month. Based on the study, it was found that most of the residents work at nearby factories. These three residential areas were near to each other and also near to industrial areas.

The overall mean bodyweight for these three residential areas were $65.99 \pm 14.39\text{kg}$ and ranged from 40-125 kg. The highest mean recorded was 70.6 ± 19.72 kg from Taman Kamunting Bakti, followed by 66.71 ± 11.56 kg from Taman Yayasan and lastly 62.14 ± 11.92 kg from Taman Mewah.

For the duration of residence, the mean was 7.81 ± 6.53 years. Taman Mewah and Taman Yayasan recorded almost 10 years of residencies, but Taman Kamunting Bakti showed mean of 1.78 ± 0.96 years. This was due to this residential area was still new.

There were 56% male respondents and 44% female respondents in this study. For the education level, there is none (0%) of the respondents with no education. For UPSR level, there were twelve (12) respondents (12%) followed by PMR (25%), SPM (55%), IPT (6%) and lastly others is 2%.

All the socio-demographic data was generated based on several inclusive criterias such as adult respondents and respondents that not use water filters.

5.1.2 The Concentration of Residual Al in Drinking Water

The mean residual of Al concentration in drinking water for these three residential areas were 0.33 ± 0.18 mg/l. It ranged from 0.01-0.86 mg/l. Based on the mean residual of Al concentration, it was already against the limit by WHO which was set at 0.2 mg/l.

This could be due to several factors that induced the increase of the concentration of alum in drinking water. The treatment plant was fully utilized the alum in coagulation process. According to Driscoll and Letterman (1988), it was reported that approximately 11% of Al input remained in the treated water. Although alum was efficient in removing turbidity, they may result in high concentration of Al residue in the treated water.

Besides that, the highest concentration achieved in this study was 0.86 mg/l. In a 1987 survey in Ontario, Al levels in treated drinking water ranged from 0.003 to 4.6 mg/l (Miller, Kopfler, Keitly, Stober, & Ulmer, 1984). In Manitoba, Al level of up to 1.79 mg/l had been recorded in finished water of the distribution system although the levels were mostly below 0.1 mg/l in the drinking water (Health Canada, 1995). In Saskatchewan, the average dissolved Al concentration in Regina's drinking water is about 0.035 mg/l, whereas that in Saskatoon's drinking water is about 0.724 mg/l (Nargang, 1998)

5.1.3 Comparison of Residual Al Concentration across Three Residential Areas

Kruskal Wallis test was done to compare the residual Al concentration across the three residential areas since the residual Al concentration is non parametric. Based on the results, it showed that the p-value is 0 indicating that that the observed association is unlikely to have occurred by chance and there was a significant difference of residual Al concentration in drinking water between the three residential areas.

According to Driscoll and Letterman (1988), it was reported that approximately 11% of Al input remained in the treated water. Where residual concentrations are high, Al iron (III) may be deposited in the distribution system. Disturbance of the deposits by change in flow rate may increase levels of Al and iron ions at the tap and lead to undesirable colour and turbidity and health problems (WHO, 1996). The deposition in the pipe depends on chemical factors, such as pH, alkalinity, dissolving residual coagulant (Al and iron (II, III)), and physical properties, such as flow and velocity, as well as the pipe material (McNeill, & Edwards, 2000). Distribution systems could be the factor that led to the significant difference of al concentration in drinking water between the three residential areas.

A study by Lopez, Cabrera, Lorenzo, and Lopez (2002) in Granada, Spain produced same findings where there was significant different in residual Al concentration between difference areas. In addition, a study by Rubinos *et al.*, (2005) also came out with differences between residual Al concentration between coast Galicia basins and inner Galicia basins.

5.1.4 Relationship of Residual Al Concentration with Distance from Water Treatment Plant

According to Ronald, Nicholas, & William (1992), concentration of residual Al in domestic water supply in Llanbrynmair area have been shown to increase from 1mg to 50mg/l during its 18 km journey along the water main.

Another study stated otherwise results and similar to this study. According to Cech & Montera (2000), concentrations of total Al up to 530 mg/l were observed in tap water treated with alum coagulant. There was a progressive decrease in total Al concentrations away from the water treatment plant, the gradient was rather small, on average of 7 mg/l km of distance, in the distribution system as long as 36 km.

5.1.5 Residual Al Concentration in Drinking Water and pH Reading in Drinking Water and Their Relationship.

Spearman correlation test showed there was low relationship between residual Al concentration and pH reading where the r value ($R=0.349$). According to Figure 1, it showed that Al was more soluble in basic pH solution. It could be due to the excess hydrated lime used to increase the pH value or inefficient mixture of the alum and the hydrated lime. It can be observed that mostly waters containing Al above 0.2 mg/l presented pH above 7. According to Rubinos *et al.*,(2005), they observed that all the waters containing Al above 0.2 mg L⁻¹ presented pH values below 7, and the waters with the highest Al content (above 0.5 mg L⁻¹) presented pH values below 6.

Several investigators have described how the pH of drinking water may affect the solubility of Al components (Forbes, McAiney, & Agwani, 1994). It is plausible that the biological availability of Al is higher for low pH than for high pH, which would lead to an interaction between pH and Al. According to Rondeau, Commenges, Jacquemin-Gadda, and Dartigues (2000), these results were not confirmed in the study nevertheless, 98.7 percent of the pH values were higher than 7 (range, 6.31–8.44).

Meanwhile, Srinivasan et al. (1998) stated that Al being an amphoteric element is soluble at extremely acidic ($\text{pH} < 6$) and alkaline ($\text{pH} > 8.5$) conditions, but is insoluble at near neutral pH values (7.0 to 7.5).

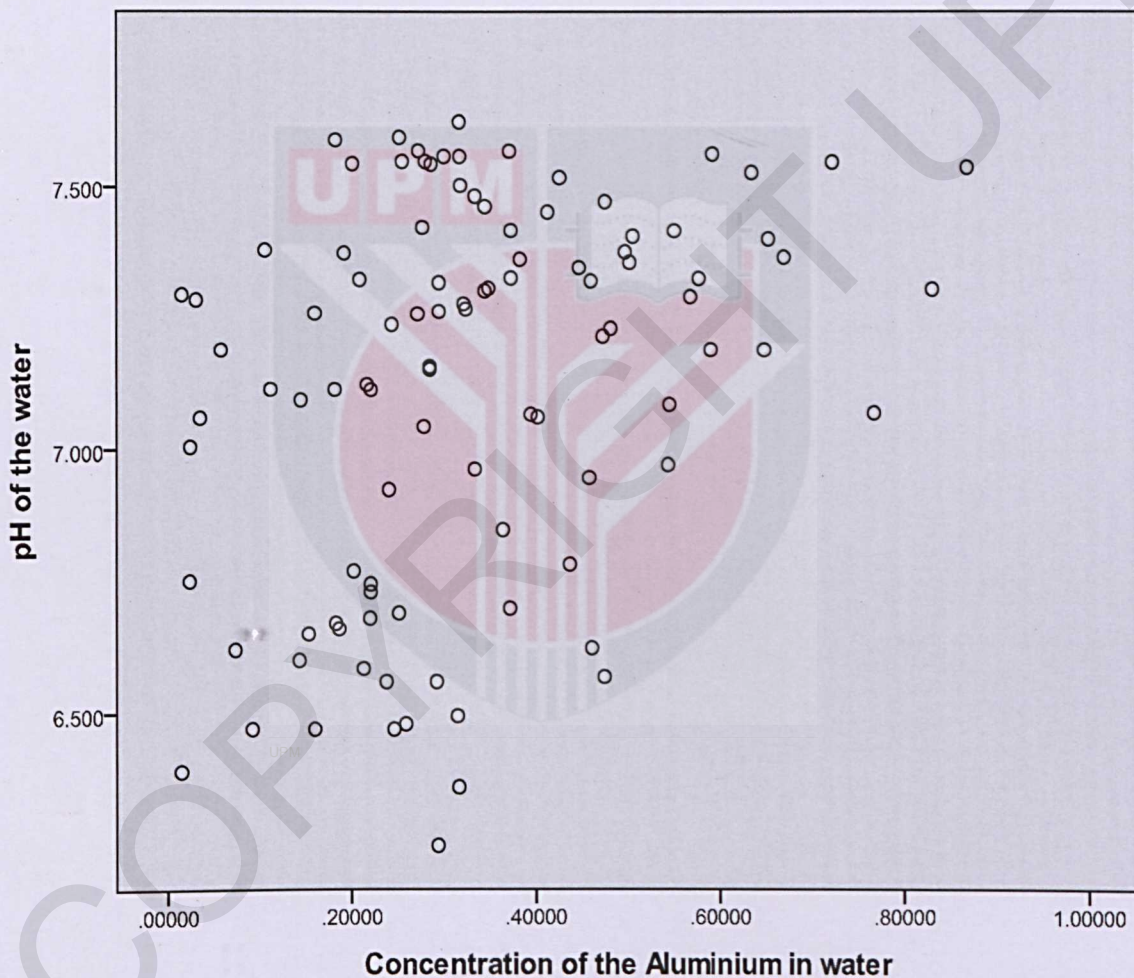


Figure 5.1: Residual Al (mg/l) concentration in drinking waters sampled versus measured pH

5.1.6 To Compare the Concentration of Residual Al in Drinking Water with the limit of National Standard of Drinking Water Quality (NSDWQ)

Based on this study, it was found that 79% of the house exceeded the NSDWQ standards (0.2mg/l). According to Miller et al., (1984), there was reported to be a 40 to 50% chance of increase in residual Al concentrations in drinking water over the concentrations in the raw water in plants using Al-based coagulants. Miller et al. (1984) found that after coagulation with Al salts, the residual Al concentration in the treated water varied from 0.01 to 2.37 mg/l.

Most of the houses exceeded the standard could be due to high pH coagulation and inefficient filtration system. According to Letterman and Driscoll (1988) found that low pH coagulation (6.50–7.00) combined with efficient filtration could reduce residual Al concentration. Besides that, the absence of phosphate salts could increase residual Al concentration because according to Frommel, Feld, Snoeyink, and Melcher (2004), the presence of phosphate salts could enhance the coagulation efficiency and reduce the residual Al concentration effectively.

According to Rahman (1992), a high (3.6 to 6mg/l) concentration of residual Al in treated water gives rise to turbidity, reduces disinfection efficiency, and may precipitate as $\text{Al}(\text{OH})_3$ during the course of distribution. According to Costello (1984),

deposition of Al hydrolysis products on pipe walls, which decreases carrying capacity also associated with increase of al concentration.

5.1.7 To Calculate the Chronic Daily Intake (CDI) and Hazard Index (HI).

CDI of the respondents were ranged from 0.0003 ± 0.0219 with mean of 0.006 ± 0.004 . WHO recommends reference dose (RfD) of 7 mg/kg/day (FAO/WHO, 1989) where it is an estimate of daily ingestion exposure to human population that is likely to be without an appreciable risk of deleterious effect during a lifetime.

Hazard index (HI) was used to estimate for non-carcinogenic risk. CDI will divide with reference dose which was 7 mg/kg /day.

HI values for all respondents were below 1 indicated that all the respondents were safe and the values were tolerable for them. HI values greater than 1 indicate that there is potential for an adverse health effect to occur.

5.2 Conclusion

First hypothesis was rejected since there was a difference of residual Al concentration between the three residential areas in Kamunting, Perak. It showed that the p-value is 0 indicating that that the observed association is unlikely to have occurred by chance and there was a significant difference of residual Al concentration in drinking water between the three residential areas.

Second hypothesis accepted since the distance of the residential areas from the water treatment plant in Gunung Semanggol does affect the residual Al concentration and it produces inversely proportional direction and low relationship

Third hypothesis was accepted since there was a relationship between residual Al concentration and also pH. In this study, the results showed low relationship where $r=0.349$.

The fourth hypothesis was accepted since there was a significant difference between NSDWQ Al limit standard and residual Al concentration level in drinking water.

The final hypothesis was accepted since there is no respondent where their HI above 1.

5.3 Recommendations

Turbidity can be caused by many substances like silt, minerals dissolution (as iron), fine organic and inorganic matter, algae (phytoplankton), and other microscopic organisms (virus, bacteria, etc) (Hassiba, Madani, Amna, Hakim, and Nabil,2012). That was why to purify potable water; a combination of chemical and physical processes is used. It consists of coagulation/flocculation followed by settling, filtration and/or flotation where alum was used extensively.

In order to achieve an optimum and a low level of residual Al in drinking water, there were several recommendations to be considered by both parties, which were the authority and public themselves.

For the authority attention, the easiest way is to enhanced and upgrades the efficiencies of the temperature, pH and turbidity of the water. These three components are important factors in determining Al solubility and consequently residual Al concentration. Al being an amphoteric element is soluble at extremely acidic ($\text{pH} < 6$)

and alkaline ($\text{pH} > 8.5$) conditions, but is insoluble at near neutral pH values (7.0 to 7.5). At lower temperature (4°C), the pH of minimum solubility increases, resulting in alum coagulation and hence resulting in higher residual Al levels (Srivinasan et al., 1999).

Another recommendation is to use sulphuric acid. Jasim, Fraser, Huck, Urfer, & Anderson (1997), reported that pH depression (when alum was used with sulphuric acid (Case 1) down to as low as 6.5 resulted in a significant reduction of soluble Al concentration, compared to use of alum without the addition of sulphuric acid (Case 2). Soluble Al levels for Case 1 were 30, 40 and 75 mg/l at pH of 6.5, 6.7 and 6.9 respectively. For Case 2, soluble Al levels were 120, 140, and 150 mg/l at pH of 7.3, 7.5 and 7.6 respectively. These experiments show that soluble Al is dependent on the pH value.

Other recommendation is the usage of Chitosan as the alum aid which was a natural polymer prepared from crab, shrimp and lobster shells. It has been used as coagulant in water treatment to avoid the human health problems caused by the residual Al and chemical polymers in water. It has been tested for Keddara dam in Algeria and characterised by low turbidity was treated using Chitosan as primary flocculants and as coagulant aid with alum. When it was use as a substitute to alum, the results was not as efficient as alum, but when it combines with alum, it reduces turbidity for 97 % (Hassiba et al., 2012). So, it may reduce the use of alum by combine both of the materials.

The second option is to use the plant based coagulants such as Nirmali seed, Oleifera, cactus, and Tannin. The advantages of using plants base coagulants are they are cost effective, unlikely to produce treated water with extreme pH and highly biodegradable. In the age of climate change, depletion of earth's natural resources and widespread environmental degradation, application of these coagulants is a vital effort in line with the global sustainable development initiatives (Chun, 2010).

According to Diaz, Rincon, Escorihuela, Fernandez, Chacin, & Forster (1999), the coagulation ability of the *Cactus latifaria* and the seeds of *Prosopis juliflora* were assessed by the use of standard jar test measurements. Both materials produced comparable turbidity removals and were able to produce final water whose turbidity was close to the required standard of 5NTU with both high (100–200 NTU) and low (30–40 NTU) initial turbidities. This was comparable with the performance achieved by previous workers using *Moringa oleifera* extracts. The optimum coagulant dose was found to be lower than that for alum.

Public also may take proactive steps in order to prevent excessive intake of alum in drinking water. Some of the recommendations here are using the water filter with reverse osmosis machine. Researchers have discovered that if we have two types of solution which are hypertonic and hypotonic and feed the water with sufficient pressure to overcome the osmotic pressure of the two waters, it can produce clean water on the

side of the membrane that has no pressure. Researcher often use the word “filter” the water through the membrane. Reverse osmosis machine will reduce the Al content by 98% according to according to the University of Arizona's SAHRA Project (Sustainability of semi-Arid Hydrology and Riparian Areas).

Another type of filter with proven efficiency in removing Al in tap water is the distillation system filter. The system concept is by removing minerals and boiling the water and uses the steam to produce pure water.

Public were also advice to take mineral water since they are free from Al. Mineral water obtained from running water sources located underground, this type of water picks up these minerals from the rocks it flows over such as potassium, sodium, magnesium and calcium by taking this initiative, public may reduce the use of consuming the tap water and also maintaining a healthy lifestyle.

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APPENDICES

Project information explanation sheet to respondents

Respondents consent letter

Ethical approval letter

Permission letter from Lembaga Air Perak (LAP) water
distribution chart in Kamunting

Questionnaire (Malay version)

GFAAS results

PENERANGAN KEPADA PESERTA

TAJUK KAJIAN:

Kajian Risiko Kesihatan terhadap Pendedahan Aluminium di dalam Air Minum di Tiga Kawasan Perumahan di Taiping Perak

Terima kasih kerana membantu kami di dalam kajian ini.

1. **Apakah kajian ini?**

Kajian ini adalah berkaitan dengan risiko kesihatan terhadap air minum kalangan responden. Kandungan alumium dalam air minum boleh menyebabkan kesan kesihatan seperti penyakit Alzheimer atau dikenali sebagai nyanyuk.

2. **Apakah tujuan kajian ini?**

Kajian ini dijalankan bertujuan untuk mengkaji risiko kesihatan terhadap pendedahan aluminium di dalam air minum di kalangan penduduk di kawasan perumahan. Kajian ini menentukan sama ada penduduk terdedah atau tidak kepada risiko kesihatan yang disebabkan pendedahan aluminium dalam air minum.

3. **Berapa ramai responden yang terpilih?**

Responden akan dipilih dari tiga buah kawasan perumahan di Taiping Perak. Seramai 100 orang responden akan dipilih untuk kajian ini.

4. **Apakah jenis ujian yang akan dijalankan?**

Semua responden akan diberikan borang soal selidik untuk diisi sendiri oleh responden. Selain daripada itu, sampel air minum dari paip air di bahagian dapur akan diambil bagi proses analisis sampel air. Berat badan respondent serta pengambilan air minum bagi sehari untuk setiap respondent akan diambil dan dicatat oleh pengkaji.

5. Adakah bayaran dikenakan?

Pengkaji akan menanggung segala pembiayaan ujian yang akan dijalankan dan tiada sebarang bayaran dikenakan terhadap setiap responden.

6. Adakah maklumat dijamin sulit?

Semua maklumat yang diberikan oleh responden di dalam borang kaji selidik adalah dijamin sulit. Tiada huraian individu akan dibuat pada mana-mana bahagian di dalam kajian atau penerbitan.

7. Adakah hak anda?

Kajian ini melibatkan anda sebagai peserta secara sukarela. Oleh itu, peserta mempunyai hak untuk menarik diri dari penyertaan dalam kajian ini pada bila-bila masa sekiranya peserta merasa tidak selesa untuk memberikan maklumat kepada pengkaji.

8. Apakah yang harus anda lakukan?

Anda dikehendaki menandatangani borang penyertaan responden yang menyatakan minat anda untuk menyertai kajian ini. Ianya boleh dilakukan setelah anda membaca dan memahami isi kandungan penerangan ini. Borang penyertaan responden haruslah dikembalikan kepada penyelidik sebelum ujian dijalankan. Sekiranya anda mempunyai sebarang kemusykilan, penyelidik akan membantu untuk memberi maklumat yang selanjutnya.

Terima kasih atas kerjasama dan bantuan anda.

MOHD AIZUDDIN AHMAD

Penyelidik

B. Sc. Kesihatan Persekitaran dan Pekerjaan

Unit Kesihatan Persekitaran dan Pekerjaan

Jabatan Kesihatan komuniti

Fakulti Perubatan dan Sains Kesihatan

Universti Putra Malaysia.

013-9971535

mohdaizuddinahmad@yahoo.com

CONSENT FORM (RESPONDENT)

RESEARCH TITLE :

RESEARCHER :

I Identity Card No.
address.....

.....hereby voluntarily agree to
take part in the clinical research *(clinical study, questionnaire study/ drug trial) specified
above.

I have been informed about the nature of the clinical research in terms of methodology,
possible adverse effects and complications (refer to Information Sheet). I understand that I
have the right to withdraw from this clinical research at any time without assigning any reason
whatsoever. I also understand that this study is confidential and all information provided with
regards to my identity will remain private and confidential.

I wish to *know/don't wish to know the results of the tests performed on my sample.

* delete where necessary

Signature
(Respondent)

Signature
(Witness)

Date :

Name :

I/C No. :

I confirm that I have explained to the respondent the nature and purpose of the above –
mentioned clinical research.

Date

Signature
(Researcher)

Borang Soal Selidik Aluminium

BAHAGIAN A

No. KadPengenalan

--	--	--	--	--	--	--	--	--	--	--	--

Nama:

Alamat:

No Tel. Rumah:

Bimbit:

1. Jantina

Lelaki

Perempuan

5. Jumlah Pendapatan isi rumah

..... (Nyatakan)

2. Bangsa

Melayu

Cina

India

Lain-lain

..... (Nyatakan)

3. Tahap pendidikan

Tidak Belajar, UPSR

PMR, SPM

IPT, Lain-lain

..... (nyatakan)

4. Pekerjaan

Kerajaan, Swasta

Sendiri, Tidak bekerja

Lain-lain

..... (Nyatakan)

BAHAGIAN B

5. Berapa lama tinggal di kawasan ini?

..... (Tahun)..... (bulan)

6. Apakah bekalan air yang digunakan

Paip air JBA
Telaga
Gabungan diatas
Lain-lain

..... (Nyatakan)

7. Berapa lama anda menerima bekalan air paip

..... (Tahun)..... (bulan)

8. Berapa gelas air yang anda minum sehari

.....Gelas sehari

9. Pernahkah air paip berbau?

Ya

Tidak

10. Pernahkah air paip mengalami kekeruhan

Ya

Tidak

11. Apakah sumber air yang anda kerap gunakan?

Air paip

Air botol

12. Adakah anda mengambil ubat-ubatan?

Ya

Tidak

13. Jika Ya, apakah ubat-ubatan tersebut

..... (Nyatakan)

BAHAGIAN C: Kegunaan penyelidikan

14. Berat badan responden

.....KG

15. Kepekatan aluminium dalam air

.....Mg/L

16. Adakah sering kali anda bersifat pelupa?

Ya Tidak

17. Adakah ahli keluarga anda mempunyai sejarah penyakit Alzheimer (penyakit nyanyuk)?

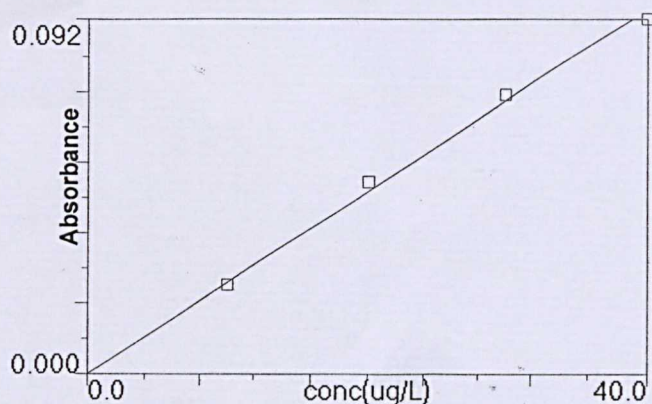
Ya Tidak

*Baseline, descriptive and time, National Human Exposure Assessment Survey (NHEXAS)-Arizona study (Kavcar et. Al, 2009).

Method: AI_KPP (50ppb)

Result: FYP-AI-10 feb

AI 309.3



Calib Eq'n: Lin Thru 0
Corr Coeff: 0.997349



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Mean: 6.812 6.812 0.0161
 SD: 1.677 1.677 0.0040
 %RSD: 24.62 24.62 24.62

Sequence No.: 61

Autosampler Location: 70

Sample ID: Sample ID (I)58

Date Collected: 2/10/2012 9:43:48 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 70

Replicate Data: Sample ID (I)58

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	10.21	10.21	0.0241	0.0254	0.1734	0.0054	0.0301	21:44:38	Yes
2	9.551	9.551	0.0226	0.0239	0.1620	0.0055	0.0308	21:47:18	Yes
Mean:	9.880	9.880	0.0234						
SD:	0.465	0.465	0.0011						
%RSD:	4.709	4.709	4.71						

Sequence No.: 62

Autosampler Location: 71

Sample ID: Sample ID (I)59

Date Collected: 2/10/2012 9:49:08 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 71

Replicate Data: Sample ID (I)59

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	9.622	9.622	0.0227	0.0240	0.1421	0.0051	0.0285	21:50:13	Yes
2	-0.510	-0.510	-0.0012	0.0001	0.0004	0.0000	0.0004	21:52:53	Yes
Mean:	4.556	4.556	0.0108						
SD:	7.165	7.165	0.0169						
%RSD:	157.3	157.3	157.26						

Sequence No.: 63

Autosampler Location: 72

Sample ID: Sample ID (I)60

Date Collected: 2/10/2012 9:54:43 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 72

Replicate Data: Sample ID (I)60

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	-0.463	-0.463	-0.0011	0.0002	0.0013	0.0002	0.0006	21:55:34	Yes
2	-0.508	-0.508	-0.0012	0.0001	0.0005	0.0000	0.0006	21:58:14	Yes
Mean:	-0.486	-0.486	-0.0011						
SD:	0.032	0.032	0.0001						
%RSD:	6.550	6.550	6.55						

Sequence No.: 64

Autosampler Location: 73

Sample ID: Sample ID (D)1

Date Collected: 2/10/2012 10:00:04 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 73

Replicate Data: Sample ID (D)1

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	0.274	0.274	0.0006	0.0019	0.0064	0.0006	0.0012	22:00:55	Yes
2	1.224	1.224	0.0029	0.0042	0.0309	0.0007	0.0045	22:03:35	Yes
Mean:	0.749	0.749	0.0018						
SD:	0.671	0.671	0.0016						
%RSD:	89.68	89.68	89.68						

Sequence No.: 65
 Sample ID: Sample ID (D)2
 Analyst:
 uL dispensed: 5 from 121, 20 from 74

Autosampler Location: 74
 Date Collected: 2/10/2012 10:05:25 PM
 Data Type: Original

Replicate Data: Sample ID (D)2

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	27.64	27.64	0.0653	0.0666	0.2565	0.0129	0.0498	22:06:15	Yes
2	9.558	9.558	0.0226	0.0239	0.2114	0.0051	0.0345	22:08:55	Yes
Mean:	18.60	18.60	0.0440						
SD:	12.79	12.79	0.0302						
%RSD:	68.75	68.75	68.75						

Sequence No.: 66
 Sample ID: Sample ID (D)3
 Analyst:
 uL dispensed: 5 from 121, 20 from 75

Autosampler Location: 75
 Date Collected: 2/10/2012 10:10:45 PM
 Data Type: Original

Replicate Data: Sample ID (D)3

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	8.748	8.748	0.0207	0.0220	0.1716	0.0055	0.0369	22:11:36	Yes
2	20.65	20.65	0.0488	0.0501	0.2951	0.0106	0.0556	22:14:16	Yes
Mean:	14.70	14.70	0.0347						
SD:	8.417	8.417	0.0199						
%RSD:	57.26	57.26	57.26						

Sequence No.: 67
 Sample ID: Sample ID (D)4
 Analyst:
 uL dispensed: 5 from 121, 20 from 76

Autosampler Location: 76
 Date Collected: 2/10/2012 10:16:06 PM
 Data Type: Original

Replicate Data: Sample ID (D)4

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	6.428	6.428	0.0152	0.0165	0.1417	0.0036	0.0283	22:16:56	Yes
2	7.889	7.889	0.0186	0.0199	0.1833	0.0050	0.0361	22:19:37	Yes
Mean:	7.158	7.158	0.0169						
SD:	1.034	1.034	0.0024						
%RSD:	14.44	14.44	14.44						

Sequence No.: 68
 Sample ID: Sample ID (D)5
 Analyst:
 uL dispensed: 5 from 121, 20 from 77

Autosampler Location: 77
 Date Collected: 2/10/2012 10:21:27 PM
 Data Type: Original

Replicate Data: Sample ID (D)5

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	14.13	14.13	0.0334	0.0347	0.2698	0.0074	0.0615	22:22:17	Yes
2	9.664	9.664	0.0228	0.0241	0.1984	0.0050	0.0386	22:24:57	Yes
Mean:	11.90	11.90	0.0281						
SD:	3.159	3.159	0.0075						
%RSD:	26.55	26.55	26.55						

Sequence No.: 69

Autosampler Location: 78

Sample ID: Sample ID (D)6

Date Collected: 2/10/2012 10:26:47 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 78

Replicate Data: Sample ID (D)6

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	8.564	8.564	0.0202	0.0215	0.1614	0.0048	0.0343	22:27:37	Yes
2	0.672	0.672	0.0016	0.0029	0.0122	0.0008	0.0023	22:30:33	Yes
Mean:	4.618	4.618	0.0109						
SD:	5.580	5.580	0.0132						
%RSD:	120.8	120.8	120.83						

Sequence No.: 70

Autosampler Location: 79

Sample ID: Sample ID (D)7

Date Collected: 2/10/2012 10:32:23 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 79

Replicate Data: Sample ID (D)7

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	1.152	1.152	0.0027	0.0040	0.0168	0.0008	0.0030	22:33:14	Yes
2	6.227	6.227	0.0147	0.0160	0.1629	0.0042	0.0269	22:35:54	Yes
Mean:	3.689	3.689	0.0087						
SD:	3.589	3.589	0.0085						
%RSD:	97.27	97.27	97.27						

Sequence No.: 71

Autosampler Location: 80

Sample ID: Sample ID (D)8

Date Collected: 2/10/2012 10:37:44 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 80

Replicate Data: Sample ID (D)8

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	13.05	13.05	0.0309	0.0321	0.2779	0.0070	0.0602	22:38:34	Yes
2	12.85	12.85	0.0304	0.0317	0.2648	0.0066	0.0424	22:41:14	Yes
Mean:	12.95	12.95	0.0306						
SD:	0.146	0.146	0.0003						
%RSD:	1.126	1.126	1.13						

Sequence No.: 72

Autosampler Location: 81

Sample ID: Sample ID (D)9

Date Collected: 2/10/2012 10:43:04 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 81

Replicate Data: Sample ID (D)9

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	14.15	14.15	0.0334	0.0347	0.3830	0.0079	0.0785	22:43:54	Yes
2	7.863	7.863	0.0186	0.0199	0.0874	0.0038	0.0163	22:46:34	Yes
Mean:	11.01	11.01	0.0260						
SD:	4.445	4.445	0.0105						
%RSD:	40.39	40.39	40.39						

Sequence No.: 73

Autosampler Location: 82

Sample ID: Sample ID (D)10

Date Collected: 2/10/2012 10:48:24 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 82

Replicate Data: Sample ID (D)10

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	9.652	9.652	0.0228	0.0241	0.2116	0.0059	0.0459	22:49:15	Yes
2	8.646	8.646	0.0204	0.0217	0.1636	0.0050	0.0369	22:51:56	Yes
Mean:	9.149	9.149	0.0216						
SD:	0.711	0.711	0.0017						
%RSD:	7.772	7.772	7.77						

Sequence No.: 74

Autosampler Location: 83

Sample ID: Sample ID (D)11

Date Collected: 2/10/2012 10:53:46 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 83

Replicate Data: Sample ID (D)11

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	7.582	7.582	0.0179	0.0192	0.1662	0.0044	0.0281	22:54:37	Yes
2	7.768	7.768	0.0184	0.0197	0.1560	0.0044	0.0287	22:57:17	Yes
Mean:	7.675	7.675	0.0181						
SD:	0.131	0.131	0.0003						
%RSD:	1.713	1.713	1.71						

Sequence No.: 75

Autosampler Location: 84

Sample ID: Sample ID (D)12

Date Collected: 2/10/2012 10:59:07 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 84

Replicate Data: Sample ID (D)12

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	14.02	14.02	0.0331	0.0344	0.3053	0.0073	0.0530	22:59:57	Yes
2	15.21	15.21	0.0360	0.0372	0.2702	0.0078	0.0595	23:02:37	Yes
Mean:	14.62	14.62	0.0345						
SD:	0.840	0.840	0.0020						
%RSD:	5.746	5.746	5.75						

Sequence No.: 76

Autosampler Location: 85

Sample ID: Sample ID (D)13

Date Collected: 2/10/2012 11:04:27 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 85

Replicate Data: Sample ID (D)13

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	18.26	18.26	0.0432	0.0445	0.2313	0.0086	0.0436	23:05:17	Yes
2	13.41	13.41	0.0317	0.0330	0.2805	0.0070	0.0460	23:07:58	Yes
Mean:	15.84	15.84	0.0374						
SD:	3.429	3.429	0.0081						
%RSD:	21.65	21.65	21.65						

Sequence No.: 77

Autosampler Location: 86

Sample ID: Sample ID (D)14

Date Collected: 2/10/2012 11:09:48 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 86

Replicate Data: Sample ID (D)14

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	10.18	10.18	0.0240	0.0253	0.2400	0.0064	0.0406	23:10:38	Yes
2	8.467	8.467	0.0200	0.0213	0.1821	0.0049	0.0320	23:13:19	Yes
Mean:	9.321	9.321	0.0220						
SD:	1.208	1.208	0.0029						
%RSD:	12.96	12.96	12.96						

Sequence No.: 78

Sample ID: Sample ID (D)15

Analyst:

uL dispensed: 5 from 121, 20 from 87

Autosampler Location: 87

Date Collected: 2/10/2012 11:15:09 PM

Data Type: Original

Replicate Data: Sample ID (D)15

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	24.81	24.81	0.0586	0.0599	0.4359	0.0121	0.0843	23:16:00	Yes
2	22.63	22.63	0.0535	0.0548	0.4456	0.0112	0.0835	23:18:40	Yes
Mean:	23.72	23.72	0.0561						
SD:	1.543	1.543	0.0036						
%RSD:	6.504	6.504	6.50						

Sequence No.: 79

Sample ID: Sample ID (D)16

Analyst:

uL dispensed: 5 from 121, 20 from 88

Autosampler Location: 88

Date Collected: 2/10/2012 11:20:30 PM

Data Type: Original

Replicate Data: Sample ID (D)16

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	11.68	11.68	0.0276	0.0289	0.2026	0.0062	0.0399	23:21:20	Yes
2	13.48	13.48	0.0319	0.0331	0.1714	0.0062	0.0312	23:24:01	Yes
Mean:	12.58	12.58	0.0297						
SD:	1.272	1.272	0.0030						
%RSD:	10.12	10.12	10.12						

Sequence No.: 80

Sample ID: Sample ID (D)17

Analyst:

uL dispensed: 5 from 121, 20 from 89

Autosampler Location: 89

Date Collected: 2/10/2012 11:25:51 PM

Data Type: Original

Replicate Data: Sample ID (D)17

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	12.06	12.06	0.0285	0.0298	0.2707	0.0069	0.0511	23:26:42	Yes
2	12.56	12.56	0.0297	0.0310	0.2694	0.0069	0.0488	23:29:37	Yes
Mean:	12.31	12.31	0.0291						
SD:	0.357	0.357	0.0008						
%RSD:	2.900	2.900	2.90						

Sequence No.: 81

Sample ID: Sample ID (D)18

Analyst:

uL dispensed: 5 from 121, 20 from 90

Autosampler Location: 90

Date Collected: 2/10/2012 11:31:27 PM

Data Type: Original

Replicate Data: Sample ID (D)18

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	4.379	4.379	0.0104	0.0116	0.0615	0.0024	0.0115	23:32:17	Yes

2 11.63 11.63 0.0275 0.0288 0.2644 0.0057 0.0484 23:34:57 Yes
 Mean: 8.004 8.004 0.0189
 SD: 5.126 5.126 0.0121
 %RSD: 64.04 64.04 64.04

Sequence No.: 82 Autosampler Location: 91
 Sample ID: Sample ID (D)19 Date Collected: 2/10/2012 11:36:47 PM
 Analyst: Data Type: Original
 uL dispensed: 5 from 121, 20 from 91

Replicate Data: Sample ID (D)19

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	12.15	12.15	0.0287	0.0300	0.2454	0.0062	0.0398	23:37:37	Yes
2	9.167	9.167	0.0217	0.0230	0.1859	0.0054	0.0393	23:40:17	Yes
Mean:	10.66	10.66	0.0252						
SD:	2.109	2.109	0.0050						
%RSD:	19.79	19.79	19.79						

Sequence No.: 83 Autosampler Location: 92
 Sample ID: Sample ID (D)20 Date Collected: 2/10/2012 11:42:07 PM
 Analyst: Data Type: Original
 uL dispensed: 5 from 121, 20 from 92

Replicate Data: Sample ID (D)20

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	10.81	10.81	0.0255	0.0268	0.2334	0.0062	0.0388	23:42:57	Yes
2	11.30	11.30	0.0267	0.0280	0.2193	0.0066	0.0479	23:45:37	Yes
Mean:	11.05	11.05	0.0261						
SD:	0.348	0.348	0.0008						
%RSD:	3.146	3.146	3.15						

Sequence No.: 84 Autosampler Location: 93
 Sample ID: Sample ID (D)21 Date Collected: 2/10/2012 11:47:27 PM
 Analyst: Data Type: Original
 uL dispensed: 5 from 121, 20 from 93

Replicate Data: Sample ID (D)21

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	5.600	5.600	0.0132	0.0145	0.0617	0.0029	0.0117	23:48:17	Yes
2	16.48	16.48	0.0390	0.0402	0.3445	0.0091	0.0698	23:50:58	Yes
Mean:	11.04	11.04	0.0261						
SD:	7.695	7.695	0.0182						
%RSD:	69.70	69.70	69.70						

Sequence No.: 85 Autosampler Location: 94
 Sample ID: Sample ID (D)22 Date Collected: 2/10/2012 11:52:48 PM
 Analyst: Data Type: Original
 uL dispensed: 5 from 121, 20 from 94

Replicate Data: Sample ID (D)22

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	11.57	11.57	0.0274	0.0286	0.2093	0.0057	0.0389	23:53:38	Yes
2	10.10	10.10	0.0239	0.0252	0.2160	0.0055	0.0407	23:56:18	Yes
Mean:	10.84	10.84	0.0256						
SD:	1.044	1.044	0.0025						

%RSD: 9.632 9.632 9.63

Sequence No.: 86

Autosampler Location: 95

Sample ID: Sample ID (D)23

Date Collected: 2/10/2012 11:58:08 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 95

Replicate Data: Sample ID (D)23

Repl	SampleConc	StndConc	Blncorr	Peak	Peak	Bkgnd	Bkgnd	Time	Peak
#	ug/L	ug/L	Signal	Area	Height	Area	Height		Stored
1	25.26	25.26	0.0597	0.0610	0.4320	0.0124	0.0838	23:58:59	Yes
2	207.7	207.7	0.4908	0.4921	0.4599	0.0978	0.0958	00:01:40	Yes

Sample concentration is greater than that of the highest standard.

Mean: 116.5 116.5 0.2753

SD: 129.0 129.0 0.3048

%RSD: 110.7 110.7 110.75

Sample concentration is greater than that of the highest standard.

Sequence No.: 87

Autosampler Location: 96

Sample ID: Sample ID (D)24

Date Collected: 2/11/2012 12:03:30 AM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 96

Replicate Data: Sample ID (D)24

Repl	SampleConc	StndConc	Blncorr	Peak	Peak	Bkgnd	Bkgnd	Time	Peak
#	ug/L	ug/L	Signal	Area	Height	Area	Height		Stored
1	10.24	10.24	0.0242	0.0255	0.1592	0.0049	0.0285	00:04:20	Yes
2	10.65	10.65	0.0252	0.0265	0.1873	0.0060	0.0374	00:07:01	Yes

Mean: 10.44 10.44 0.0247

SD: 0.292 0.292 0.0007

%RSD: 2.797 2.797 2.80

Sequence No.: 88

Autosampler Location: 97

Sample ID: Sample ID (D)25

Date Collected: 2/11/2012 12:08:51 AM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 97

Replicate Data: Sample ID (D)25

Repl	SampleConc	StndConc	Blncorr	Peak	Peak	Bkgnd	Bkgnd	Time	Peak
#	ug/L	ug/L	Signal	Area	Height	Area	Height		Stored
1	12.12	12.12	0.0286	0.0299	0.2366	0.0062	0.0404	00:09:42	Yes
2	11.91	11.91	0.0282	0.0295	0.1983	0.0059	0.0418	00:12:36	Yes

Mean: 12.02 12.02 0.0284

SD: 0.145 0.145 0.0003

%RSD: 1.208 1.208 1.21

Sequence No.: 89

Autosampler Location: 98

Sample ID: Sample ID (D)26

Date Collected: 2/11/2012 12:14:26 AM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 98

Replicate Data: Sample ID (D)26

Repl	SampleConc	StndConc	Blncorr	Peak	Peak	Bkgnd	Bkgnd	Time	Peak
#	ug/L	ug/L	Signal	Area	Height	Area	Height		Stored
1	30.63	30.63	0.0724	0.0737	0.4119	0.0146	0.0856	00:15:16	Yes
2	23.69	23.69	0.0560	0.0573	0.4342	0.0117	0.0854	00:17:56	Yes

Mean: 27.16 27.16 0.0642

SD: 4.909 4.909 0.0116

%RSD: 18.07 18.07 18.07

Sequence No.: 90
 Sample ID: Sample ID (D)27
 Analyst:
 uL dispensed: 5 from 121, 20 from 99

Autosampler Location: 99
 Date Collected: 2/11/2012 12:19:46 AM
 Data Type: Original

Replicate Data: Sample ID (D)27

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	1.839	1.839	0.0043	0.0056	0.0250	0.0010	0.0047	00:20:36	Yes
2	1.693	1.693	0.0040	0.0053	0.0369	0.0011	0.0065	00:23:16	Yes
Mean:	1.766	1.766	0.0042						
SD:	0.103	0.103	0.0002						
%RSD:	5.856	5.856	5.86						

Sequence No.: 91
 Sample ID: Sample ID (D)28
 Analyst:
 uL dispensed: 5 from 121, 20 from 100

Autosampler Location: 100
 Date Collected: 2/11/2012 12:25:06 AM
 Data Type: Original

Replicate Data: Sample ID (D)28

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	1.775	1.775	0.0042	0.0055	0.0241	0.0012	0.0045	00:25:57	Yes
2	9.415	9.415	0.0223	0.0235	0.1806	0.0051	0.0327	00:28:38	Yes
Mean:	5.595	5.595	0.0132						
SD:	5.402	5.402	0.0128						
%RSD:	96.56	96.56	96.56						

Sequence No.: 92
 Sample ID: Sample ID (D)29
 Analyst:
 uL dispensed: 5 from 121, 20 from 101

Autosampler Location: 101
 Date Collected: 2/11/2012 12:30:28 AM
 Data Type: Original

Replicate Data: Sample ID (D)29

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	27.04	27.04	0.0639	0.0652	0.3377	0.0124	0.0652	00:31:20	Yes
2	21.08	21.08	0.0498	0.0511	0.3816	0.0106	0.0769	00:34:02	Yes
Mean:	24.06	24.06	0.0569						
SD:	4.215	4.215	0.0100						
%RSD:	17.52	17.52	17.52						

Sequence No.: 93
 Sample ID: Sample ID (D)30
 Analyst:
 uL dispensed: 5 from 121, 20 from 102

Autosampler Location: 102
 Date Collected: 2/11/2012 12:35:52 AM
 Data Type: Original

Replicate Data: Sample ID (D)30

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	13.35	13.35	0.0316	0.0328	0.2790	0.0073	0.0478	00:36:44	Yes
2	13.80	13.80	0.0326	0.0339	0.2571	0.0078	0.0573	00:39:27	Yes
Mean:	13.58	13.58	0.0321						
SD:	0.320	0.320	0.0008						
%RSD:	2.355	2.355	2.36						

Sequence No.: 94

Autosampler Location: 103

Sample ID: Sample ID (D)31

Date Collected: 2/11/2012 12:41:18 AM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 103

Replicate Data: Sample ID (D)31

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	7.418	7.418	0.0175	0.0188	0.1634	0.0043	0.0297	00:42:10	Yes
2	12.81	12.81	0.0303	0.0316	0.1790	0.0068	0.0375	00:44:51	Yes
Mean:	10.12	10.12	0.0239						
SD:	3.815	3.815	0.0090						
%RSD:	37.71	37.71	37.71						

===== Sequence No.: 95

Autosampler Location: 104

Sample ID: Sample ID (D)32

Date Collected: 2/11/2012 12:46:41 AM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 104

Replicate Data: Sample ID (D)32

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	14.24	14.24	0.0337	0.0350	0.2627	0.0073	0.0515	00:47:33	Yes
2	13.62	13.62	0.0322	0.0335	0.1869	0.0064	0.0351	00:50:15	Yes
Mean:	13.93	13.93	0.0329						
SD:	0.439	0.439	0.0010						
%RSD:	3.153	3.153	3.15						

===== Sequence No.: 96

Autosampler Location: 105

Sample ID: Sample ID (D)33

Date Collected: 2/11/2012 12:52:05 AM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 105

Replicate Data: Sample ID (D)33

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	10.67	10.67	0.0252	0.0265	0.2110	0.0057	0.0348	00:52:56	Yes
2	8.520	8.520	0.0201	0.0214	0.1650	0.0046	0.0286	00:55:38	Yes
Mean:	9.593	9.593	0.0227						
SD:	1.517	1.517	0.0036						
%RSD:	15.81	15.81	15.81						

===== Sequence No.: 97

Autosampler Location: 106

Sample ID: Sample ID (D)34

Date Collected: 2/11/2012 12:57:29 AM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 106

Replicate Data: Sample ID (D)34

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	9.439	9.439	0.0223	0.0236	0.1888	0.0051	0.0300	00:58:21	Yes
2	8.820	8.820	0.0208	0.0221	0.1872	0.0053	0.0377	01:01:03	Yes
Mean:	9.129	9.129	0.0216						
SD:	0.437	0.437	0.0010						
%RSD:	4.791	4.791	4.79						

===== Sequence No.: 98

Autosampler Location: 107

Sample ID: Sample ID (D)35

Date Collected: 2/11/2012 1:02:53 AM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 107

Replicate Data: Sample ID (D)35

Repl	SampleConc	StndConc	BlnkCorr	Peak	Peak	Bkgnd	Bkgnd	Time	Peak
#	ug/L	ug/L	Signal	Area	Height	Area	Height		Stored
1	4.358	4.358	0.0103	0.0116	0.0306	0.0021	0.0054	01:03:45	Yes
2	10.11	10.11	0.0239	0.0252	0.2031	0.0059	0.0438	01:06:27	Yes
Mean:	7.232	7.232	0.0171						
SD:	4.064	4.064	0.0096						
%RSD:	56.20	56.20	56.20						

Sequence No.: 99

Autosampler Location: 108

Sample ID: Sample ID (D)36

Date Collected: 2/11/2012 1:08:18 AM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 108

Replicate Data: Sample ID (D)36

Repl	SampleConc	StndConc	BlnkCorr	Peak	Peak	Bkgnd	Bkgnd	Time	Peak
#	ug/L	ug/L	Signal	Area	Height	Area	Height		Stored
1	11.74	11.74	0.0278	0.0291	0.2309	0.0063	0.0464	01:09:10	Yes
2	12.61	12.61	0.0298	0.0311	0.2229	0.0070	0.0491	01:11:52	Yes
Mean:	12.18	12.18	0.0288						
SD:	0.614	0.614	0.0015						
%RSD:	5.040	5.040	5.04						

Sequence No.: 100

Autosampler Location: 109

Sample ID: Sample ID (D)37

Date Collected: 2/11/2012 1:13:42 AM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 109

Replicate Data: Sample ID (D)37

Repl	SampleConc	StndConc	BlnkCorr	Peak	Peak	Bkgnd	Bkgnd	Time	Peak
#	ug/L	ug/L	Signal	Area	Height	Area	Height		Stored
1	14.61	14.61	0.0345	0.0358	0.2212	0.0067	0.0425	01:14:34	Yes
2	62.08	62.08	0.1467	0.1480	0.5241	0.0293	0.1102	01:17:17	Yes
Sample concentration is greater than that of the highest standard.									
Mean:	38.34	38.34	0.0906						
SD:	33.56	33.56	0.0793						
%RSD:	87.54	87.54	87.54						

Sequence No.: 101

Autosampler Location: 110

Sample ID: Sample ID (D)38

Date Collected: 2/11/2012 1:19:08 AM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 110

Replicate Data: Sample ID (D)38

Repl	SampleConc	StndConc	BlnkCorr	Peak	Peak	Bkgnd	Bkgnd	Time	Peak
#	ug/L	ug/L	Signal	Area	Height	Area	Height		Stored
1	90.93	90.93	0.2149	0.2162	0.7922	0.0873	0.6122	01:20:00	Yes
Sample concentration is greater than that of the highest standard. Sample beyond calibration range. It will be diluted and reanalyzed.									

Sequence No.: 102

Autosampler Location: 110

Sample ID: Sample ID (D)38

Date Collected: 2/11/2012 1:21:51 AM

Analyst:

Data Type: Original

uL dispensed: 5 from 1, 5 from 121, 15 from 110

Replicate Data: Sample ID (D)38

Repl	SampleConc	StndConc	BlnkCorr	Peak	Peak	Bkgnd	Bkgnd	Time	Peak
------	------------	----------	----------	------	------	-------	-------	------	------

#	ug/L	ug/L	Signal	Area	Height	Area	Height		Stored
1	143.9	108.0	0.2551	0.2564	0.7745	0.0823	0.3785	01:22:44	Yes

Sample concentration is greater than that of the highest standard.
 Sample beyond calibration range. It will be diluted and reanalyzed.

Sequence No.: 103

Autosampler Location: 110

Sample ID: Sample ID (D)38

Date Collected: 2/11/2012 1:24:35 AM

Analyst:

Data Type: Original

uL dispensed: 10 from 1, 5 from 121, 10 from 110

Replicate Data: Sample ID (D)38

Repl	SampleConc	StndConc	Blncorr	Peak	Peak	Bkgnd	Bkgnd	Time	Peak
#	ug/L	ug/L	Signal	Area	Height	Area	Height		Stored
1	148.8	74.42	0.1759	0.1772	0.7935	0.0605	0.4556	01:25:27	Yes

Sample concentration is greater than that of the highest standard.
 Sample beyond calibration range. It will be diluted and reanalyzed.

Sequence No.: 104

Autosampler Location: 110

Sample ID: Sample ID (D)38

Date Collected: 2/11/2012 1:27:18 AM

Analyst:

Data Type: Original

uL dispensed: 15 from 1, 5 from 121, 5 from 110

Replicate Data: Sample ID (D)38

Repl	SampleConc	StndConc	Blncorr	Peak	Peak	Bkgnd	Bkgnd	Time	Peak
#	ug/L	ug/L	Signal	Area	Height	Area	Height		Stored
1	246.6	61.65	0.1457	0.1470	0.7765	0.0421	0.3190	01:28:10	Yes

Sample concentration is greater than that of the highest standard.
 Sample beyond calibration range. It will be diluted and reanalyzed.

Sequence No.: 105

Autosampler Location: 110

Sample ID: Sample ID (D)38

Date Collected: 2/11/2012 1:30:01 AM

Analyst:

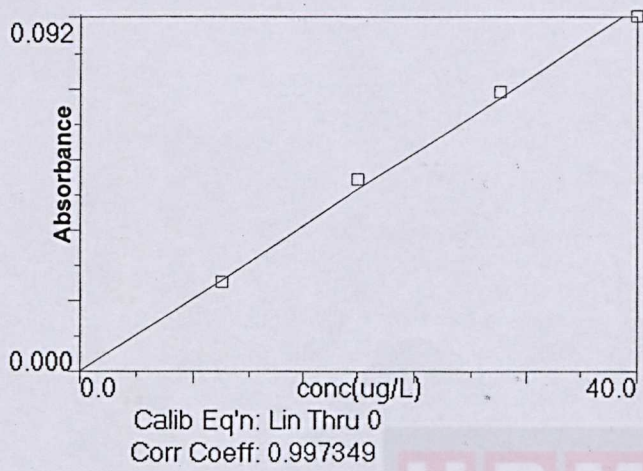
Data Type: Original

uL dispensed: 18 from 1, 5 from 121, 2 from 110

Replicate Data: Sample ID (D)38

Repl	SampleConc	StndConc	Blncorr	Peak	Peak	Bkgnd	Bkgnd	Time	Peak
#	ug/L	ug/L	Signal	Area	Height	Area	Height		Stored
1	305.4	30.54	0.0722	0.0735	0.5428	0.0169	0.1366	01:30:54	Yes
2	291.9	29.19	0.0690	0.0703	0.5093	0.0146	0.1165	01:33:39	Yes
Mean:	298.6	29.86	0.0706						
SD:	9.565	0.956	0.0023						
%RSD:	3.203	3.203	3.20						

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Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1		[10]	0.0195	0.0208	0.2122	0.0054	0.0442	11:40:29	No
2		[10]	0.0265	0.0278	0.2834	0.0064	0.0574	11:43:11	No
Mean:		[10]	0.0230						
SD:		0	0.0050						
%RSD:		0	21.69						

Standard number 1 applied. [10]
Correlation Coef.: 0.997349 Slope: 0.00236 Intercept: 0.00000

Sequence No.: 3 Autosampler Location: 129
Sample ID: Calib Std 2 Date Collected: 2/9/2012 11:45:02 AM
Analyst: Data Type: Reprocessed on 2/11/2012 10:33:43 AM
Logged In Analyst (Original) :

Replicate Data: Calib Std 2

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1		[20]	0.0514	0.0527	0.4546	0.0110	0.0806	11:45:54	No
2		[20]	0.0481	0.0494	0.4438	0.0102	0.0894	11:48:37	No
Mean:		[20]	0.0498						
SD:		0	0.0023						
%RSD:		0	4.62						

Standard number 2 applied. [20]
Correlation Coef.: 0.997349 Slope: 0.00236 Intercept: 0.00000

Sequence No.: 4 Autosampler Location: 129
Sample ID: Calib Std 3 Date Collected: 2/9/2012 11:50:28 AM
Analyst: Data Type: Reprocessed on 2/11/2012 10:33:44 AM
Logged In Analyst (Original) :

Replicate Data: Calib Std 3

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1		[30]	0.0718	0.0731	0.5810	0.0155	0.1379	11:51:20	No
2		[30]	0.0731	0.0744	0.5904	0.0160	0.1418	11:54:02	No
Mean:		[30]	0.0724						
SD:		0	0.0009						
%RSD:		0	1.22						

Standard number 3 applied. [30]
Correlation Coef.: 0.997349 Slope: 0.00236 Intercept: 0.00000

Sequence No.: 5 Autosampler Location: 129
Sample ID: Calib Std 4 Date Collected: 2/9/2012 11:55:53 AM
Analyst: Data Type: Reprocessed on 2/11/2012 10:33:44 AM
Logged In Analyst (Original) :

Replicate Data: Calib Std 4

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1		[40]	0.0906	0.0919	0.7031	0.0193	0.1635	11:56:45	No
2		[40]	0.0937	0.0950	0.6725	0.0204	0.1770	11:59:28	No
Mean:		[40]	0.0921						
SD:		0	0.0022						
%RSD:		0	2.34						

Standard number 4 applied. [40]
Correlation Coef.: 0.997349 Slope: 0.00236 Intercept: 0.00000

Analysis Begun

Logged In Analyst: AAnalyst600
Spectrometer Model: AA600, S/N 600S7110601

Technique: AA Furnace
Autosampler Model: AS-800

Sample Information File: C:\data-AA\AAnalyst600\Sample Information\FYP-Al-11 feb.sif
Batch ID: FYP-Al-11 feb
Results Data Set: FYP-Al-11 feb
Results Library: C:\data-AA\AAnalyst600\Results\Results.mdb

Sequence No.: 1
Sample ID: Sample ID-(D)1
Analyst:
uL dispensed: 5 from 121, 20 from 1

Autosampler Location: 1
Date Collected: 2/11/2012 10:34:48 AM
Data Type: Original

Replicate Data: Sample ID-(D)1

Repl	SampleConc	StndConc	BlnkCorr	Peak	Peak	Bkgnd	Bkgnd	Time	Peak
#	ug/L	ug/L	Signal	Area	Height	Area	Height		Stored
1	8.992	8.992	0.0213	0.0225	0.2143	0.0048	0.0389	10:35:31	Yes
2	9.165	9.165	0.0217	0.0230	0.1613	0.0048	0.0312	10:38:10	Yes
Mean:	9.078	9.078	0.0215						
SD:	0.122	0.122	0.0003						
%RSD:	1.346	1.346	1.35						

Analysis Begun

Logged In Analyst: AAnalyst600
Spectrometer Model: AA600, S/N 600S7110601

Technique: AA Furnace
Autosampler Model: AS-800

Sample Information File: C:\data-AA\AAnalyst600\Sample Information\FYP-Al-11 feb.sif
Batch ID: FYP-Al-11 feb
Results Data Set: FYP-Al-11 feb
Results Library: C:\data-AA\AAnalyst600\Results\Results.mdb

Sequence No.: 1
Sample ID: Sample ID-(D)2
Analyst:
uL dispensed: 5 from 121, 20 from 2

Autosampler Location: 2
Date Collected: 2/11/2012 10:44:07 AM
Data Type: Original

Replicate Data: Sample ID-(D)2

Repl	SampleConc	StndConc	BlnkCorr	Peak	Peak	Bkgnd	Bkgnd	Time	Peak
#	ug/L	ug/L	Signal	Area	Height	Area	Height		Stored
1	31.89	31.89	0.0754	0.0767	0.3648	0.0144	0.0628	10:44:50	Yes
2	15.36	15.36	0.0363	0.0376	0.3175	0.0079	0.0567	10:47:28	Yes
Mean:	23.62	23.62	0.0558						
SD:	11.69	11.69	0.0276						
%RSD:	49.50	49.50	49.50						

Sequence No.: 2
Sample ID: Sample ID-(D)3
Analyst:
uL dispensed: 5 from 121, 20 from 3

Autosampler Location: 3
Date Collected: 2/11/2012 10:49:19 AM
Data Type: Original

Replicate Data: Sample ID-(D)3

Repl	SampleConc	StndConc	BlnkCorr	Peak	Peak	Bkgnd	Bkgnd	Time	Peak
#	ug/L	ug/L	Signal	Area	Height	Area	Height		Stored
1	8.170	8.170	0.0193	0.0206	0.1809	0.0040	0.0286	10:50:08	Yes
2	7.842	7.842	0.0185	0.0198	0.0912	0.0038	0.0172	10:53:02	Yes
Mean:	8.006	8.006	0.0189						
SD:	0.232	0.232	0.0005						
%RSD:	2.900	2.900	2.90						

Sequence No.: 3

Sample ID: Sample ID-(D)4

Analyst:

uL dispensed: 5 from 121, 20 from 4

Autosampler Location: 4

Date Collected: 2/11/2012 10:54:53 AM

Data Type: Original

Replicate Data: Sample ID-(D)4

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	14.24	14.24	0.0336	0.0349	0.3303	0.0072	0.0541	10:55:41	Yes
2	68.80	68.80	0.1626	0.1639	0.2972	0.0311	0.0565	10:58:21	Yes

Sample concentration is greater than that of the highest standard.

Mean: 41.52 41.52 0.0981
SD: 38.58 38.58 0.0912
%RSD: 92.93 92.93 92.93

Sequence No.: 4

Sample ID: Sample ID-(D)5

Analyst:

uL dispensed: 5 from 121, 20 from 5

Autosampler Location: 5

Date Collected: 2/11/2012 11:00:12 AM

Data Type: Original

Replicate Data: Sample ID-(D)5

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	54.08	54.08	0.1278	0.1291	0.7707	0.0329	0.2777	11:01:01	Yes

Sample concentration is greater than that of the highest standard.
Sample beyond calibration range. It will be diluted and reanalyzed.

Sequence No.: 5

Sample ID: Sample ID-(D)5

Analyst:

uL dispensed: 5 from 1, 5 from 121, 15 from 5

Autosampler Location: 5

Date Collected: 2/11/2012 11:02:52 AM

Data Type: Original

Replicate Data: Sample ID-(D)5

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	65.14	48.86	0.1155	0.1168	0.7554	0.0277	0.2397	11:03:41	Yes

Sample concentration is greater than that of the highest standard.
Sample beyond calibration range. It will be diluted and reanalyzed.

Sequence No.: 6

Sample ID: Sample ID-(D)5

Analyst:

uL dispensed: 10 from 1, 5 from 121, 10 from 5

Autosampler Location: 5

Date Collected: 2/11/2012 11:05:32 AM

Data Type: Original

Replicate Data: Sample ID-(D)5

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	134.5	67.25	0.1589	0.1602	0.6935	0.0320	0.1545	11:06:21	Yes

Sample concentration is greater than that of the highest standard.
Sample beyond calibration range. It will be diluted and reanalyzed.

Sequence No.: 7

Sample ID: Sample ID-(D)5

Analyst:

uL dispensed: 15 from 1, 5 from 121, 5 from 5

Autosampler Location: 5

Date Collected: 2/11/2012 11:08:12 AM

Data Type: Original

Replicate Data: Sample ID-(D)5

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	113.2	28.31	0.0669	0.0682	0.5566	0.0141	0.1031	11:09:22	Yes
2	118.1	29.52	0.0698	0.0711	0.5593	0.0149	0.1104	11:12:02	Yes
Mean:	115.7	28.91	0.0683						
SD:	3.440	0.860	0.0020						
%RSD:	2.974	2.974	2.97						

Sequence No.: 8

Autosampler Location: 6

Sample ID: Sample ID-(D)6

Date Collected: 2/11/2012 11:13:53 AM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 6

Replicate Data: Sample ID-(D)6

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	20.96	20.96	0.0495	0.0508	0.2391	0.0102	0.0464	11:14:42	Yes
2	10.84	10.84	0.0256	0.0269	0.2183	0.0059	0.0408	11:17:22	Yes
Mean:	15.90	15.90	0.0376						
SD:	7.159	7.159	0.0169						
%RSD:	45.03	45.03	45.03						

Sequence No.: 9

Autosampler Location: 7

Sample ID: Sample ID-(D)7

Date Collected: 2/11/2012 11:19:13 AM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 7

Replicate Data: Sample ID-(D)7

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	14.73	14.73	0.0348	0.0361	0.2583	0.0075	0.0475	11:20:02	Yes
2	14.75	14.75	0.0349	0.0362	0.2484	0.0075	0.0510	11:22:42	Yes
Mean:	14.74	14.74	0.0348						
SD:	0.017	0.017	0.0000						
%RSD:	0.113	0.113	0.11						

Sequence No.: 10

Autosampler Location: 8

Sample ID: Sample ID-(D)8

Date Collected: 2/11/2012 11:24:33 AM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 8

Replicate Data: Sample ID-(D)8

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	36.52	36.52	0.0863	0.0876	0.5271	0.0179	0.1255	11:25:22	Yes
2	35.69	35.69	0.0843	0.0856	0.5670	0.0175	0.1180	11:28:16	Yes
Mean:	36.10	36.10	0.0853						
SD:	0.588	0.588	0.0014						
%RSD:	1.628	1.628	1.63						

Sequence No.: 11

Autosampler Location: 9

Sample ID: Sample ID-(D)9

Date Collected: 2/11/2012 11:30:07 AM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 9

Replicate Data: Sample ID-(D)9

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	13.50	13.50	0.0319	0.0332	0.2435	0.0072	0.0476	11:31:10	Yes

2	11.67	11.67	0.0276	0.0289	0.2091	0.0064	0.0470	11:33:50	Yes
Mean:	12.59	12.59	0.0297						
SD:	1.290	1.290	0.0030						
%RSD:	10.25	10.25	10.25						

Sequence No.: 12

Autosampler Location: 10

Sample ID: Sample ID-(D)10

Date Collected: 2/11/2012 11:35:41 AM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 10

Replicate Data: Sample ID-(D)10

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	31.29	31.29	0.0740	0.0752	0.4913	0.0153	0.1021	11:36:44	Yes
2	27.90	27.90	0.0659	0.0672	0.4516	0.0136	0.0872	11:39:38	Yes
Mean:	29.60	29.60	0.0699						
SD:	2.397	2.397	0.0057						
%RSD:	8.099	8.099	8.10						

Sequence No.: 13

Autosampler Location: 11

Sample ID: Sample ID-(D)11

Date Collected: 2/11/2012 11:41:29 AM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 11

Replicate Data: Sample ID-(D)11

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	12.82	12.82	0.0303	0.0316	0.2336	0.0069	0.0495	11:42:18	Yes
2	12.69	12.69	0.0300	0.0313	0.2228	0.0068	0.0455	11:44:58	Yes
Mean:	12.75	12.75	0.0301						
SD:	0.087	0.087	0.0002						
%RSD:	0.678	0.678	0.68						

Sequence No.: 14

Autosampler Location: 12

Sample ID: Sample ID-(D)12

Date Collected: 2/11/2012 11:46:49 AM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 12

Replicate Data: Sample ID-(D)12

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	38.62	38.62	0.0913	0.0926	0.4893	0.0184	0.0896	11:47:38	Yes
2	24.82	24.82	0.0587	0.0600	0.3712	0.0122	0.0801	11:50:32	Yes
Mean:	31.72	31.72	0.0750						
SD:	9.760	9.760	0.0231						
%RSD:	30.77	30.77	30.77						

Sequence No.: 15

Autosampler Location: 13

Sample ID: Sample ID-(D)13

Date Collected: 2/11/2012 11:52:23 AM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 13

Replicate Data: Sample ID-(D)13

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	18.25	18.25	0.0431	0.0444	0.2844	0.0091	0.0579	11:53:26	Yes
2	18.88	18.88	0.0446	0.0459	0.3127	0.0096	0.0575	11:56:06	Yes
Mean:	18.57	18.57	0.0439						
SD:	0.444	0.444	0.0011						

%RSD: 2.394 2.394 2.39

Sequence No.: 16

Autosampler Location: 14

Sample ID: Sample ID-(D)14

Date Collected: 2/11/2012 11:57:57 AM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 14

Replicate Data: Sample ID-(D)14

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	13.63	13.63	0.0322	0.0335	0.2783	0.0071	0.0502	11:59:00	Yes
2	14.37	14.37	0.0340	0.0353	0.2569	0.0075	0.0444	12:01:54	Yes
Mean:	14.00	14.00	0.0331						
SD:	0.519	0.519	0.0012						
%RSD:	3.706	3.706	3.71						

Sequence No.: 17

Autosampler Location: 15

Sample ID: Sample ID-(D)15

Date Collected: 2/11/2012 12:03:45 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 15

Replicate Data: Sample ID-(D)15

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	15.30	15.30	0.0362	0.0375	0.2378	0.0078	0.0485	12:04:48	Yes
2	28.41	28.41	0.0671	0.0684	0.3181	0.0137	0.0617	12:07:42	Yes
Mean:	21.85	21.85	0.0516						
SD:	9.269	9.269	0.0219						
%RSD:	42.41	42.41	42.41						

Sequence No.: 18

Autosampler Location: 16

Sample ID: Sample ID-(D)16

Date Collected: 2/11/2012 12:09:33 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 16

Replicate Data: Sample ID-(D)16

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	17.90	17.90	0.0423	0.0436	0.3317	0.0094	0.0601	12:10:22	Yes
2	18.52	18.52	0.0438	0.0451	0.3394	0.0097	0.0661	12:13:02	Yes
Mean:	18.21	18.21	0.0430						
SD:	0.441	0.441	0.0010						
%RSD:	2.420	2.420	2.42						

Sequence No.: 19

Autosampler Location: 17

Sample ID: Sample ID-(D)17

Date Collected: 2/11/2012 12:14:53 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 17

Replicate Data: Sample ID-(D)17

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	23.11	23.11	0.0546	0.0559	0.3871	0.0120	0.0814	12:15:42	Yes
2	22.97	22.97	0.0543	0.0556	0.3788	0.0116	0.0837	12:18:37	Yes
Mean:	23.04	23.04	0.0545						
SD:	0.099	0.099	0.0002						
%RSD:	0.427	0.427	0.43						

Sequence No.: 20

Autosampler Location: 18

Sample ID: Sample ID-(D)18

Date Collected: 2/11/2012 12:20:28 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 18

Replicate Data: Sample ID-(D)18

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	17.13	17.13	0.0405	0.0418	0.3084	0.0092	0.0601	12:21:17	Yes
2	138.1	138.1	0.3263	0.3276	0.5521	0.0673	0.1210	12:23:57	Yes

Sample concentration is greater than that of the highest standard.

Mean: 77.59 77.59 0.1834

SD: 85.50 85.50 0.2021

%RSD: 110.2 110.2 110.19

Sample concentration is greater than that of the highest standard.

Sequence No.: 21

Autosampler Location: 19

Sample ID: Sample ID-(D)19

Date Collected: 2/11/2012 12:25:48 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 19

Replicate Data: Sample ID-(D)19

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	23.21	23.21	0.0549	0.0561	0.3781	0.0117	0.0754	12:26:37	Yes
2	22.58	22.58	0.0534	0.0547	0.3660	0.0114	0.0773	12:29:17	Yes

Mean: 22.89 22.89 0.0541

SD: 0.448 0.448 0.0011

%RSD: 1.957 1.957 1.96

Sequence No.: 22

Autosampler Location: 20

Sample ID: Sample ID-(D)20

Date Collected: 2/11/2012 12:31:08 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 20

Replicate Data: Sample ID-(D)20

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	20.13	20.13	0.0476	0.0489	0.2967	0.0099	0.0647	12:32:12	Yes
2	20.08	20.08	0.0475	0.0487	0.3257	0.0103	0.0634	12:35:07	Yes

Mean: 20.10 20.10 0.0475

SD: 0.035 0.035 0.0001

%RSD: 0.175 0.175 0.18

Sequence No.: 23

Autosampler Location: 21

Sample ID: Sample ID-(D)21

Date Collected: 2/11/2012 12:36:58 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 21

Replicate Data: Sample ID-(D)21

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	16.08	16.08	0.0380	0.0393	0.3016	0.0085	0.0565	12:38:01	Yes
2	17.27	17.27	0.0408	0.0421	0.3465	0.0089	0.0658	12:40:41	Yes

Mean: 16.68 16.68 0.0394

SD: 0.841 0.841 0.0020

%RSD: 5.044 5.044 5.04

Sequence No.: 24

Autosampler Location: 22

Sample ID: Sample ID-(D)22

Date Collected: 2/11/2012 12:42:32 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 22

Replicate Data: Sample ID-(D)22

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	27.45	27.45	0.0649	0.0662	0.4681	0.0136	0.0970	12:43:21	Yes
2	27.02	27.02	0.0639	0.0652	0.4461	0.0135	0.0938	12:46:15	Yes
Mean:	27.23	27.23	0.0644						
SD:	0.303	0.303	0.0007						
%RSD:	1.113	1.113	1.11						

Sequence No.: 25

Autosampler Location: 23

Sample ID: Sample ID-(D)23

Date Collected: 2/11/2012 12:48:06 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 23

Replicate Data: Sample ID-(D)23

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	30.27	30.27	0.0716	0.0728	0.4678	0.0151	0.1049	12:48:55	Yes
2	28.68	28.68	0.0678	0.0691	0.4871	0.0146	0.1040	12:51:49	Yes
Mean:	29.48	29.48	0.0697						
SD:	1.130	1.130	0.0027						
%RSD:	3.833	3.833	3.83						

Sequence No.: 26

Autosampler Location: 24

Sample ID: Sample ID-(D)24

Date Collected: 2/11/2012 12:53:40 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 24

Replicate Data: Sample ID-(D)24

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	32.24	32.24	0.0762	0.0775	0.5145	0.0163	0.1120	12:54:43	Yes
2	32.32	32.32	0.0764	0.0777	0.4907	0.0162	0.1061	12:57:23	Yes
Mean:	32.28	32.28	0.0763						
SD:	0.057	0.057	0.0001						
%RSD:	0.175	0.175	0.18						

Sequence No.: 27

Autosampler Location: 25

Sample ID: Sample ID-(D)25

Date Collected: 2/11/2012 12:59:14 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 25

Replicate Data: Sample ID-(D)25

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	14.77	14.77	0.0349	0.0362	0.2562	0.0077	0.0516	13:00:17	Yes
2	14.73	14.73	0.0348	0.0361	0.2653	0.0080	0.0520	13:03:11	Yes
Mean:	14.75	14.75	0.0349						
SD:	0.027	0.027	0.0001						
%RSD:	0.184	0.184	0.18						

Sequence No.: 28

Autosampler Location: 26

Sample ID: Sample ID-(D)26

Date Collected: 2/11/2012 1:05:02 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 26

Replicate Data: Sample ID-(D)26

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	14.35	14.35	0.0339	0.0352	0.2403	0.0078	0.0478	13:06:05	Yes
2	14.12	14.12	0.0334	0.0347	0.2519	0.0076	0.0512	13:08:45	Yes
Mean:	14.24	14.24	0.0336						
SD:	0.166	0.166	0.0004						
%RSD:	1.169	1.169	1.17						

=====

Sequence No.: 29
Sample ID: Sample ID-(D)27

Autosampler Location: 27

Date Collected: 2/11/2012 1:10:36 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 27

Replicate Data: Sample ID-(D)27

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	19.72	19.72	0.0466	0.0479	0.3358	0.0104	0.0715	13:11:39	Yes
2	19.71	19.71	0.0466	0.0479	0.3576	0.0101	0.0671	13:14:33	Yes
Mean:	19.72	19.72	0.0466						
SD:	0.008	0.008	0.0000						
%RSD:	0.041	0.041	0.04						

=====

Sequence No.: 30
Sample ID: Sample ID-(D)28

Autosampler Location: 28

Date Collected: 2/11/2012 1:16:24 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 28

Replicate Data: Sample ID-(D)28

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	17.14	17.14	0.0405	0.0418	0.2863	0.0091	0.0584	13:17:27	Yes
2	17.32	17.32	0.0409	0.0422	0.3178	0.0093	0.0626	13:20:07	Yes
Mean:	17.23	17.23	0.0407						
SD:	0.131	0.131	0.0003						
%RSD:	0.763	0.763	0.76						

=====

Sequence No.: 31
Sample ID: Sample ID-(D)29

Autosampler Location: 29

Date Collected: 2/11/2012 1:21:58 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 29

Replicate Data: Sample ID-(D)29

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	22.96	22.96	0.0543	0.0555	0.3846	0.0117	0.0727	13:22:47	Yes
2	22.97	22.97	0.0543	0.0556	0.3696	0.0118	0.0789	13:25:27	Yes
Mean:	22.97	22.97	0.0543						
SD:	0.014	0.014	0.0000						
%RSD:	0.060	0.060	0.06						

=====

Sequence No.: 32
Sample ID: Sample ID-(D)30

Autosampler Location: 30

Date Collected: 2/11/2012 1:27:18 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 30

Replicate Data: Sample ID-(D)30

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	18.68	18.68	0.0442	0.0455	0.3040	0.0098	0.0663	13:28:21	Yes
2	18.62	18.62	0.0440	0.0453	0.3339	0.0097	0.0595	13:31:01	Yes
Mean:	18.65	18.65	0.0441						
SD:	0.042	0.042	0.0001						
%RSD:	0.225	0.225	0.22						

Sequence No.: 33

Autosampler Location: 31

Sample ID: Sample ID-(D)31

Date Collected: 2/11/2012 1:32:52 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 31

Replicate Data: Sample ID-(D)31

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	16.30	16.30	0.0385	0.0398	0.2767	0.0086	0.0599	13:33:41	Yes
2	16.08	16.08	0.0380	0.0393	0.2997	0.0087	0.0613	13:36:35	Yes
Mean:	16.19	16.19	0.0383						
SD:	0.151	0.151	0.0004						
%RSD:	0.935	0.935	0.93						

Sequence No.: 34

Autosampler Location: 32

Sample ID: Sample ID-(D)32

Date Collected: 2/11/2012 1:38:26 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 32

Replicate Data: Sample ID-(D)32

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	24.36	24.36	0.0576	0.0589	0.4089	0.0127	0.0825	13:39:29	Yes
2	23.30	23.30	0.0551	0.0564	0.4381	0.0120	0.0780	13:42:09	Yes
Mean:	23.83	23.83	0.0563						
SD:	0.755	0.755	0.0018						
%RSD:	3.170	3.170	3.17						

Sequence No.: 35

Autosampler Location: 33

Sample ID: Sample ID-(D)33

Date Collected: 2/11/2012 1:44:00 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 33

Replicate Data: Sample ID-(D)33

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	16.26	16.26	0.0384	0.0397	0.3011	0.0088	0.0536	13:45:03	Yes
2	15.89	15.89	0.0375	0.0388	0.3042	0.0085	0.0535	13:47:57	Yes
Mean:	16.07	16.07	0.0380						
SD:	0.265	0.265	0.0006						
%RSD:	1.649	1.649	1.65						

Sequence No.: 36

Autosampler Location: 34

Sample ID: Sample ID-(D)34

Date Collected: 2/11/2012 1:49:48 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 34

Replicate Data: Sample ID-(D)34

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	29.80	29.80	0.0704	0.0717	0.4611	0.0149	0.0895	13:50:51	Yes

2	26.95	26.95	0.0637	0.0650	0.4310	0.0138	0.0875	13:53:45	Yes
Mean:	28.37	28.37	0.0671						
SD:	2.020	2.020	0.0048						
%RSD:	7.121	7.121	7.12						

Sequence No.: 37

Autosampler Location: 35

Sample ID: Sample ID-(D)35

Date Collected: 2/11/2012 1:55:36 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 35

Replicate Data: Sample ID-(D)35

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	13.64	13.64	0.0322	0.0335	0.2432	0.0076	0.0501	13:56:39	Yes
2	14.04	14.04	0.0332	0.0345	0.2574	0.0078	0.0460	13:59:33	Yes
Mean:	13.84	13.84	0.0327						
SD:	0.280	0.280	0.0007						
%RSD:	2.024	2.024	2.02						

Sequence No.: 38

Autosampler Location: 36

Sample ID: Sample ID-(D)36

Date Collected: 2/11/2012 2:01:24 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 36

Replicate Data: Sample ID-(D)36

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	28.68	28.68	0.0678	0.0691	0.4250	0.0144	0.0856	14:02:13	Yes
2	21.84	21.84	0.0516	0.0529	0.3664	0.0116	0.0704	14:04:53	Yes
Mean:	25.26	25.26	0.0597						
SD:	4.835	4.835	0.0114						
%RSD:	19.14	19.14	19.14						

Sequence No.: 39

Autosampler Location: 37

Sample ID: Sample ID-(D)37

Date Collected: 2/11/2012 2:06:44 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 37

Replicate Data: Sample ID-(D)37

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	22.84	22.84	0.0540	0.0553	0.3570	0.0118	0.0718	14:07:33	Yes
2	21.83	21.83	0.0516	0.0529	0.3746	0.0112	0.0707	14:10:13	Yes
Mean:	22.33	22.33	0.0528						
SD:	0.717	0.717	0.0017						
%RSD:	3.212	3.212	3.21						

Sequence No.: 40

Autosampler Location: 38

Sample ID: Sample ID-(D)38

Date Collected: 2/11/2012 2:12:04 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 38

Replicate Data: Sample ID-(D)38

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	24.66	24.66	0.0583	0.0596	0.4092	0.0125	0.0866	14:13:06	Yes
2	25.03	25.03	0.0592	0.0605	0.4137	0.0130	0.0809	14:15:59	Yes
Mean:	24.84	24.84	0.0587						
SD:	0.263	0.263	0.0006						

%RSD: 1.060 1.060 1.06

Sequence No.: 41

Autosampler Location: 39

Sample ID: Sample ID-(D)39

Date Collected: 2/11/2012 2:17:50 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 39

Replicate Data: Sample ID-(D)39

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	34.47	34.47	0.0815	0.0828	0.4792	0.0175	0.1098	14:18:39	Yes
2	32.42	32.42	0.0766	0.0779	0.5306	0.0164	0.1151	14:21:33	Yes
Mean:	33.45	33.45	0.0791						
SD:	1.446	1.446	0.0034						
%RSD:	4.323	4.323	4.32						

Sequence No.: 42

Autosampler Location: 40

Sample ID: Sample ID-(D)40

Date Collected: 2/11/2012 2:23:24 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 40

Replicate Data: Sample ID-(D)40

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	34.42	34.42	0.0814	0.0827	0.4531	0.0171	0.0985	14:24:27	Yes
2	30.82	30.82	0.0729	0.0741	0.4309	0.0148	0.0891	14:27:07	Yes
Mean:	32.62	32.62	0.0771						
SD:	2.545	2.545	0.0060						
%RSD:	7.800	7.800	7.80						

Sequence No.: 43

Autosampler Location: 41

Sample ID: Sample ID-(D)41

Date Collected: 2/11/2012 2:28:58 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 41

Replicate Data: Sample ID-(D)41

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	21.18	21.18	0.0501	0.0514	0.3644	0.0111	0.0743	14:29:49	Yes
2	20.09	20.09	0.0475	0.0488	0.3738	0.0102	0.0727	14:32:44	Yes
Mean:	20.64	20.64	0.0488						
SD:	0.772	0.772	0.0018						
%RSD:	3.742	3.742	3.74						

Sequence No.: 44

Autosampler Location: 42

Sample ID: Sample ID-(D)42

Date Collected: 2/11/2012 2:34:34 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 42

Replicate Data: Sample ID-(D)42

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	25.00	25.00	0.0591	0.0604	0.4111	0.0129	0.0883	14:35:24	Yes
2	25.16	25.16	0.0595	0.0608	0.3672	0.0128	0.0761	14:38:04	Yes
Mean:	25.08	25.08	0.0593						
SD:	0.117	0.117	0.0003						
%RSD:	0.466	0.466	0.47						

Sequence No.: 45
 Sample ID: Sample ID-(D)43
 Analyst:
 uL dispensed: 5 from 121, 20 from 43

Autosampler Location: 43
 Date Collected: 2/11/2012 2:39:54 PM
 Data Type: Original

Replicate Data: Sample ID-(D)43

Repl	SampleConc	StndConc	Blncorr	Peak	Peak	Bkgnd	Bkgnd	Time	Peak
#	ug/L	ug/L	Signal	Area	Height	Area	Height		Stored
1	15.10	15.10	0.0357	0.0370	0.2665	0.0082	0.0492	14:40:59	Yes
2	14.92	14.92	0.0353	0.0365	0.2470	0.0082	0.0503	14:43:39	Yes
Mean:	15.01	15.01	0.0355						
SD:	0.131	0.131	0.0003						
%RSD:	0.871	0.871	0.87						

Sequence No.: 46
 Sample ID: Sample ID-(D)44
 Analyst:
 uL dispensed: 5 from 121, 20 from 44

Autosampler Location: 44
 Date Collected: 2/11/2012 2:45:29 PM
 Data Type: Original

Replicate Data: Sample ID-(D)44

Repl	SampleConc	StndConc	Blncorr	Peak	Peak	Bkgnd	Bkgnd	Time	Peak
#	ug/L	ug/L	Signal	Area	Height	Area	Height		Stored
1	42.94	42.94	0.1015	0.1028	0.5952	0.0220	0.1398	14:46:19	Yes
2	43.68	43.68	0.1032	0.1045	0.5169	0.0214	0.1086	14:49:00	Yes
Mean:	43.31	43.31	0.1024						
SD:	0.523	0.523	0.0012						
%RSD:	1.208	1.208	1.21						

Sequence No.: 47
 Sample ID: Sample ID-(D)45
 Analyst:
 uL dispensed: 5 from 121, 20 from 45

Autosampler Location: 45
 Date Collected: 2/11/2012 2:50:50 PM
 Data Type: Original

Replicate Data: Sample ID-(D)45

Repl	SampleConc	StndConc	Blncorr	Peak	Peak	Bkgnd	Bkgnd	Time	Peak
#	ug/L	ug/L	Signal	Area	Height	Area	Height		Stored
1	16.05	16.05	0.0379	0.0392	0.2564	0.0086	0.0514	14:51:40	Yes
2	15.66	15.66	0.0370	0.0383	0.2501	0.0084	0.0491	14:54:35	Yes
Mean:	15.85	15.85	0.0375						
SD:	0.273	0.273	0.0006						
%RSD:	1.723	1.723	1.72						

Sequence No.: 48
 Sample ID: Sample ID-(D)46
 Analyst:
 uL dispensed: 5 from 121, 20 from 46

Autosampler Location: 46
 Date Collected: 2/11/2012 2:56:25 PM
 Data Type: Original

Replicate Data: Sample ID-(D)46

Repl	SampleConc	StndConc	Blncorr	Peak	Peak	Bkgnd	Bkgnd	Time	Peak
#	ug/L	ug/L	Signal	Area	Height	Area	Height		Stored
1	15.55	15.55	0.0367	0.0380	0.2375	0.0081	0.0419	14:57:15	Yes
2	16.17	16.17	0.0382	0.0395	0.2780	0.0087	0.0503	14:59:55	Yes
Mean:	15.86	15.86	0.0375						
SD:	0.442	0.442	0.0010						
%RSD:	2.787	2.787	2.79						

Sequence No.: 49
 Sample ID: Sample ID-(D)47
 Analyst:

Autosampler Location: 47
 Date Collected: 2/11/2012 3:01:45 PM
 Data Type: Original

uL dispensed: 5 from 121, 20 from 47

Replicate Data: Sample ID-(D)47

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	10.06	10.06	0.0238	0.0251	0.1544	0.0059	0.0282	15:02:36	Yes
2	10.04	10.04	0.0237	0.0250	0.1771	0.0060	0.0316	15:05:17	Yes
Mean:	10.05	10.05	0.0238						
SD:	0.016	0.016	0.0000						
%RSD:	0.160	0.160	0.16						

Sequence No.: 50

Autosampler Location: 48

Sample ID: Sample ID-(D)48

Date Collected: 2/11/2012 3:07:07 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 48

Replicate Data: Sample ID-(D)48

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	14.25	14.25	0.0337	0.0350	0.1933	0.0077	0.0394	15:07:57	Yes
2	14.25	14.25	0.0337	0.0350	0.2048	0.0078	0.0410	15:10:53	Yes
Mean:	14.25	14.25	0.0337						
SD:	0.000	0.000	0.0000						
%RSD:	0.002	0.002	0.00						

Sequence No.: 51

Autosampler Location: 49

Sample ID: Sample ID-(D)49

Date Collected: 2/11/2012 3:12:43 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 49

Replicate Data: Sample ID-(D)49

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	94.73	94.73	0.2239	0.2252	0.2671	0.0425	0.0501	15:13:33	Yes

Sample concentration is greater than that of the highest standard.

Sample beyond calibration range. It will be diluted and reanalyzed.

Sequence No.: 52

Autosampler Location: 49

Sample ID: Sample ID-(D)49

Date Collected: 2/11/2012 3:15:23 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 1, 5 from 121, 15 from 49

Replicate Data: Sample ID-(D)49

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	23.69	17.77	0.0420	0.0433	0.3170	0.0094	0.0640	15:16:14	Yes
2	31.32	23.49	0.0555	0.0568	0.2098	0.0114	0.0394	15:19:19	Yes
Mean:	27.51	20.63	0.0488						
SD:	5.397	4.048	0.0096						
%RSD:	19.62	19.62	19.62						

Sequence No.: 53

Autosampler Location: 50

Sample ID: Sample ID-(D)50

Date Collected: 2/11/2012 3:21:09 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 50

Replicate Data: Sample ID-(D)50

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
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#	ug/L	ug/L	Signal	Area	Height	Area	Height	Stored
1	24.65	24.65	0.0583	0.0596	0.3667	0.0126	0.0730	15:21:59 Yes
2	22.85	22.85	0.0540	0.0553	0.2890	0.0114	0.0545	15:24:39 Yes
Mean:	23.75	23.75	0.0561					
SD:	1.273	1.273	0.0030					
%RSD:	5.361	5.361	5.36					

Sequence No.: 54
 Sample ID: Sample ID-(D)51
 Analyst:
 uL dispensed: 5 from 121, 20 from 51

Autosampler Location: 51
 Date Collected: 2/11/2012 3:26:30 PM
 Data Type: Original

Replicate Data: Sample ID-(D)51

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	24.23	24.23	0.0573	0.0586	0.2541	0.0119	0.0485	15:27:36	Yes
2	18.36	18.36	0.0434	0.0447	0.1867	0.0092	0.0371	15:30:16	Yes
Mean:	21.29	21.29	0.0503						
SD:	4.150	4.150	0.0098						
%RSD:	19.49	19.49	19.49						

Sequence No.: 55
 Sample ID: Sample ID-(D)52
 Analyst:
 uL dispensed: 5 from 121, 20 from 52

Autosampler Location: 52
 Date Collected: 2/11/2012 3:32:06 PM
 Data Type: Original

Replicate Data: Sample ID-(D)52

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	20.12	20.12	0.0475	0.0488	0.2385	0.0103	0.0477	15:32:57	Yes
2	17.19	17.19	0.0406	0.0419	0.2011	0.0091	0.0413	15:35:37	Yes
Mean:	18.65	18.65	0.0441						
SD:	2.068	2.068	0.0049						
%RSD:	11.09	11.09	11.09						

Sequence No.: 56
 Sample ID: Sample ID-(D)53
 Analyst:
 uL dispensed: 5 from 121, 20 from 53

Autosampler Location: 53
 Date Collected: 2/11/2012 3:37:27 PM
 Data Type: Original

Replicate Data: Sample ID-(D)53

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	0.881	0.881	0.0021	0.0034	0.0260	0.0023	0.0063	15:38:18	Yes
2	0.682	0.682	0.0016	0.0029	0.0252	0.0020	0.0063	15:40:58	Yes
Mean:	0.782	0.782	0.0018						
SD:	0.141	0.141	0.0003						
%RSD:	18.00	18.00	18.00						

Sequence No.: 57
 Sample ID: Sample ID-(D)54
 Analyst:
 uL dispensed: 5 from 121, 20 from 54

Autosampler Location: 54
 Date Collected: 2/11/2012 3:42:48 PM
 Data Type: Original

Replicate Data: Sample ID-(D)54

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	1.455	1.455	0.0034	0.0047	0.0296	0.0023	0.0072	15:43:38	Yes
2	1.649	1.649	0.0039	0.0052	0.0371	0.0025	0.0085	15:46:33	Yes

Mean: 1.552 1.552 0.0037
 SD: 0.137 0.137 0.0003
 %RSD: 8.846 8.846 8.85

Sequence No.: 58

Autosampler Location: 55

Sample ID: Sample ID-(D)55

Date Collected: 2/11/2012 3:48:23 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 55

Replicate Data: Sample ID-(D)55

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	1.005	1.005	0.0024	0.0037	0.0277	0.0026	0.0080	15:49:13	Yes
2	4.814	4.814	0.0114	0.0127	0.0355	0.0039	0.0082	15:51:53	Yes
Mean:	2.910	2.910	0.0069						
SD:	2.693	2.693	0.0064						
%RSD:	92.56	92.56	92.56						

Sequence No.: 59

Autosampler Location: 56

Sample ID: Sample ID-(D)56

Date Collected: 2/11/2012 3:53:43 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 56

Replicate Data: Sample ID-(D)56

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	1.709	1.709	0.0040	0.0053	0.0281	0.0024	0.0072	15:54:33	Yes
2	0.733	0.733	0.0017	0.0030	0.0182	0.0021	0.0058	15:57:13	Yes
Mean:	1.221	1.221	0.0029						
SD:	0.690	0.690	0.0016						
%RSD:	56.48	56.48	56.48						

Sequence No.: 60

Autosampler Location: 57

Sample ID: Sample ID-(D)57

Date Collected: 2/11/2012 3:59:03 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 57

Replicate Data: Sample ID-(D)57

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	1.721	1.721	0.0041	0.0054	0.0271	0.0027	0.0069	16:00:07	Yes
2	0.688	0.688	0.0016	0.0029	0.0233	0.0020	0.0062	16:03:03	Yes
Mean:	1.204	1.204	0.0028						
SD:	0.730	0.730	0.0017						
%RSD:	60.66	60.66	60.66						

Sequence No.: 61

Autosampler Location: 58

Sample ID: Sample ID-(D)58

Date Collected: 2/11/2012 4:04:53 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 58

Replicate Data: Sample ID-(D)58

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	13.58	13.58	0.0321	0.0334	0.2076	0.0077	0.0409	16:05:44	Yes
2	13.66	13.66	0.0323	0.0336	0.2534	0.0079	0.0482	16:08:39	Yes
Mean:	13.62	13.62	0.0322						
SD:	0.057	0.057	0.0001						
%RSD:	0.420	0.420	0.42						

Sequence No.: 62
 Sample ID: Sample ID-(D)59
 Analyst:
 uL dispensed: 5 from 121, 20 from 59

Autosampler Location: 59
 Date Collected: 2/11/2012 4:10:29 PM
 Data Type: Original

Replicate Data: Sample ID-(D)59

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	16.64	16.64	0.0393	0.0406	0.1958	0.0090	0.0425	16:11:19	Yes
2	16.74	16.74	0.0396	0.0409	0.2860	0.0090	0.0546	16:13:59	Yes
Mean:	16.69	16.69	0.0394						
SD:	0.069	0.069	0.0002						
%RSD:	0.413	0.413	0.41						

Sequence No.: 63
 Sample ID: Sample ID-(D)60
 Analyst:
 uL dispensed: 5 from 121, 20 from 60

Autosampler Location: 60
 Date Collected: 2/11/2012 4:15:50 PM
 Data Type: Original

Replicate Data: Sample ID-(D)60

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	17.45	17.45	0.0412	0.0425	0.1721	0.0089	0.0358	16:16:41	Yes
2	17.04	17.04	0.0403	0.0416	0.2899	0.0092	0.0553	16:19:21	Yes
Mean:	17.24	17.24	0.0408						
SD:	0.292	0.292	0.0007						
%RSD:	1.691	1.691	1.69						

Sequence No.: 64
 Sample ID: Sample ID-(D)61
 Analyst:
 uL dispensed: 5 from 121, 20 from 61

Autosampler Location: 61
 Date Collected: 2/11/2012 4:21:11 PM
 Data Type: Original

Replicate Data: Sample ID-(D)61

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	19.45	19.45	0.0460	0.0473	0.2675	0.0102	0.0541	16:22:01	Yes
2	18.80	18.80	0.0444	0.0457	0.3494	0.0102	0.0713	16:24:41	Yes
Mean:	19.13	19.13	0.0452						
SD:	0.461	0.461	0.0011						
%RSD:	2.408	2.408	2.41						

Sequence No.: 65
 Sample ID: Sample ID-(D)62
 Analyst:
 uL dispensed: 5 from 121, 20 from 62

Autosampler Location: 62
 Date Collected: 2/11/2012 4:26:31 PM
 Data Type: Original

Replicate Data: Sample ID-(D)62

Repl #	SampleConc ug/L	StndConc ug/L	Blncorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	14.49	14.49	0.0342	0.0355	0.1641	0.0078	0.0311	16:27:21	Yes
2	14.14	14.14	0.0334	0.0347	0.2549	0.0082	0.0502	16:30:02	Yes
Mean:	14.31	14.31	0.0338						
SD:	0.246	0.246	0.0006						
%RSD:	1.722	1.722	1.72						

Sequence No.: 66

Autosampler Location: 63

Sample ID: Sample ID-(D) 63
 Analyst:
 uL dispensed: 5 from 121, 20 from 63

Date Collected: 2/11/2012 4:31:52 PM
 Data Type: Original

 Replicate Data: Sample ID-(D) 63

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	5.183	5.183	0.0122	0.0135	0.0544	0.0038	0.0123	16:32:42	Yes
2	5.415	5.415	0.0128	0.0141	0.1069	0.0043	0.0211	16:35:36	Yes
Mean:	5.299	5.299	0.0125						
SD:	0.164	0.164	0.0004						
%RSD:	3.099	3.099	3.10						

Sequence No.: 67
 Sample ID: Sample ID-(D) 64
 Analyst:
 uL dispensed: 5 from 121, 20 from 64

Autosampler Location: 64
 Date Collected: 2/11/2012 4:37:26 PM
 Data Type: Original

 Replicate Data: Sample ID-(D) 64

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	11.17	11.17	0.0264	0.0277	0.0930	0.0061	0.0184	16:38:17	Yes
2	10.93	10.93	0.0258	0.0271	0.1748	0.0061	0.0342	16:40:58	Yes
Mean:	11.05	11.05	0.0261						
SD:	0.169	0.169	0.0004						
%RSD:	1.530	1.530	1.53						

Sequence No.: 68
 Sample ID: Sample ID-(A) 1
 Analyst:
 uL dispensed: 5 from 121, 20 from 65

Autosampler Location: 65
 Date Collected: 2/11/2012 4:42:48 PM
 Data Type: Original

 Replicate Data: Sample ID-(A) 1

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	10.85	10.85	0.0256	0.0269	0.1629	0.0064	0.0332	16:43:39	Yes
2	11.08	11.08	0.0262	0.0275	0.1415	0.0059	0.0287	16:46:20	Yes
Mean:	10.96	10.96	0.0259						
SD:	0.169	0.169	0.0004						
%RSD:	1.543	1.543	1.54						

Sequence No.: 69
 Sample ID: Sample ID-(A) 2
 Analyst:
 uL dispensed: 5 from 121, 20 from 66

Autosampler Location: 66
 Date Collected: 2/11/2012 4:48:10 PM
 Data Type: Original

 Replicate Data: Sample ID-(A) 2

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	8.212	8.212	0.0194	0.0207	0.0975	0.0050	0.0204	16:49:00	Yes
2	8.304	8.304	0.0196	0.0209	0.0907	0.0053	0.0195	16:51:40	Yes
Mean:	8.258	8.258	0.0195						
SD:	0.064	0.064	0.0002						
%RSD:	0.781	0.781	0.78						

Sequence No.: 70
 Sample ID: Sample ID-(A) 3
 Analyst:
 uL dispensed: 5 from 121, 20 from 67

Autosampler Location: 67
 Date Collected: 2/11/2012 4:53:30 PM
 Data Type: Original

Replicate Data: Sample ID-(I)32

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	7.457	7.457	0.0162	0.0258	0.1645	-0.0014	0.0277	19:49:34	Yes
2	7.234	7.234	0.0157	0.0253	0.1611	-0.0013	0.0289	19:52:14	Yes
Mean:	7.345	7.345	0.0160						
SD:	0.158	0.158	0.0003						
%RSD:	2.155	2.155	2.15						

Sequence No.: 31

Autosampler Location: 59

Sample ID: Sample ID-(D)1

Date Collected: 2/17/2012 7:54:04 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 59

Replicate Data: Sample ID-(D)1

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	17.64	17.64	0.0384	0.0479	0.2777	0.0022	0.0518	19:54:54	Yes
2	17.19	17.19	0.0374	0.0470	0.2691	0.0022	0.0480	19:57:34	Yes
Mean:	17.42	17.42	0.0379						
SD:	0.313	0.313	0.0007						
%RSD:	1.797	1.797	1.80						

Sequence No.: 32

Autosampler Location: 60

Sample ID: Sample ID-(D)2

Date Collected: 2/17/2012 7:59:24 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 60

Replicate Data: Sample ID-(D)2

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	15.80	15.80	0.0344	0.0439	0.2510	0.0013	0.0446	20:00:28	Yes
2	15.73	15.73	0.0342	0.0438	0.2690	0.0016	0.0457	20:03:09	Yes
Mean:	15.76	15.76	0.0343						
SD:	0.050	0.050	0.0001						
%RSD:	0.315	0.315	0.31						

Sequence No.: 33

Autosampler Location: 61

Sample ID: Sample ID-(M)1

Date Collected: 2/17/2012 8:04:59 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 61

Replicate Data: Sample ID-(M)1

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
1	35.39	35.39	0.0770	0.0866	0.3959	0.0093	0.0690	20:05:49	Yes
2	35.46	35.46	0.0772	0.0867	0.4262	0.0094	0.0746	20:08:29	Yes
Mean:	35.43	35.43	0.0771						
SD:	0.049	0.049	0.0001						
%RSD:	0.137	0.137	0.14						

Sequence No.: 34

Autosampler Location: 62

Sample ID: Sample ID-(M)2

Date Collected: 2/17/2012 8:10:19 PM

Analyst:

Data Type: Original

uL dispensed: 5 from 121, 20 from 62

Replicate Data: Sample ID-(M)2

Repl #	SampleConc ug/L	StndConc ug/L	BlnkCorr Signal	Peak Area	Peak Height	Bkgnd Area	Bkgnd Height	Time	Peak Stored
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