THE TOLERANCE OF *Typha latifolia* AND *Phragmites australis* TO WASTE WATER STRENGTH.

BY

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A RESEARCH REPORT SUBMITTED TO THE DEPARTMENT OF BIOCHEMISTRY AND SPORTS SCIENCE, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF SCIENCE OF MAKERERE UNIVERSITY

SUPERVISOR: MR. JOHN OMARA

JUNE, 2018
DECLARATION

I declare that this report is original and that it has never been submitted to any other institution for any academic award.

EVARIST NATUGONZA

Signature: ......................................................
Date: .......................................................... July 1, 2018

Academic supervisor

MR JOHN OMARA

Signature: ......................................................
Date: .......................................................... 07, 2018
DEDICATION
I would like to dedicate this entire work that was done in this dissertation to Mr. Beyaka Silivano and Mrs. Katushabe Jane (my Beloved parents), Mr. Everest Ruzitiramu (uncle), Mr. Frank Bishop (brother) and Dear friend Miss. Scovia Nabulime
ACKNOWLEDGEMENT

I thank the almighty God for the life, cooperation, determination and attitude that he has given to staff members of department of biochemistry and sports science, Makerere university which has continuously supported me as far as academics is concerned and funding of this project, I would like to send my sincere thanks to all people who have been fundamental in this project most especially my supervisor Mr. John Omara who have worked so hard to see that this project is a stepping stone to my successful completion of this fundamental level in my life. Honestly I appreciate for the work done in favour of me, may the good lord reward you abundantly.

I would like to send my endless thanks to Mr. Kalmax Lutaro, Dr. Apollo Balyeidhuse and Mr. David Mutende who tirelessly continued to give me the advice on how to deal with matters and the guidance they extended to me during the proposal period when my supervisor was out of the country.

I would like to also send my sincere thanks to the following; Miss. Judith Naturinda, Miss. Juliet Nakaye, Miss. Salome Atuhumuza, Miss. Victoria Nakirya and other fellow coursements for the advice and words of encouragement always given to me during this project. May the God almighty richly bless you all.

In the special way I endlessly thank Miss. Scovia Nabulime for the advice always she has given me and always helping me tirelessly before, after and during this project period, may the creator of the universe bless you endlessly.

Conclusively I would like to take this opportunity to send my special thanks to the great parents, Mr. Silivano Beyaka, Mrs Jane Katushabe and my uncle Mr. Everest Ruzitiramu who have tirelessly continued to support me in terms of finances, morals and several other aspects. The spiritual, moral, intellectual and financial assistance extended to me by my parents and brother Mr Frank Bishop, is highly and genuinely appreciated. May the Almighty God bless and abundantly reward these people.
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<tbody>
<tr>
<td>Mg</td>
<td>Milligram</td>
</tr>
<tr>
<td>mL</td>
<td>Milliliter</td>
</tr>
<tr>
<td>ATP</td>
<td>Adenosine Triphosphate</td>
</tr>
<tr>
<td>TN</td>
<td>Total Nitrogen</td>
</tr>
<tr>
<td>TP</td>
<td>Total Phosphorus</td>
</tr>
<tr>
<td>COD</td>
<td>Chemical Oxygen Demand</td>
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<tr>
<td><em>T. latifolia</em></td>
<td><em>Typha latifolia</em></td>
</tr>
<tr>
<td><em>p. australis</em></td>
<td><em>Phragmites australis</em></td>
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<tr>
<td>ADP</td>
<td>Adenosine Triphosphate</td>
</tr>
<tr>
<td>H2PO4⁻</td>
<td>Orthophosphate ion</td>
</tr>
<tr>
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</tr>
<tr>
<td>RNA</td>
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<td>P</td>
<td>Phosphorus</td>
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<td>Volume</td>
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<td>t</td>
<td>Total</td>
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<tr>
<td>C</td>
<td>Carbon</td>
</tr>
<tr>
<td>ha⁻¹</td>
<td>Per hectare</td>
</tr>
<tr>
<td>MnSO₄⁺</td>
<td>Manganese (ii) sulphate</td>
</tr>
<tr>
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<td>Potassium hydroxide</td>
</tr>
<tr>
<td>Mn(OH)₂</td>
<td>Manganese hydroxide</td>
</tr>
<tr>
<td>K₂SO₄</td>
<td>Potassium sulphate</td>
</tr>
<tr>
<td>K₂Cr₂O₇</td>
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<tr>
<td>H₂SO₄</td>
<td>Sulphuric acid</td>
</tr>
<tr>
<td>HgSO₄</td>
<td>Mercury sulphate</td>
</tr>
<tr>
<td>Ag₂SO₄</td>
<td>Silver sulphate</td>
</tr>
<tr>
<td>L</td>
<td>Litres</td>
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ABSTRACT

Treating wastewater is the way to overcome water shortage due to the water pollution problems. Wastewater is any water that has been adversely affected in quality by anthropogenic influence while clean water is produced from varies of wastewater treatment system. Therefore, this study is conducted to analyse the tolerance of organic matter for both typha latifolia and phragmite australis that are some of the wetland plant species that are used in wastewater treatment process by using these two types of aquatic plants as phytoremediation agents. Phytogreen system has greatly resulted into reducing the main cost and maintenance cost of treating wastewater without ignoring the effectiveness of the system itself. Nevertheless, the aquatic plants itself is the important agents and the time taken for these plants to tolerate the organic matter in these sewage waters determines the percentage interaction between absorption and adsorption to prove the effectiveness of this system in the treatment of the waste water that might be discharged in the environment. However according to the observation performed, the typha latifolia used in this study showed to have greater time of resistance towards a given concentration of the organic matter compared to phragmite australis.

The highest concentration for organic matter both typha latifolia and phragmite australis could tolerate without death in this study was found to be 2257.86 mg/l and the concentration at which the two species of plants could not tolerate was 5611.72 mg/l. Therefore tolerance concentration range is 2257.86 mg/l to 5611.72 mg/l.
1 INTRODUCTION
Waste water is any water that has been negatively impacted by human use. Waste water is a result of domestic, industrial, commercial and agricultural activities; the composition of waste water varies widely. It contains heavy metals, organic particles, soluble organic material, inorganic materials and nutrients. Waste water contains chemicals such as nitrogen, phosphorus and dissolved oxygen and others which affect its composition (Njenga Mburu, et-al., 2014)
Growing *T. latifolia* and *P. australis* absorb organic nutrients from both water and sediment and thus trap nutrients especially nitrogen and phosphorus. During senescence, the *T. latifolia* and *P. australis* plants accumulate nutrients in their root zones and the decaying *T. latifolia* and *P. australis* release nutrients back in the water. About one third of the dead biomass is deposited back in the wetland; the rest is lost to elution, rain and decomposition (Gaude 1977; Muthuri and Jones 1997).

A wetland is a land area that is saturated with water, either permanently or seasonally, such that it takes on the characteristics of a distinct ecosystem. The primary factor that distinguishes wetlands from other land forms or water bodies is the characteristic vegetation of aquatic plants, adapted to the unique hydric soil. Wetlands play a number of roles in the environment, principally water purification, flood control, carbon sink and shoreline stability. Wetlands are also considered the most biologically diverse of all ecosystems, serving as home to a wide range of plant and animal life.

The death of the wetland plants as the result of waste water strength has greatly resulted into lack of the clean fresh water for the human domestic use in most of the urban areas in the developing countries. In Uganda increased urbanisation and industrialisation is leading to the death of the wetland plants, industries have greatly resulted into this due to the is no research that have ever been carried to establish the discharge limits for the individual plant species of *T. latifolia* and *P. australis*. However NEMA discharge standards of waste waters are not adhered to. Therefore it is important to establish the maximum limits for the individual plant species of *T. latifolia* and *P. australis* on the tolerance of the waste waters.
This study will establish the maximum amount of concentration of waste water organic matter that can be effectively utilized and tolerated by T. latifolia and P. australis. Information regarding the tolerance limit of T. latifolia and P. australis to waste water will establish the discharge limit of waste into wetlands. Therefore industries and the government will be sensitized on the extent to which they should treat their waste waters before discharging it into wetlands. Therefore this will improve the sustainability of both natural and constructed wetlands for treatment of waste water.

Ecosystems are destroyed by the rising temperature in the water, as coral reefs are affected by the bleaching effect due to warmer temperatures. Additionally, the warm water forces indigenous water species to seek cooler water in other areas, causing an ecological damaging shift of the affected area. The discharge of cooling water from industrial and commercial operations generally heats up the aquatic environment. Organisms may become physiologically stress or may even be killed when exposed to heated water. If water heating is supplemented by the summer heat, the impact on aquatic environment can be disastrous. According to UNICEF, more than 3,000 children die every day all over the world due to consumption of contaminated drinking water.

Sewage, fertilizer, and agricultural run-off contain organic materials that when discharged into waters, increase the growth of algae, which causes the depletion of oxygen. The low oxygen levels are not able to support most indigenous organisms in the area and therefore upset the natural ecological balance in rivers and lakes.

Thermal pollution also causes a decrease on the driving force or oxygenation which may directly kill aquatic life through asphyxiation. If toxic pollutants are present in the aquatic environment, thermal pollution may increase their toxicity to the aquatic life. Bioavailability of many pollutants may also increase due to thermal pollution, which may ultimately adversely affect the aquatic life.
2 1.2 PROBLEM STATEMENT AND JUSTIFICATION OF THE STUDY

Many trials on organic manure have clearly indicated their effects on the plant biomass of different species of plant, the contribution of organic manure are comparatively quite high. However, the rate of biomass increase is greatly affected by the environmental changes such as temperature, rainfall among others. Other factors like nutrients have also greatly resulted into the rate at which biomass increases.

In Uganda, typha latifolia and phragmite australis are some of the widely distributed to a large extent in the water drained areas mostly around lakes and rivers. This serves a purpose of maintaining the environment through the recycling of nutrients which includes nitrogen and phosphorus that are some of the important nutrient to both plants and animals. Therefore, the results from the study will give a direct educative impact to Ugandans giving clear information about how waste water from places like the abettor that always give rise to water which has high concentration of organic manure that is rich in nitrogen and phosphorus can be of use as fertilizers to plants. It shall also bring sensitization for the role of wetlands and *T. latifolia* and *P. australis* on environment conservation and it shall also provide the information the information which can be used to design the waste water treatment plants.
3 1.3 OBJECTIVES

3.1 1.3.1 GENERAL OBJECTIVE

To establish the effects of waste water strength on the survival of wetland plants.

3.2 1.3.2 Specific Objective

To determine the effect of organic matter strength on the survival of *T. latifolia* and *P. australis*.

3.3 1.3.3 Research Questions

❖ What is the quality of water obtained from abattoir?
❖ Is there a positive correlation between the concentration of organic matter and the growth of *typha latifolia* and *phragmte australis*?

3.4 1.3.4 Scope of the study

The study was conducted within a period of one months of the close investigation of the effects of organic matter of a known constant concentration to the growth of *typha latifolia* and *phragmte australis*.

The study was conducted by experimental measurements of the physico-chemical characteristics of the waste water and the determination of the concentration of the organic matter. However only two species of wetland plants were considered for the study.
CHAPTER TWO

4 2.0 LITERATURE REVIEW

Nitrogen and phosphorus are the vital elements needed for the survival of all living things. Nitrogen is the most abundant composing of about 78% in the earth atmosphere. Chemically it exists as ammonia, nitric acid, organic nitrates and cyanides to form unique compounds with different chemical and physical properties. However, plants cannot take nitrogen directly from the atmosphere, uptake is through ammonium and nitrate forms.

Typha latifolia and Phragmites australis are some of the most prolific emergent macrophytes in African subtropical and tropical wetlands. Botanical studies have shown that stands of these plants are capable of accumulating large amounts of nutrients and have a high standing biomass (H.t.Mann and D. Williamson 1993)

The above pictures show the type of wetland plants that was dealt with in this study: Where A is T. latifolia and B is Phragmites australis
The Table below shows scientific classification of the two type of wetland plants that was dealt with in the study.

<table>
<thead>
<tr>
<th>plants</th>
<th>T. latifolia</th>
<th>Phragmites australis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kingdom</td>
<td>Plantae</td>
<td>Plantae</td>
</tr>
<tr>
<td>Clade</td>
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<tr>
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<tr>
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</tr>
<tr>
<td>Family</td>
<td>Typhaceae</td>
<td>Poaceae</td>
</tr>
<tr>
<td>Genus</td>
<td>Typha</td>
<td>Phragmites</td>
</tr>
<tr>
<td>Species</td>
<td>T. latifolia</td>
<td>p. australis</td>
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</tbody>
</table>

Phosphorus is one of 17 nutrients essential for plant growth. Phosphorus (P) is vital to plant growth and is found in living plant cell. It is involved in several key plant functions, including energy transfer, photosynthesis, transformation of sugars and starches, nutrient movement within the plant and transfer of genetic characteristics from one generation to the next (Gichuki et-al., 2014) Its functions cannot be performed by any other nutrient, and an adequate supply of P is required for optimum growth and reproduction. Phosphorus is classified as a major nutrient, meaning that it is frequently deficient for crop production and is required by crops in relatively large amounts. The total P concentration in agricultural crops generally varies from 0.1 to 0.5 percent. (Robert Hay and John Porter 2006).

4.1 Uptake and Transport of Phosphorus
Phosphorus enters the plant through root hairs, root tips, and the outermost layers of root cells. Uptake is also facilitated by mycorrhizal fungi that grow in association with the roots of many crops. Phosphorus is taken up mostly as the primary orthophosphate ion (H2PO4\(^-\)), but some is also absorbed as secondary orthophosphate (HPO4\(^2-\)), this latter form increasing as the soil pH increases. Once inside the plant root, P may be stored in the root or transported to the upper portions of the plant. Through various chemical reactions, it is incorporated into organic compounds, including nucleic acids (DNA and RNA), phosphoproteins, phospholipids, sugar phosphates, enzymes, and energy-rich phosphate compounds for example, adenosine
triphosphate (ATP). It is in these organic forms as well as the inorganic phosphate ion that P is moved throughout the plant, where it is available for further reactions (www.Cropnutrition.com) Phosphorus plays a vital role in virtually every plant process that involves energy transfer. High-energy phosphate, held as a part of the chemical structures of adenosine diphosphate (ADP) and ATP, is the source of energy that drives the multitude of chemical reactions within the plant. When ADP and ATP transfer the high-energy phosphate to other molecules (termed phosphorylation), the stage is set for many essential processes to occur.

The most important chemical reaction in nature is photosynthesis. It utilizes light energy in the presence of chlorophyll to combine carbon dioxide and water into simple sugars, with the energy being captured in ATP. The ATP is then available as an energy source for the many other reactions that occur within the plant, and the sugars are used as building blocks to produce other cell structural and storage components (Robert Hay 2006)

Phosphorus is a vital component of the substances that are building blocks of genes and chromosomes. So, it is an essential part of the process of carrying the genetic code from one generation to the next, providing the “blueprint” for all aspects of plant growth and development. An adequate supply of P is essential to the development of new cells and to the transfer of the genetic code from one cell.

Phosphorus (p) is very vital to plant growth and is found in every living plant cell. It is involved in several key plant functions, including energy transfer, photosynthesis, transformation of sugars and starches, nutrient movement within the plant and transfer of genetic characteristics from one generation to the next. Chlorophyll photosynthesis is achieved as a result of carbon dioxide combining with water in the presence of sunlight to form oxygen and carbohydrates (Windle Taylor 1955). Carbohydrates in turn combine with phosphate groups to yield high energy compound that provides energy for proper growth of a plant through giving rise to the new cells that are formed. Large quantities of p are found in seeds and fruit where it is believed essential for seed formation and development. Phosphorus is also a component of phytin, a major storage form of p in seeds. About 50 percent of the total p in legume seeds and 60 to 70 percent in cereal grains is stored as phytin or closely related compounds. An inadequate supply of p can reduce seed size, seed number, and viability (Rooney P, 2013).

Plant cells can accumulate nutrients at much higher concentrations than are present in the soil solution that surrounds them. This allows roots to extract nutrients from the soil solution where
they are present in very low concentrations. Movement of nutrients within the plant depends largely upon transport through cell membranes, which requires energy to oppose the forces of osmosis. Here again, ATP and other high energy P compounds provide the needed energy. Adequate P allows the processes described above to operate at optimum rates and growth and development of the plant to proceed at a normal pace. When P is limiting, the most striking effects are a reduction in leaf expansion and leaf surface area (Kyambadde J et-al., 2005), as well as the number of leaves. Shoot growth is more affected than root growth, which leads to a decrease in the shoot root dry weight ratio (Robert Hay and John Porter 2006). Nonetheless, root growth is also reduced by P deficiency, leading to lesser root mass to reach water and nutrients. Generally, inadequate P slows the processes of carbohydrate utilization, while carbohydrate production through photosynthesis continues. This results in a buildup of carbohydrates and the development of a dark green leaf color. In some plants, P-deficient leaves develop a purple color, tomatoes and corn being two examples. Since P is readily mobilized in the plant, when a deficiency occurs the P is translocate from older tissues to active meristematic tissues, resulting in foliar deficiency symptoms appearing on the older (lower) portion of the plant. However, such symptoms of P deficiency are seldom observed in the field other than loss of yields their effects of P deficiency on plant growth include delayed maturity, reduced quality of forage, fruit, vegetable, and grain crops, and decreased disease resistance. (Better Crops Vol.83 1999).

4.2 2.1 Nitrogen

Nitrogen is the paramount element for plants being required in the largest amount of all the nutrients since it is the core component of many plant structures and for both internal and external metabolic processes. Nitrogen being an essential element for plant biological processes such as growth, absorption, transportation and excretion. For the *T. latifolia* and *P. australis* relying on soil solution for their supply of nitrogen, total nitrogen is the sum of the nitrates and ammonium ion contents of the soil profile, and the quantities of nitrates and ammonium released to the solution by mineralization and nitrification during the life time of the *T. latifolia and P. australis* (Goulding 1990)
After the uptake of the nitrate ions uptake are converted to ammonium by the nitrate reductase either in the root system or in the leaves and normally there is little storage of nitrogen as nitrate in the vacuoles of the root hair or leaf cells. As ammonium ions are phytotoxic at relatively low concentration, they are used rapidly in the synthesis of successively, glutamine and glutamate. The newly assimilated amine group can then contribute to the synthesis of the other amino acids by trans amination reactions; subsequent biochemical reaction pathways lead to the formation of other nitrogen containing compounds including nucleic acids, pigments and alkaloids (Robert Hay and John Porter 2006).

The enzyme Rubisco is far the predominant nitrogen containing compound in *T. latifolia* and *P. australis* representing up to 25% and the leaf nitrogen content is normally linearly related Rubisco content. These observations have led to the suggestion that the enzyme may play a storage role in addition to its central part in photosynthesis. Therefore, nitrogen use efficiencies that is expressed in terms of dry biomass produced per unit of nitrogen taken up, depends on:

- The proportion of the nitrogen resources of the *T. latifolia* and *P. australis* allocated to systematic information available for the comparison among species.
- The distribution of rubisco within *T. latifolia* and *P. australis* and other plants.
- The properties of Rubisco and the longevity of rubisco/functional leaves.

However, nitrogen deficiency may arise irrespective of its abundance in the atmosphere this leads to *T. latifolia* and *P. australis* disorders. This is likely to occur when other elements such as carbon are added to the nearby soils that would directly lead to an availability of it to plants. This is because a lot of nitrogen will be used will be used by soil organism to break down the harmful carbon sources taking away the nitrogen from the soil this results into the reduction in chlorophyll content of *T. latifolia* and *P. australis*

Nitrogen deficiency causes significant reductions in *T. latifolia* and *P. australis* growth rate and it would be reasonable to assume since Rubisco forms the dominant protein in the leaves that the main effect of the lack of nitrogen would through reduced rate of photosynthesis. This certainly happen but the main effect of nitrogen on *T. latifolia* and *P. australis* photosynthesis is through its effects on radiation capture rather than the radiation powered reduction of carbon dioxide and water into carbohydrates into carbohydrates and other compounds (Robert Hay and John Porter 2006).
The fig. 1 shows a simple illustration of nitrogen cycle
4.3 2.2 Major importance of nitrogen to typha latifolia and phragmite australis

Nitrogen being the major core components it is important in the following.

❖ It is essential element for the amino acids in plant structures which are the building blocks of the plant proteins important for the growth and development of vital plant tissues and cells like the cell membranes and chlorophyll
❖ It is a constituent of nucleic acids that forms genetic material
❖ Component of chlorophyll
❖ Plants with sufficient nitrogen concentration exhibits high rates of photosynthesis.

Biomass yield is dependent on how much nitrogen is the *T. latifolia* and *P. australis* can absorb and how much leaf area can be constructed per unit of nitrogen taken up. This is the characteristic that can be constant across the seasons (Lemaine and Gastal 1997)

The effects of nitrogen status upon the carbon harvest index varies considerably among the geographical zones and depending on the variety of the *T. latifolia* and *P. australis* depending upon the extent to which nitrogen supply is critical for the duration for the functioning canopy and for the harvested organs (Hay and Walker 1999)

4.3.1.1 2.3 Phosphorus

Phosphorus is one of 17 nutrients essential for plant growth. Phosphorus (P) is vital to plant growth and is found in every living plant cell. It is involved in several key plant functions, including energy transfer, photosynthesis, transformation of sugars and starches, nutrient movement within the plant and transfer of genetic characteristics from one generation to the next. (Robert Calos et-al., 1993). Its functions cannot be performed by any other nutrient, and an adequate supply of P is required for optimum growth and reproduction. Phosphorus is classified as a major nutrient, meaning that it is frequently deficient for crop production and is required by crops in relatively large amounts. The total P concentration in agricultural crops generally varies from 0.1 to 0.5 percent (Robert Hay and John Porter 2006).
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Phosphorus enters the plant through root hairs, root tips, and the outermost layers of root cells. Uptake is also facilitated by mycorrhizal fungi that grow in association with the roots of many crops. Phosphorus is taken up mostly as the primary orthophosphate ion (H$_2$PO$_4^-$), but some is also absorbed as secondary orthophosphate (HPO$_4^{2-}$), this latter form increasing as the soil pH increases. Once inside the plant root, P may be stored in the root or transported to the upper portions of the plant. Through various chemical reactions, it is incorporated into organic compounds, including nucleic acids (DNA and RNA), phosphoproteins, phospholipids, sugar phosphates, enzymes, and energy-rich phosphate compounds for example, adenosine triphosphate (ATP). It is in these organic forms as well as the inorganic phosphate ion that P is moved throughout the plant, where it is available for further reactions. (Robert et-al 2006)

4.5 2.5 Major Importance of Phosphorus To typha latifolia and phragmite australis.

Phosphorus plays a vital role in virtually every plant process that involves energy transfer. High-energy phosphate, held as a part of the chemical structures of adenosine diphosphate (ADP) and ATP, is the source of energy that drives the multitude of chemical reactions within the plant. When ADP and ATP transfer the high-energy phosphate to other molecules (termed phosphorylation), the stage is set for many essential processes to occur. The most important chemical reaction in nature is photosynthesis. It utilizes light energy in the presence of chlorophyll to combine carbon dioxide and water into simple sugars, with the energy being captured in ATP. The ATP is then available as an energy source for the many other reactions that occur within the plant, and the sugars are used as building blocks to produce other cell structural and storage components.

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Plant cells can accumulate nutrients at much higher concentrations than are present in the soil solution that surrounds them. This allows roots to extract nutrients from the soil solution where they are present in very low concentrations. Movement of nutrients within the plant depends largely upon transport through cell membranes, which requires energy to oppose the forces of osmosis. ATP and other high energy P compounds provide the needed energy (Njenga Mbura et al., 2014).

4.5.1 Phosphorus Deficiency

Adequate P allows the processes described above to operate at optimum rates and growth and development of the plant to proceed at a normal pace. When P is limiting, the most striking effects are a reduction in leaf expansion and leaf surface area, as well as the number of leaves. Shoot growth is more affected than root growth, which leads to a decrease in the shoot root dry weight ratio (O'Connor, P.W., Syers, J.K., 1975). Nonetheless, root growth is also reduced by P deficiency, leading to fewer roots mass to reach water and nutrients. Generally, inadequate P slows the processes of carbohydrate utilization, while carbohydrate production through photosynthesis continues. This results in a buildup of carbohydrates and the development of a dark green leaf color (Robert Calos et al., 1993).

The T. latifolia and P. australis has great roles in its native environment in tropical Africa. T. latifolia and P. australis swamps are an important habitat supporting a wide diversity of species, notably populations of sitatunga antelope (Tragelaphus spekii) African python (Python sebae), several birds with restricted distributions including the T. latifolia and P. australis yellow warbler (Chloropeta glacilirostris), and the T. latifolia and P. australis gonolek (Laniarius
The swamps provide breeding and feeding grounds for numerous species of fish, as well as grazing for large herbivores (Owino and Ryan 2006; Terer 2011). Established that nitrogen fixation occurs in the intact root systems of typha latifolia, phragmite australis and nitrogen fixation associated with young roots could provide 26% of the nitrogen requirements of growing *T. latifolia* and *P. australis* plants. This nitrogen fixation was thought to be due to the presence of diazotrophs in the root zone of the plant typha latifolia and phragmite australis. Apart from major biodiversity and ecological ecosystem services, a wide range of regulatory ecosystem services are provided by typha latifolia and phragmite australis wetlands, services in relation to water, carbon and nitrogen cycles and buffering capacity for sediment and nutrient loads, as well as a huge range of services in respect of natural products of benefit to communities, including biofuels, drinking water, building materials and flood control (Gichuki et al., 2001 Van Dam et al., 2011). Some modern uses mooted for typha latifolia and phragmite australis include as a biofuel and as a part of filtration systems for removing sediments, sewage and heavy metals from polluted water (Gaudet 2014). Dry matter productivity is very high, especially as it can come from otherwise unused aquatic environments (Rooney 2013).

Another important role for *typha latifolia* and *phragmite australis* are the assimilation and sequestration of significant amounts of carbon dioxide from the atmosphere. (Saunders et al., 2014) estimated that up to 80 t C ha\(^{-1}\) is stored in above and below-ground components of vegetation and, under flooded conditions, a further 640 t C ha\(^{-1}\) may be stored in detritus and peat deposits. (Gichuki 2014) found that carbon derived from *T. latifolia* and *P. australis* is largely retained in *T. latifolia* and *P. australis* swamps; additionally, high mineralization of organic matter occurs in the swamp, indicating that the retained *T. latifolia* and *P. australis*-derived carbon is largely respired.
4.6 2.7.0 PHYSICO-CHEMICAL PARAMETERS

4.7 2.7.1 Dissolved Oxygen.

This is the amount oxygen present in water. This is important in the maintenance of health lakes, rivers and swamps. This clearly shows the ability of the water to sustain aquatic life. DO is of an environmental significance in that it makes water to be of a good taste this in turn allows organisms to possess good biological processes. This will be determined by titrimetric method that is based on the oxidizing property of dissolved oxygen. However, in this method, permanganate modification will be used. Divalent manganese salt in solution is precipitated to divalent manganese hydroxide according to the following equation

\[ \text{MnSO}_4 + 2\text{KOH} \rightarrow \text{Mn(OH)}_2 + \text{K}_2\text{SO}_4 \]
\[ \text{Mn(OH)}_2 + \text{O}_2 \rightarrow \text{MnO(OH)}_2 \text{ brown precipitate} \]
\[ \text{Mn(OH)}_2 + 2\text{KI} + \text{H}_2\text{O} \rightarrow \text{Mn(OH)}_2 + \text{I}_2 + \text{KOH} \]
\[ \text{I}_2 + 2\text{S}_2\text{O}_3^{2-} \rightarrow \text{S}_4\text{O}_6^{2-} + 2\text{I}^- \]

The iodine that will be liberated is equal to the amount of dissolved oxygen.

4.8 2.7.2 Chemical oxygen demand (COD)

Decaying matter in sewage, industrial discharges, agricultural runoff uses oxygen that is dissolved in water. COD is the measure of the dissolved amount of chemicals most especially organics that consume oxygen. These measurements are extremely useful to those concerned with water quality since it represents the amount of oxygen required for the aerial biological oxidation of the dissolved organic compounds in water to carbon dioxide and water which are of great importance to the growth and development of plants.
CHAPTER THREE

5 3.1 MATERIALS AND METHODS

Materials
Spectrophotometer
Acid-washed glassware
Autoclave
Destruction bottles 50-100ml
Reduction column
Digestion vessels: preferably borosilicate culture with TFE-lined screw caps.
Borosilicate ampules, 10ml capacity, 19- to 20-mm diameter.
Heating block
Evaporating dishes: Dishes of 100ml
High-silica glass.
Muffle furnace
pH meter
Thermometer
Ruler
Threads
Buckets
Test tubes
Pipettes
Burette and its stand
Steam bath
Gumboots
Desiccator provided with a desiccant containing a colour indicator of moisture concentration or an instrumental indicator.
Drying oven, for operation at 103-105°C
Analytical balance, capable of weighing to 0.1mg
Magnetic stirrer with TFE stirring bar
Wide-bore pipes

**5.1 3.2 Collection of effluent and the young plant species**

In this study, young plants of the two species were considered and collected from Lubigi wetland and taken to the city abettor where they were put into the treated water for acclimatisation and to ensure that there is no doubting that the death of the plants was caused by high waste water strength as shown in the figure below.

Blood Samples of the city abattoir effluent were collected in 20L buckets then immediately diluted with distilled water to prevent the blood clotting and serial dilutions (refer to the appendix) were made and put in different buckets from which the young plants of the two species were monitored from for the period of one month

**5.2**

**5.3 3.3 CHEMICAL OXYGEN DEMAND DETERMINATION**

The amount of oxygen required to oxidize all the organic material in the sample of water. This is expressed in terms of milligrams oxygen required per liter of water. In this determination a
strong oxidizing agent is used to oxidize the organic matter rather than relying on the microorganism.

The following apparatus will be used in the determination of biochemical oxygen demand.

- Digestion vessels: borosilicate culture tubes, screw caps. Alternatively, use borosilicate ampules, 10ml capacity.
- Heating block
- Spectrophotometer

The following reagents shall be used in the determination of biochemical oxygen demand.

- Digestion solution: about 250ml distilled water shall be added to 5.11 g K₂Cr₂O₇, primary standard grade, 84ml conc. H₂SO₄, and 16.7g HgSO₄. Dissolve, cool to room temperature, and dilute to 50ml.
- Sulphuric acid reagent: add Ag₂SO₄, reagent of technical grade, crystals or powder, to conc. H₂SO₄ at the rate of 5.5g Ag₂SO₄/Kg H₂SO₄. Let it stand 1 to 2 days to dissolve silver (ii) sulphate (Ag₂SO₄).

**Procedure**

Ampules and caps were washed with 20% H₂SO₄ before first use to prevent contamination. 2.5ml of suitably diluted samples were measured into ampules; 1.5ml of digestion solution was added. 3.5ml of sulphuric acid reagent were carefully run down inside of vessel so an acid layer was formed under the sample-digestion solution layer. Ampules were tightly capped, and inverted several times to mix completely.

Ampules were then placed in block digester or even preheated to 150°C and refluxed for 2hours. These were then cooled to room temperature and vessels placed in test tube rack. Cooled samples and blank were inverted for several times and allowed to settle before measuring absorbance at 600nm and then comparing to calibration curve.
The table showing the concentrations of blood samples that were

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<tr>
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<td>Y</td>
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<td>P</td>
<td>d</td>
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</table>

Where

- n Indicates normal growth of the plant species.
- p indicates the starting point of no growth of the plant species.
- d indicates the death of plant species.
- X Indicates typha latifolia plant species.
- Y Indicates phragmite australis plant species.
CHAPTER FOUR

6 4.1 DISCUSSION

In the study both the growth of typha latifolia and phragmite australis were found to give a response to organic matter that was present in the water. The highest organic matter both plants could tolerate was 2257.86 mg/l where all the plants grew normally without even any sign of death that was at first associated with the yellowing of the leaves and finally the whole plant. However according to the time typha latifolia stayed without even yellowing of leaves, this confirmed that typha latifolia has high capacity of tolerance of the organic matter compared to phragmite australis and hence is a typical and important in the treatment of waste waters in both natural and constructed wetlands that receives high concentrations of organic matter and highly nutrient rich habitat (Davis 1990). Observations from the experiments that were closely monitored showed that typha latifolia can still survive in the highest concentrations (24506.10 mg/l) of the organic matter used in the experiment for about 17-20 days before it dies compared to phragmite australis that stayed for about 10-14 days, this may be because typha latifolia is known to possess both well-developed internal gas transport system and efficient convective gas flow, it also exhibits higher photosynthetic adaptation (Pezeshki et-al 1996). Therefore typha latifolia possess both morphological and physiological characteristics that gives it a more survival advantage. Generally the growth of wetland plants typha latifolia and phragmite australis initially (1st week) showed the positive response and they were growing normally in all the two plant species characterized with green leaves and there were no signs of yellowing of the leaves. This is because when the blood samples were applied to the plants at first, the growth of these plants greatly indicates that when the waste water is applied, there will be no immediate death of these wetland plant species, however death occurs after some few days after the discharge of these waste waters and phragmite australis being the first plant species to die this may be due to large surface area it has compared to typha latifolia.
In the control the both plants grew well because of the presence of the nutrients that supports growth. The-fore distilled water should be used as the control in the further research since it is nutrient free to some extent in vitro to further see whether there will be normal growth.
6.1 4.2 RECOMMENDATION

This is not enough literature to give clear conclusions as to why the plants died therefore more research should be done on the individual basis of the each category of the nutrients such that more reliable information.

More research should be done to get a comparison for both rainy and dry season to exactly see whether there is an effect on the amount of water on the wetland plant species that may be present in the waste waters.

6.2 4.3 CONCLUSION

The wastewater is rich in organic matter and contains high COD. Nutrients are present in waste water with high variability. Typha latifolia was better than Phragmites australis in tolerating the concentrations of organic matter that were present in blood that was obtained from the city abattoir.

High concentrations of organic matter can eventually kill both Typha latifolia and Phragmites australis. However the highest organic matter both plants could tolerate was 2257.86 mg/l where all the plants grew normally without even any sign of death that was at first associated with the yellowing of the leaves and finally the whole plant

In the control the both plants grew well because of the presence of the nutrients that supports growth.
6.3 4.2 REFERENCES


[WWW.Cropnutrition.com/efu-phosphorus.nitrogen](http://WWW.Cropnutrition.com/efu-phosphorus.nitrogen)
APPENDIX

*The table showing waste water dilutions*

<table>
<thead>
<tr>
<th>Dilution</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
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<td>0.3</td>
<td>0.15</td>
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<td>7.5</td>
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<td>9.40</td>
<td>9.70</td>
<td>9.85</td>
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<td>10</td>
</tr>
<tr>
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<td>10</td>
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<td>10</td>
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