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DIFFERENTIAL EXPRESSION OF HEAVY METALS IN FRESH WATER AND FISHES IN SOUTHWESTERN UGANDA

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BU/UG/2017/43

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A DISSERTATION SUBMITTED TO FACULTY OF AGRICULTURE AND ANIMAL SCIENCES IN PARTIAL FULFILLMENT OF REQUIREMENTS FOR THE AWARD OF A BACHELORS DEGREE OF ANIMAL PRODUCTION AND MANAGEMENT OF BUSITEMA UNIVERSITY

18 February 2021

DECLARATION

I MBABAZI ADREEN MUHINDO declare that this thesis is my work towards the award of Bachelor of Science in Animal production and management and it includes no material previously published by another person or which has been accepted for the award of a degree of any other university, with exception to where due acknowledgment is made in the text.

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ACKNOWLEDGEMENT

I am grateful to Busitema University, the Animal Production and Management Department, my supervisors; Dr Kenneth Iceland Kasozi and Dr. Zirintunda Gerald, and my examiner Mr. Muyinda Robert who have significantly contributed to my pursuit of a bachelors degree in animal production and management.

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LIST OF ABBREVIATIONS

Cd .....Cadmium

Pb ..... Lead

Zn .....Zinc

Cu .....Copper

Hg .....Mercury

As .....Arsenic

Cr .....Chromium

Ni .....Nickel

APGAR .....Appearance, Pulse, Grimace, Activity, and Respiration

IARC ..... International Agency for Research on Cancer

WHO .....World Health Organization

EU .....European Union

USEPA .....United States Environmental Protection Agency

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CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND

The consumption of fish worldwide has exponentially increased in recent years due to awareness of its nutritional and therapeutic benefits (Bawuro et al., 2018). Moreover, a lot of populations globally depend on fish as part of their daily diet since it provides many essential nutrients such as high-value proteins, various vitamins and minerals and polyunsaturated omega-3 fatty acids (Bosch et al., 2016). However, fish usually accumulate heavy metals from water, sediment, and food, which is a good indicator of heavy metal contamination in water (Bawuro et al., 2018).

Heavy metals are non-biodegradable natural components in the earth's crust (Karunanidhi et al., 2017). They enter the environment through sources that are natural, anthropogenic, and the constant increase in industrialization and urbanization (Piglowski, 2018). Consequently, aquatic environments are polluted heavily with these heavy metals (Ullah et al., 2017) which enter fish through gills and other organs thus having a chance to accumulate in different parts of the body tissues and the excessive amount can build up to a toxic level (Karunanidhi et al., 2017). Heavy metals such as lead (Pb), mercury (Hg), cadmium (Cd) and arsenic (As) are said to be toxic to life forms (Gbogbo et al., 2018). The FAO/WHO limits of cadmium, zinc and lead are 0.05 ppm, 0.04 ppm, 0.3 ppm respectively in fish (FAO/WHO, 2015) and 0.003 ppm and 0.01 ppm of cadmium and lead in water respectively (*A Global Overview of National Regulations and Standards for Drinking-Water Quality*, n.d.).

Positive studies on heavy metals in fish have been carried out in some fishing communities of Lake Albert (T. Andrew et al., 2016); Sudan (A. K. Andrew et al., 2017), among others. Since aquatic heavy metal pollution commonly presents high levels of Hg, Cr, Pb, Cd, Cu, Zn, Ni,and so forth (Zhou et al., 2008), the objective of this study was to determine the concentration of lead (Pb), zinc (Zn) and cadmium (Cd) in fresh water and fishes of southwestern Uganda.

1.2 STATEMENT OF THE PROBLEM

The earth contains only 2.5% of its water as fresh and yet, not only is its abundance and distribution critical for human welfare but also its integrity (Kaushal et al., 2018). Human activities are

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