EFFICIENCY OF CASSAVA PEEL IN REMOVING HEAVY METALS FROM AN HOSPITAL SEWAGE SLUDGE IN IBADAN, NIGERIA

ADEDOTUN TIMOTHY ADEOLU

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ABSTRACT

The geometric increase in urbanisation and industrialisation has resulted in drastic increase in the volume of wastewater and sludge which contain contaminants. Hence, the need to remove these becomes imperative. The application of sewage sludge on farmlands is of concern to man owing to the potentials of heavy metals which deteriorate the soil, ground water quality and bioaccumulate in food chains. The use of strain-specific microbial fermentation in the production of organic acids has been extensively studied. However, the use of indigenous microflora toward the bioleaching of heavy metals has not been well researched. This study however assessed the potentials of fermentation extracts from cassava peels in the removal of heavy metals from an hospital sewage sludge. A composite sewage sludge sample was collected from the University College Hospital sewage treatment plant, Ibadan, Oyo State, Nigeria. Heavy metal concentrations in the sample were determined for Copper (Cu), Zinc (Zn), Chromium (Cr), Nickel (Ni), Cadmium (Cd) and Lead (Pb) using Atomic Absorption Spectrophotometry (Buck Scientific Model 210 VGP). Source-segregated cassava peels were collected from a market in Ibadan. *Aspergillus niger* Fermentation Extract (ANFE) of 0.045M, *Aspergillus tereus* Fermentation Extract (ATFE) of 0.043M and Crude Fermentation Extract (CFE) of 0.055M were obtained each from 50g of cassava peels after 13-day fermentation using acid-producing strains of *Aspergillus niger, Aspergillus tereus* and indigenous microbial populations respectively; Commercial-grade Citric Acid (CCA) and Commercial-grade Itaconic Acid (CIA) served as controls. The experiment was carried out by adding 10 ml of the extracts and controls at room temperature (28^{o}C) and elevated temperature (45^{o}C), and pH (3– 5) to 3g of the sample each. The mixture was centrifuged after a leaching time of 1-12 days at 1000 rpm for 1hour. The filtrate was analysed for heavy metals concentrations and compared with the standards. Data were analyzed using descriptive statistics, paired t-test and ANOVA at $p>0.05$. The heavy metal concentrations (mg/kg) in the sewage sludge were Cu (2.22±0.2), Zn (52.3±0.1), Cr (1.46±0.1), Ni (5.6±0.01) and Pb (1.9±0.1). The values of the recorded concentrations (mg/kg) were below the permissible limits of NESREA of Cu (100), Zn (421), Cr (100), Ni (76) and Pb (164). Optimum heavy metals removal for ANFE at room temperature was achieved on day 12 at pH 3.5 for Zn (74.5%) and at elevated temperature was achieved on day 9 at pH 3.0 for Pb (79.3%) while Optimum heavy metals removal for ATFE at room temperature was achieved on day 12 at pH 3.5 for Ni (78.4%) and at elevated temperature was achieved on day 1 at pH 4.0 for Zn (72.3%). The optimum pH for CFE lies between 3 – 4.5 for Ni (76.2%) at room temperature and Cr (76.6%) at elevated temperature. The concentration of heavy metals removed by CFE was significantly higher than ANFE except (Cr and Ni) at room temperature. ANFE showed higher removal when compared with control, except for Cu, Zn and Ni. ATFE showed higher removal when compared with control, except Cr and Pb. Crude fermentation extract of cassava peel was found to be effective in removing the heavy metals from sewage sludge. Therefore, its use could be embraced and promoted for removing heavy metals from sewage sludge, thus safe disposal could be achieved.

Keywords: *Aspergillus niger* Fermentation Extract, *Aspergillus tereus* Fermentation Extract, Crude Fermentation Extract, Hospital sewage sludge, Cassava peels.

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CERTIFICATION

This is to certify that the project titled assessment of efficiency of cassava peel in removing heavy metals from an hospital sewage sludge was conducted by ADEDOTUN TIMOTHY ADEOLU with matriculation number 14/27/PEHS001 of Environmental Health Unit, School of Allied Health and Environmental Sciences, College of Pure and Applied Sciences, Kwara State University, Malete, Nigeria in partial fulfilment requirements for the award of Doctor of Philosophy Degree in Environmental Health.

Prof S.O Adewoye **(Major Supervisor)**	**Date**
Prof A.A Oladimeji **(Co-Supervisor)**	**Date**
Dr. H. O. Sawyerr **(Head of Department)**	**Date**
(External Examiner)	**Date**

DEDICATION

This dissertation is dedicated to God Almighty, the all sufficient one, the source of my inspiration.

TABLE OF CONTENTS

Content **Page**

Title page……...i

Abstract……ii

Acknowledgement……...iii

Certification……..iv

Dedication……v

Table of Contents……vi

List of Appendix……..xii

List of Tables……...…xv

List of Plates……..xvii

List of Figures……...xviii

Abbreviations and acronyms……...xxi

CHAPTER ONE

INTRODUCTION

1.1 Background Information of the study 1

1.2 Problem Statement.....4

1.3 Justification of the study.....7

1.4 Aim and Objectives.....8

1.4.1 Aim.....8

1.4.2 Objectives.....8

1.4.3 Research Questions.....9

CHAPTER TWO

LITERATURE REVIEW

2.1 Production and Processing of Cassava (*Manihot esculenta* Cratntz).....10

2.2 Wastes from Processing of Cassava……...12

2.3 Cassava peel and its utilization…….....13
2.4 Sewage Sludge…….....14
2.4.1 Composition of sewage sludge…….....15
2.4.2 Treatment of sewage sludge…….....16
2.4.3 Application of sewage sludge…….....17
2.5.0 Heavy Metals in the sewage sludge……...19
2.5.1 Lead.....……..21
2.5.2 Cadmium.....……....22
2.5.3 Chromium.....……....22
2.5.4 Copper…….....23
2.5.5 Zinc…….....23
2.5.6 Nickel…….....23
2.6.0 Standard limits of heavy metal concentration in the sludge…….....24
2.7.0 Removal of heavy metals from sewage sludge…….....26
2.7.1 Bioleaching of sewage sludge…….....26
2.8.0 Development of organic aids from agricultural waste…….....28
2.8.1 Solid waste fermentation…….....29
2.8.2 Fermentation Parameters…….....29
2.8.2.1 Carbon source…….....30
2.8.2.2 Nutrient Limitation…….....30
2.8.2.3 pH…….....30
2.8.2.4 Temperature…….....31
2.9.0 Recovery of metal from biosolids…….....31

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study design …….....32
3.2 Collection of materials…….....32
3.2.1 Source segregation cassava peels…….32

3.2.2 Dewatered sewage sludge……....35
3.3.0 Analysis of materials…….....38
3.3.1 Proximate analysis of cassava peels……....38
3.3.1.1 Moisture……...38
3.3.1.2 Ash…….....38
3.3.1.3 Crude fibre……39
3.3.1.4 Crude nitrogen……..……39
3.3.1.5 Crude protein….....……...40
3.3.1.6 Crude fat…….....40
3.3.1.7 Hydrocyanic acid…….....41
3.3.2 Analysis of dewatered sewage sludge…….....42
3.3.2.1 pH…….42
3.3.2.2 Nitrogen……....42
3.3.2.3 Organic Matter…….43
3.3.2.4 Organic carbon…….....43
3.3.2.5 Phosphorus…….....44
3.3.2.6 Potassium…….....44
3.3.2.7 Nitric-perchloric acid digestion…….....45
3.4. Synthesis of organic acids from source-segregated cassava peels…….....45
3.4.1 Fermentation of cassava peel…….....45
3.4.1.1 Substrate (cassava peel) ……...…….....45
3.4.1.2 Isolation of fungal strain……...45
3.4.2 Screening of organic acids producing strains…….....48
3.4.2.1 Citric acid…….....48
3.4.2.2 Itaconic acid…….....48
3.4.3 Determination of the acid unitage values…….....49
3.4.4 Organic acids production medium preparation……49
3.4.5 Inoculum…….....49
3.5 Fermentation techniques…….....50

3.5.1 Solid State Fermentation…….50
3.6 Effect of Moisture Holding Capacity…….....50
3.7 Analysis of fermentation extracts……....54
3.7.1 Preparation of DNS solution…….....54
3.7.2 Estimation of Sucrose…….....54
3.7.3 Standard plot for sucrose solution……55
3.7.4 Estimation of Citric acid…….....57
3.7.5 Standard plot for citric acid…….....57
3.7.6 Estimation of Itaconic acid…….....59
3.7.7 Estimation of Total Titratable Acidity…….....59
3.7.8 Estimation of Biomass (Dry cell mass)…….....59
3.8 Heavy metal removal experiments…….....60
3.8.1 Extractant or leaching agent…….....60
3.8.2 Extractant pH…….....60
3.8.3 Contact time…….....60
3.8.5 Temperature…….....60
3.8.5 Extractant dose…….....60
3.9 Data Management…….....61
3.10 Limitation/Challenges of the study.....62

CHAPTER FOUR

RESULTS

4.1 Physico-chemical properties of dried cassava peels…….……63
4.2 Physico-chemical properties of sewage sludge……63
4.3 Determination of acid unitage values of the isolated and screened organisms……..66
4.3.1 *Aspergillus niger*……..66
4.3.2 *Aspergillus tereus*…….....66
4.4 Analysis of fermentation extracts during formatting process ……69
4.4.1 *Aspergillus niger*……..69

4.4.1.1 Estimation of total titratable acidity (TTA)……..69

4.4.1.2 Estimation of sugar……...69

4.4.1.3 Estimation of citric acid ……..69

4.5 Analysis of fermentation extracts during the formatting process……73

4.5.1 *Aspergillus tereus*……....73

4.5.1.1 Estimation of total titratable acidity (TTA)...…….....73

4.5.1.2 Estimation of sugar…….…..73

4.5.1.3 Estimation of itaconic acid.……73

4.6 Analysis of fermentation extracts……77

4.6.1 Estimation of Total Titratable Acidity…….…..……...77

4.6.2 Estimation of sugar……..……..77

4.6.3 Estimation of citric acid……77

4.6.4 Estimation of biomass……...77

4.7 Heavy metal removal……82

4.7.1 Efficacy of the fermentation extracts for heavy metal removal……82

4.7.1.1 *Aspergillus niger* fermentation extracts……...82

4.7.1.2 *Aspergillus tereus* fermentation extracts…….....82

4.7.2 Comparison of the heavy metal removal efficacy of the *Aspergillus* spp fermentation extracts with the control…….…...83

4.8 Effect of PH on heavy metal removal……..112

4.8.1 *Aspergillus niger* fermentation extracts……...112

4.9 Effect of contact time on heavy metal removal……133

4.9.1 *Aspergillus niger* fermentation extracts……...133

4.9.2 *Aspergillus tereus* fermentation extracts……..133

CHAPTER FIVE

DISCUSSION

5.1 Source-segregation of cassava peel..…….....154

5.2 Physico-chemical properties of dried cassava peel wastes……...…….....154

5.3 Physico-chemical characteristics of sewage sludge..…….....155
5.4 Development of organic acids..…….....157
5.5 Heavy metal removal/Extraction...…….....158
5.5.1 Effect of treatment/Extractant …….....159
5.5.2 Effects of pH…….....160
5.5.3 Effect of contact time.…….....161

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions…….....163
6.2 Recommendations…….....165
6.3 Contribution to knowledge…….....165
6.4 Suggestions for future research…….....166
REFERENCES…….....167

LIST OF APPENDICES

Appendix 1 Screening for citric acid producing ability…….....186

Appendix 2 Screening for itaconic acid producing ability…….....187

Appendix 3 Total titratable acids at different days of fermentation…….....188

Appendix 4 Sugar utilization at different days of fermentation…….....189

Appendix 5 Acids production at different days of fermentation……..…….....190

Appendix 6 Percentage of heavy metals removal at temperature on day 1 using *Aspergillus niger*……..…….....191

Appendix 7 Percentage of heavy metals removal at room temperature on day 3 using *Aspergillus niger*.....192

Appendix 8 Percentage of heavy metals removal at room temperature on day 6 using *Aspergillus niger* ……...193

Appendix 9 Percentage of heavy metals removal at room temperature on day 9 using *Aspergillus niger*……...194

Appendix 10 Percentage of heavy metals removal at room temperature on day 12 using *Aspergillus niger*……..……195

Appendix 11 Percentage of heavy metals removal at room temperature on day 1 using *Aspergillus tereus*…..…….196

Appendix 12 Percentage of heavy metals removal at room temperature on day 3 using *Aspergillus tereus*...……197

Appendix 13 Percentage of heavy metals removal at room temperature on day 6 using *Aspergillus tereus*……..……198

Appendix 14 Percentage of heavy metals removal at room temperature on day 9 using *Aspergillus tereus*…...……199

Appendix 15 Percentage of heavy metals removal at room temperature on day 12 using *Aspergillus tereus*…...……200

Appendix 16 Percentage of heavy metals removal at elevated temperature on day 1 using *Aspergillus niger*……201

Appendix 17 Percentage of heavy metals removal at elevated temperature on day 3 using *Aspergillus niger*……202

Appendix 18 Percentage of heavy metals removal at elevated temperature on day 6 using *Aspergillus niger*……203

Appendix 19 Percentage of heavy metals removal at elevated temperature on day 9 using *Aspergillus niger*……204

Appendix 20 Percentage of heavy metals removal at elevated temperature on day 12 using *Aspergillus niger*……205

Appendix 21 Percentage of heavy metals removal at elevated temperature on day 1 using *Aspergillus tereus*..……206

Appendix 22 Percentage of heavy metals removal at elevated temperature on day 3 using *Aspergillus tereus*...……207

Appendix 23 Percentage of heavy metals removal at elevated temperature on day 6 using *Aspergillus tereus*…...……208

Appendix 24 Percentage of heavy metals removal at elevated temperature on day 9 using *Aspergillus tereus*..……209

Appendix 25 Percentage of heavy metals removal at elevated temperature on day 12 using *Aspergillus tereus*……...210

Appendix 26 Comparison of removal efficiencies using fermentation extract at varied temperature for citric acid...……...211

Appendix 27 Comparison of removal efficiencies using fermentation extract at varied temperature for itaconic acid…….....212

Appendix 28 Showing effect of PH on metal removal efficiency at room temperature on day 1 for citric acid……...……213

Appendix 29 Showing effect of PH on metal removal efficiency at room temperature on day 3 for citric acid……...214

Appendix 30 Showing effect of PH on metal removal efficiency at room temperature on day 6 for citric acid……...215

Appendix 31 Showing effect of PH on metal removal efficiency at room temperature on day 9 for citric acid…….……...……...…216

Appendix 32 Showing effect of PH on metal removal efficiency at room temperature on day 12 for citric acid…….…217

Appendix 33 Showing effect of PH on metal removal efficiency at room temperature on day 1 for itaconic acid…….……...…….....218

Appendix 34 Showing effect of PH on metal removal efficiency at room temperature on day 3 for itaconic…….…219

Appendix 35 Showing effect of PH on metal removal efficiency at room temperature on day 6 for itaconic……...…...220

Appendix 36 Showing effect of PH on metal removal efficiency at room temperature on day 9 for itaconic……...…221

Appendix 37 Showing effect of PH on metal removal efficiency at room temperature on day 12 for itaconic acid…….222

Appendix 38 Showing effect of PH on metal efficiency at elevated temperature on day 1 for citric acid……..……223

Appendix 39 Showing effect of PH on metal removal efficiency at elevated temperature on day 3 for citric acid.……224

Appendix 40 Showing effect of PH on metal removal efficiency at elevated temperature on day 6 for citric acid…….…….225

Appendix 41 Showing effect of PH on metal removal efficiency at elevated temperature on day 9 for citric acid….…….226

Appendix 42 Showing effect of PH on metal removal efficiency at elevated temperature on day 12 for citric acid…….……...……227

Appendix 43 Showing effect of PH on metal removal efficiency at elevated at elevated temperature on day 1 for itaconic acid……...228

Appendix 44 Showing effect of PH on metal removal efficiency at elevated temperature on day 3 for itaconic acid……229

Appendix 45 Showing effect of PH on metal removal at elevated temperature on day 6 for itaconic acid……230

Appendix 46 Showing effect of PH on metal removal efficiency at elevated temperature on day 9 for itaconic acid……231

Appendix 47 Showing effect of PH on metal removal efficiency at elevated temperature on day 12 for itaconic……..……...232

LIST OF TABLES

Table 2.1 Heavy metal permissible standard limit for sewage sludge applied on agricultural soil…..……25

Table 4.1 Physico-chemical properties of dried cassava peels…….....64

Table 4.2 Physico-chemical properties of dewatered sewage sludge……..….65

Table 4.3 Acid unitage values for the *Aspergillus niger* isolate/colonies……..…...67

Table 4.4 Acid unitage values for the *Aspergillus tereus* isolates/colonies ……..68

Table 4.5 Total Titratable Acidity *Aspergillus niger* during the formatting process…….70

Table 4.6 Sugar Concentration for *Aspergillus niger* during the formatting process……71

Table4.7 Concentration of citric acid from *Aspergillus niger* during the formatting process.....73

Table 4.8 Total Titratable Acidity for *Aspergillus tereus* during the formatting process…...74

Table 4.9 Sugar Concentration for *Aspergillus tereus* during the formatting process ……...75

Table 4.10 Concentration of Itaconic acid from *Aspergillus tereus* during the formatting process……76

Table4.11Estimated weight of Biomass (g) at different period of fermentation……...81

Table 4.12 Optimum heavy metal removal at room temperature for *Aspergillus niger* extract…….86

Table 4.13 Optimum heavy metal removal at elevated temperature for *Aspergillus niger* extract……87

Table 4.14 Optimum heavy metal removal at room temperature for *Aspergillus tereus* extract……..88

Table 4.15 Optimum heavy metal removal at elevated temperature for *Aspergillus tereus* extract……..89

Table 4.16 Comparison of Copper removal efficiency of the *Aspergillus niger* fermentation extract with the control at room temperature……92

Table 4.17 Comparison of Zinc removal efficiency of the *Aspergillus niger* fermentation extract with the control at room temperature……93

Table 4.18 Comparison of Chromium removal efficiency of the *Aspergillus niger* fermentation extract with the control at room temperature……..94

Table 4.19 Comparison of Nickel removal efficiency of the *Aspergillus niger* fermentation extract with the control at room temperature……95

Table 4.20. Comparison of Lead removal efficiency of the *Aspergillus niger* fermentation extract with the control at room temperature……..96

Table 4.21 Comparison of Copper removal efficiency of the *Aspergillus niger* fermentation extract with the control at elevated temperature……97

Table 4.22 Comparison of Zinc removal efficiency of the *Aspergillus niger* fermentation extract with the control at elevated temperature…….98

Table 4.23 Comparison of Chromium removal efficiency of the *Aspergillus niger* fermentation extract with the control at elevated temperature…….....99

Table 4.24 Comparison of Nickel removal efficiency of the *Aspergillus niger* fermentation extract with the control at elevated temperature…….100

Table 4.25 Comparison of Lead removal efficiency of the *Aspergillus niger* fermentation extract with the control at elevated temperature…….101

Table 4.26 Comparison of Copper removal efficiency of the *Aspergillus tereus* fermentation extract with the control at room temperature……..102

Table 4.27 Comparison of Zinc removal efficiency of the *Aspergillus tereus* fermentation extract with the control at room temperature…….103

Table 4.28 Comparison of Chromium removal efficiency of the *Aspergillus tereus* fermentation extract with the control at room temperature……104

Table 4.29 Comparison of Nickel removal efficiency of the *Aspergillus tereus* fermentation extract with the control at room temperature…….105

Table 4.30 Comparison of Lead removal efficiency of the *Aspergillus tereus* fermentation extract with the control at room temperature……106

Table 4.31 Comparison of Copper removal efficiency of the *Aspergillus tereus* fermentation extract with the control at elevated temperature……..107

Table 4.32 Comparison of Zinc removal efficiency of the *Aspergillus tereus* fermentation extract with the control at elevated temperature……...108

Table 4.33 Comparison of Chromium removal efficiency of the *Aspergillus tereus* fermentation extract with the control at elevated temperature…….....109

Table 4.34 Comparison of Nickel removal efficiency of the *Aspergillus tereus* fermentation extract with the control at elevated temperature…….110

Table 4.35 Comparison of Lead removal efficiency of the *Aspergillus tereus* fermentation extract with the control at elevated temperature…….111

LIST OF PLATES

Plate 3.1: Showing the source segregated cassava peel 33

Plate 3.2: Showing the grounded dried cassava peel 34

Plate 3.3: Showing the composite sample of dewatered sewage sludge.....37

Plate 3.4: Showing the isolation of acid-producing strain of *Aspergillus niger* and *A. tereus*.47

Plate 3.5: Showing the formation of zones around the *Aspergillus* spp. growth.....51

Plate3.6: Showing the bottle containing the substrates and inoculum incubating in a humidity-controlled incubator for 12 days.....52

Plate3.7: Showing the fungal and crude fermentation extracts used for the heavy metal removal.....53

LIST OF FIGURES

Figure 3.1: The study area where the sewage sludge is being collected.....36

Figure 3.2: Standard plot used for the estimation of sugar utilization.....56

Figure33: Standard plot used for the estimation of citric acid production.....58

Figure 4.1: The total titratable acidity of *Aspergillus* spp. fermentation for citric acid and itaconic acid.....78

Figure 4.2: The concentrations of sugar of *Aspergillus* spp. fermentation for citric acid and itaconic acid.....79

Figure 4.3: The concentrations of acids of *Aspergillus* spp. fermentation for citric acid and itaconic acid.....80

Figure4.4: Optimum heavy metal removal for *Aspergillus niger* extract.....90

Figure4.5: Optimum heavy metal removal for *Aspergillus tereus* extract.....91

Figure 4.6: Effect of pH on metal removal efficiency at room temperature on day 1 113

Figure 4.7: Effect of pH on metal removal efficiency at elevated temperature on day 1 114

Figure4.8: Effect of pH on metal removal efficiency at room temperature on day 3.....115

Figure 4.9: Effect of pH on metal removal efficiency at elevated temperature on day 3 116

Figure 4.10: Effect of pH on metal removal efficiency at room temperature on day 6 117

Figure 4.11: Effect of pH on metal removal efficiency at elevated temperature on day 6 ...118

Figure4.12: Effect of pH on metal removal efficiency at room temperature on day 9 119

Figure 4.13: Effect of pH on metal removal efficiency at elevated temperature on day 9 ...120

Figure 4.14: Effect of pH on metal removal efficiency at room temperature on day 12.....121

Figure 4.15: Effect of pH on metal removal efficiency at elevated temperature on day 12..122

Figure 4.16: Effect of pH on metal removal efficiency at room temperature on day 1 123

Figure 4.17: Effect of pH on metal removal efficiency at elevated temperature on day 1 ...124

Figure 4.18: Effect of pH on metal removal efficiency at room temperature on day 3 125

Figure 4.19: Effect of pH on metal removal efficiency at elevated temperature on day 3 ...126

Figure 4.20: Effect of pH on metal removal efficiency at room temperature on day 6 127

Figure 4.21: Effect of pH on metal removal efficiency at elevated temperature on day 6 ...128

Figure 4.22: Effect of pH on metal removal efficiency at room temperature on day 9.....129

Figure 4.23: Effect of pH on metal removal efficiency at elevated temperature on day 9 ...130

Figure 4.24: Effect of pH on metal removal efficiency at room temperature on day 12 131

Figure 4.25: Effect of pH on metal removal efficiency at elevated temperature on day 12 .132

Figure 4.26: Effect of contact time on copper removal from institutional sewage sludge at room temperature for citric acid 134

Figure 4.27: Effect of contact time on Zinc removal from institutional sewage sludge at room temperature for citric acid 135

Figure 4.28: Effect of contact time on Chromium removal from institutional sewage sludge at room temperature for citric acid 136

Figure 4.29: Effect of contact time on Nickel removal from institutional sewage sludge at room temperature for citric acid 137

Figure 4.30: Effect of contact time on Lead removal from institutional sewage sludge at room temperature for citric acid 138

Figure 4.31: Effect of contact time on Copper removal from institutional sewage sludge at elevated temperature for citric acid 139

Figure 4.32: Effect of contact time on Zinc removal from institutional sewage sludge at elevated temperature for citric acid 140

Figure 4.33: Effect of contact time on Chromium removal from institutional sewage sludge at elevated temperature for citric acid 141

Figure 4.34: Effect of contact time on Nickel removal from institutional sewage sludge at elevated temperature for citric acid 142

Figure 4.35: Effect of contact time on Lead removal from institutional sewage sludge at elevated temperature for citric acid 143

Figure 4.36: Effect of contact time on Copper removal from institutional sewage sludge at room temperature for itaconic acid 144

Figure 4.37: Effect of contact time on Zinc removal from institutional sewage sludge at room temperature for itaconic acid 145

Figure 4.38: Effect of contact time on Chromium removal from institutional sewage sludge at room temperature for itaconic acid 146

Figure 4.39: Effect of contact time on Nickel removal from institutional sewage sludge at room temperature for itaconic acid 147

Figure 4.40: Effect of contact time on Lead removal from institutional sewage sludge at room temperature for itaconic acid 148

Figure 4.41: Effect of contact time on Copper removal from institutional sewage sludge at elevated temperature for itaconic acid 149

Figure 4.42: Effect of contact time on Zinc removal from institutional sewage sludge at elevated temperature for itaconic acid 150

Figure 4.43: Effect of contact time on Chromium removal from institutional sewage sludge at elevated temperature for itaconic acid 151

Figure 4.44: Effect of contact time on Nickel removal from institutional sewage sludge at elevated temperature for itaconic acid 152

Figure 4.45: Effect of contact time on Lead removal from institutional sewage sludge at elevated temperature for itaconic acid 153

LIST OF ACRONYMS

AAS – Atomic Absorption Spectrophotometer

ANFE - *Aspergillus niger* Fermentation Extract

ATFE - *Aspergillus tereus* Fermentation Extract

CCA - Commercial-grade Citric Acid

CIA - Commercial-grade Itaconic Acid

CFE - Crude Fermentation Extract

EC – European Union

NESREA - National Environmental Standards and Regulations Enforcement Agency

UNEPA – United Nation Environmental Protection Agency

USEPA – United State Environmental Protection Agency

WHO – World Health Organization