CHAPTER I
INTRODUCTION

The consumption of renewable energy is dramatically increasing, along with energy security concerns, efforts to mitigate the environmental impact of conventional fuels, and improvements in living standards and renewable technologies. Bioenergy can play a central role in promoting renewable alternatives. Infact, bioenergy is estimated to be the fourth larges tenergy resource in the world (Chen and Lee, 2014) and is an early greenhouse gas (GHG) neutral replacement for fossil fuels (Haberl *et al.*, 2012) due to its renewable and widely applicable characteristics and its abundance. Forestry resources, agricultural resources. sewage and industrial organic wastewater, municipal solid wastes, live-stock and poultry dung and biogas are major categories foruse. Biogas, which is generally referring to gas from anaerobic digestion units, is apromising means of addressing global energy needs and providing multiple environmental benefits .

Anaerobic digestion involves the degradation and stabilization of organic materials under anaerobic conditions by microbial organisms and leads to the formation of biogas (a mixture of carbon dioxide and methane, a renewable energy source) and microbial biomass (Kelleher *et al.*, 2000). The process stages of anaerobic digestion are hydrolysis, acidogenesis, acetogenesis, and methanogenesis (Rapport *et al.*, 2008)

The characteristics of the cassava wastewater is potentially strong in methane production because it is acidic with high organic matter content (soluble carbohydrates and proteins) ,suspended solids (lipids and non-soluble carbohydrates-starch or cellulose fibers) ,very high chemical oxygen demand (COD) and biochemical oxygen demand (BOD) (Mao *et al.*, 2015). Besides, It also has high solubility of trace element in cassava wastewater.

The feed stocks used in anaerobic digesters have a wide range of chemical characteristics and some are particularly suitable for biogas production. Nevertheless, some constituents can have adverse effects on anaerobic digestion, especially sulphur (S). Under anaerobic conditions the inorganic and organic S contained in feedstock can be reduced (Elferink *et al.*, 1994) or fermented

(Mackie *et al.*,1998) resulting in the formation of dissolved sulphides which can be transferred to the biogas in the form of hydrogen sulphide (H_2S). H_2S smells bad, is toxic, and can damage most equipment, including combined heat and power engines.

Methanogens are an exceptional class of bacteria, with special nutrients requirements. Trace elements essential for the growth and metabolism of methanogens are iron, nickle, cobalt, molybdenum and cupper (Vintiloiu *et al.*, 2013). Problems such as low methane yield and process instability are often encountered in anaerobic digestion. The reason caused the amounts of micronutrients that present in cassava wastewater disappears to form metal sulfide and precipitate.

Chelants are organic compounds which can bind to the positively charged minerals. The category of them are devided in two types. There are non-biodegradable and biodegradable chelant. The ability of them are split to anion (Pitter *et al.*, 2001).

Ferric and cobalt ion are commonly used for sulfide precipitation. By combining addition of trace elements with addition of ferric and cobalt ion combined effects on the anaerobic digestion can be achieved simultaneously. For example, avoiding H_2S toxicity by precipitation with $Fe^{2+/3+}$ (Wang and Banks, 2006) and decreased ammonia (NH_3) concentration (Ejlertsson, 2006; Ek *et al.*, 2011; Moestedt *et al.*, 2013).

Therefore, this research work will study the effect of added non–biodegradable and biodegradable chelant as a solution in cassava wastewater to form micronutrients soluble with cassava wastewater compare by added ferric chloride has been used conventionally for the desulphurization to improve biogas production