Introduction

1 INTRODUCTION

Earthworms truly justify the statements made by Sir Charles Darwin that they are ***'unheralded soldiers of mankind', 'friends of farmers'*** and ***'no other creature on earth has done so much for mankind as the earthworms'***.

Another quote by Dr. Anatoly Igonin states that ***'Earthworms create soil and improve its fertility and provide critical biosphere functions such as disinfection, neutralization, protection and production.***

In the developing countries, industrialization is a must and demands build up of self reliance in uplifting the nation's economy. On the other hand, industrialization has also caused serious problems relating to environmental pollution.

Pollution is termed as the introduction of contaminants into the natural environment that causes instability, disorder, harm or discomfort to the ecosystem. Pollution can exist mainly in three forms - air pollution, land pollution and water pollution (Gari, 2002).

Air pollution is the introduction of chemicals, particulate matter or biological materials into the environment that causes harmful effects to humans and other living organisms. Adverse air quality can cause respiratory diseases, cardiovascular diseases, throat inflammation, chest pain and congestion. It can even kill many organisms and human beings also (Cambra *et al.*, 2011).

Land pollution is caused by the release of xenobiotic chemicals, rupture of underground storage tanks, application of pesticides, percolation of contaminated surface water to subsurface strata, oil and fuel dumping, leaching of wastes from landfills or direct discharge of industrial wastes into the soil. Chronic exposure to

chemicals released from industries has been identified to cause hazardous effects on living beings (Snyder, 2005).

Water pollution results from the release of chemicals or pathogens into water bodies like lakes, rivers, oceans and groundwater. This affects plants and organisms living in these bodies of water and in almost all cases, the effect damages not only individual species and population, but also the natural biological communities (Gupta *et al.,* 2009a).

The other types of pollution include light pollution, noise pollution, radioactive pollution and thermal pollution. These also have harmful effects on the environment. Oil spills can cause skin irritations and rashes, hearing loss, high blood pressure, stress, and sleep disturbances. Chemical and radioactive substances can cause cancer as well as birth defects.

The solid wastes generated in the environment can be classified into different types depending on their source - household waste generally termed as municipal waste, industrial waste which may be hazardous and non hazardous waste and biomedical or hospital wastes which are infectious wastes.

Disposal of these solid wastes into the environment causes pollution of air, water and land. Therefore, efforts are to be made to control pollution arising out of the disposal of solid wastes by conversion of these unwanted wastes into utilizable raw materials for various beneficial uses.

Tapioca (*Manihot esculenta Crantz*) starch is cheap and easy to find in tropical and subtropical areas like Asia and South Africa. Tapioca is believed to be the cheapest source of starch compared to the cereals, tubers and root crops (Patle and Lal, 2008). Sago, the tapioca starch is manufactured in over 800 small - scale units located in Salem district, Tamil Nadu, India. During the processing of sago, huge quantities of a biodegradable solid waste termed *thippi*

in Tamil are generated as crushed tubers (Banu *et al.,* 2008). Accumulation of this waste causes undesirable odour and growth of pathogenic organisms in and around the factories. Hence, steps should be taken to manage this huge quantity of biodegradable solid waste. Composting of tapioca solid waste using selected earthworms and microorganisms is one of the best methods to reduce the pollution caused by this waste.

Composting is becoming a more acceptable alternative for solid waste treatment due to its potential use for land application as biofertilizer and soil conditioner (Niwagaba *et al.,* 2009). Both vermicomposting and combined composting (with microbes and earthworms) are effective methods for biodegradation of organic wastes. Combined composting also eliminates the indicator pathogens from the final composts, whereas, vermicomposting alone manages to reduce the pathogen population alone (Mupondi *et al.,* 2010).

Vermes is a Latin word for worms and 'vermicomposting' is termed as the processing of organic wastes using earthworms. It has been widely identified as one of the potential ways to reduce the quantity of solid waste which is generally sent to the landfills. Earthworms are key organisms in organic matter decomposition, because of their interactions with the soil microorganisms. They enhance decomposition rates through digestion, burrowing, and cast ageing (Aira and Dominguez, 2009).

Vermicompost is finely divided peat – like manure material with high porosity, aeration, drainage and water–holding capacity. This is because they have large surface area providing strong absorption capacity and retention of nutrients (Ogefere *et al.,* 2010). Vermicomposts contain plant growth regulating materials, including plant growth hormones and humic acids which are probably responsible for most of the increased germination, growth and yields of plants

(Trevisan *et al.,* 2010). Vermicompost is a biofertilizer enriched with all beneficial soil microorganisms and all the essential plant nutrients like nitrogen, phosphorus and potassium. It also increases soil aeration and texture (Sinha *et al.,* 2010).

Polyculture vermicomposting is much better than monoculture vermicomposting in terms of organic matter mineralization (Khwairakpam and Bhargava, 2009a). The earthworms *Eisenia fetida* and *Perionyx excavatus* are very common in several parts of India. They effectively degrade the industrial and household wastes (Munnoli and Bhosle, 2008). *Lampito mauritii* is also very common with a well established composting potential (Sulata *et al.,* 2008).

Inoculation of nitrogen fixing and phosphate solubilizing bacteria enrich the nitrogen and phosphorus contents of the vermicompost (Kaushik *et al.,* 2008). The application of microbial inoculums into the waste increases temperature and improves the degradation of organic wastes (Raut *et al.,* 2008). The microorganisms present in commercial microbiological preparations also function efficiently as accelerators for the decomposition of organic wastes (Gonzalez -Villa *et al.*, 2009).

During vermicomposting, bulking material is needed for enrichment of microbial population and enzymatic activities. Partially degraded animal dung can be added as feed to the earthworms in the initial stage of the vermicomposting process. Matured vermicompost can also be used as a bulking material. It acts as a source of active microbial culture during the initial stages of the composting process (Yadav *et al.,* 2010).

Hence, the present study entitled 'Biocomposting of tapioca solid waste with selected earthworms and microbes' was taken up with the following objectives:-

- ❖ Conversion of tapioca solid waste into an ecofriendly manure
- ❖ Use of selected microbes and earthworms for the decomposition of tapioca solid waste
- ❖ Characterization of undecomposed and decomposed tapioca solid waste
- ❖ Assessment of enzyme activities, compost maturity, suitability and efficiency of the compost for plant growth.

An assemblage of the background information available in the literature relevant to the present study is reviewed in the next chapter.