



**FEDERAL UNIVERSITY OF TECHNOLOGY
MINNA**

**ALTERNATIVE ENERGY SOURCES:
THE ROLE OF MICROORGANISMS**

By

OYELEKE, SOLOMON BANKOLE

(PhD, MIPAN, MMSN, MNSB, MASM)

Professor of Microbiology

INAUGURAL LECTURE SERIES 20

11TH AUGUST, 2011



**FEDERAL UNIVERSITY OF TECHNOLOGY
MINNA**

**ALTERNATIVE ENERGY SOURCES:
THE ROLE OF MICROORGANISMS**

By

OYELEKE, SOLOMON BANKOLE

(PhD, MIPAN, MMSN, MNSB, MASM)

Professor of Microbiology

INAUGURAL LECTURE SERIES 20

11TH AUGUST, 2011

This 20th Inaugural Lecture was delivered under the Chairmanship of:

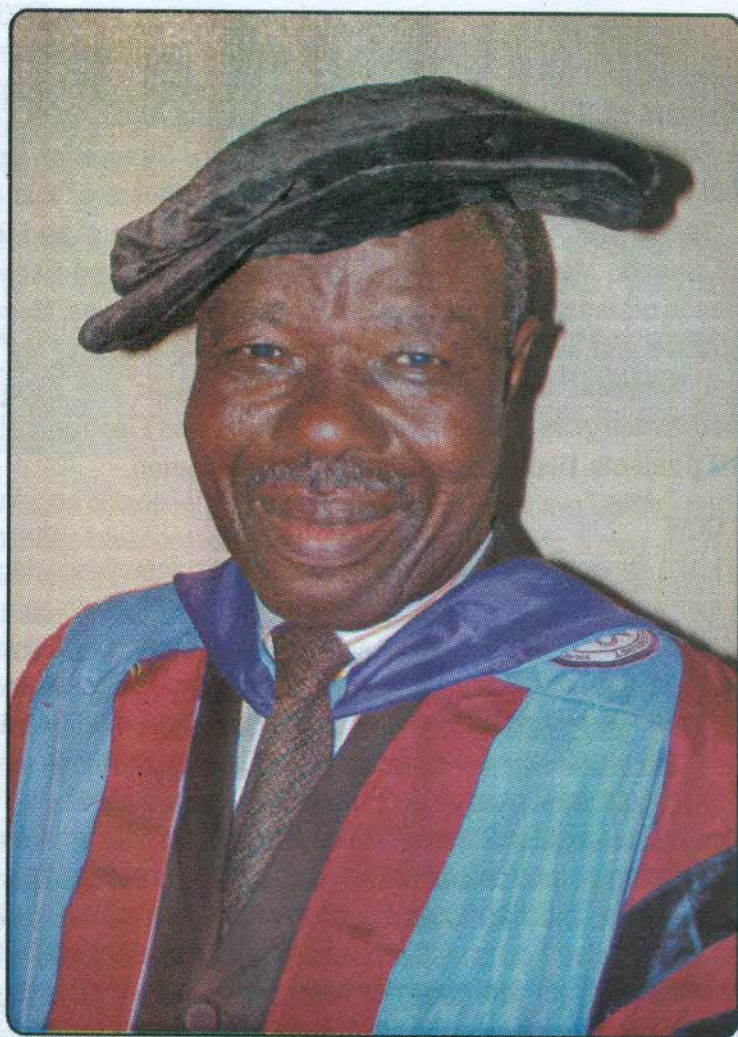


Prof. M. S. Audu, *FMAN*
Vice-Chancellor
Federal University of Technology, Minna

Published by:
University Seminar and Colloquium Committee,
Federal University of Technology, Minna.

August, 2011

Design + Print:
Global Links Communications, Nigeria
©: 08056074844, 07036446818



OYELEKE, SOLOMON BANKOLE

(PhD, MIPAN, MMSN, MNSB, MASM)

Professor of Microbiology

ALTERNATIVE ENERGY SOURCES: THE ROLE OF MICROORGANISMS

COURTESIES:

The Chief Servant of Niger State, Dr. Muazu Babagida Aliyu, OON (Talba Minna), The Executive Governor of Niger State. Mr. Vice Chancellor, Deputy Vice Chancellors, Registrar, Bursar, Other Principal officers of this great University, Deans and Directors, Distinguished Professors and other members of Senate, Members of Niger State Legislature and Executive Councils, Heads of Departments and other academic colleagues, Members of Administrative and Technical Staff, Your Royal Highnesses, My Lord Spiritual and Temporal, Members of my family, Nuclear and Extended, Distinguished invited guests, Gentlemen of the press and Electronic Media. Greatest FUT Students, Distinguished ladies and gentlemen.

INTRODUCTION

The World Health Organization (WHO) defines waste as something which the owner no longer wants at a given time and space and which has no current or perceived market value. Wastes may be gaseous, liquid or solid. Liquid and gaseous wastes are free flowing and can easily migrate from one place to another; solid wastes are not free flowing (Environmental Protection Agency, (EPA), 1972). However, what one regards as waste may not be totally useless as long as it can be recycled to produce new product(s). For example, guinea corn husk, millet husk and spoil fruits (agricultural waste with no appreciable value to industries) are used as alternative and cost-effective feed stock for the production of bioenergy (Oyeleke and Jibrin, 2009, Oyeleke *et al.*, 2010). Also microbial enzymes can be produced from cheap and readily available agricultural wastes such as cassava peels, yam peels and rice husks which currently constitutes a menace to solid waste management (Oyeleke and Oduwole 2009, Oyeleke *et al.*, 2010a and b, Ibrahim *et al.*, 2011, Oyeleke *et al.*, 2011). Energy conservation and energy production from cheaper sources are the immediate need of our time. Biotechnology can make a lot of contribution in this context, by increasing the acceptability of biomass, biogas, fuel and alcohol as feasible alternatives.

Bioenergy is energy generated through biological feed stocks and are renewable in origin. Example includes fuelwood, charcoal, livestock manure, biogas,

biohydrogen, bioalcohol, microbial biomass, agricultural waste and by-products, energy crops, and others (Yeole *et al.*, 1996, Oyeleke and Jibrin 2009, Oyeleke *et al.*, 2009).

The main sources of bioenergy are:

- (1) Agricultural residues and wastes
- (2) Purpose-grown crops, e.g. palm fruit and seeds.
- (3) Wild vegetation.

In their raw forms, these sources are usually called biomass, though the term "energy feedstock" is also used, mostly for purpose-grown energy crops.

Unlike oil, biomass can be produced in just about every country. Bioenergy already accounts for nearly 10 percent of total world energy supplies. It accounts for 33 percent of energy used in developing countries but only 3–4 percent in industrial countries.

Advantages of bioenergy generation include: bullet availability, eco-friendliness, affordability, lower cost of production, less pollution etc. If bioenergy generation is coupled with the tapping of unutilized biomass, wasteland utilization for biomass production or treatment of solid/liquid wastes, then pollution abatement and resources utilization will be simultaneously achieved. Development of reactor designs and gene manipulations of microorganisms have made the task easier and bioenergy from wastes has become a reality (Jogdand, 1994, Schor, 1994, Oyeleke and Jibrin 2009, Oyeleke *et al.*, 2010). In recent years, bioenergy has drawn policies, which now total about \$320 billion a year. Moreover, oil and coal are unevenly distributed among countries; all countries could generate some bioenergy from domestically grown biomass of one type or another, thereby helping to reduce their dependence on imported fossil fuels that is exhaustible (Hazell and Pachaur, 2006).

Effluents from dairy, cider, pectin, confectionary, yeast, and brewing, distilling, and chemical plants can be treated to produce energy. In Italy, this process has been used to treat effluents from cheese and ham processing plant, and in Spain, it is used in slaughterhouse operations. Bioenergy plant can make a financial profit, as well as satisfy statutory requirements for disposal of waste (Veermani, 1994).

Biotreatment of wastes can fall into two basic types: Aerobic and Anaerobic. Over the years, aerobic biotreatment has been considered to be more efficient in

reduction of Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) reduction, which proved better for nitrogen and phosphorus removal, and quite applicable for wide range of wastes and more stable process. Anaerobic biotreatment has been considered to be sensitive to toxicity and less reliable in performance in terms of COD reduction. However, in recent years, this misconception was proved untrue. On the contrary anaerobic processes are preferred as they produce less sludge, consume less energy, can operate at high organic loading rate and produce no odour or aerosol nuisance. Thus, anaerobic biotreatment of wastes is now gaining prominence due to energy production that is possible along with pollution abatement (Vermani, 1994).

Total global energy consumption is huge—about 400 EJ (exajoules) per year—and is expected to grow to 50 percent by 2025. Most of the increase will occur in developing countries. Majority of this demand is currently met by fossil fuels, particularly oil. Rapid growth in oil demand, finite oil supplies, and political instability in many of the major oil-exporting countries are pushing up oil prices and making them more volatile. This trend seems destined to continue. Consequently, many importing countries are looking to expand and diversify their energy sources and are looking at bioenergy as a potential alternative prospect within their broader energy portfolios. Already, bioenergy accounts for 10 percent of world energy supplies, and the potential to better exploit many unused crop residues and to grow dedicated energy crops is enormous. Bioenergy's potential will also increase as second-generation technologies come on line, enabling more efficient conversion of cellulose-rich biomass to transport fuels and electricity. Technological advances will not only help make bioenergy more competitive with fossil fuels on price, but will also expand the range of feed stock that can be used, some of which (like fast-growing grasses and trees) can thrive in less fertile and more drought-prone regions that are less competitive with food and feed than current feedstock like sugarcane, maize, and cassava. Many developing countries with tropical climates may have a comparative advantage in growing energy-rich biomass and could become major exporters. Africa in this instance has the biophysical potential to become an important producer and exporter of bioenergy.

In developing countries, biomass also constitutes the main source of household energy in rural and urban areas. Urban households primarily use wood and

