BIOHYDROGEN GENERATION FROM PALM OIL MILL EFFLUENT USING AnSBR−MEC HYBRID SYSTEM

MOHD FAHMI BIN MUHAMMAD MUBARAK

UNIVERSITI TEKNOLOGI MALAYSIA

BIOHYDROGEN GENERATION FROM PALM OIL MILL EFFLUENT USING AnSBR−MEC HYBRID SYSTEM

MOHD FAHMI BIN MUHAMMAD MUBARAK

A thesis submitted in fulfillment of the
requirements for the award of the degree of
Doctor of Philosophy (Bioscience)

Faculty of Science
Universiti Teknologi Malaysia

JULY 2020

ACKNOWLEDGEMENT

In the name of Allah, the Most Gracious, the Most Merciful.

First of all, praised to Allah, the Almighty God, for His blessings, authority and fated, finally, I am able to complete my dissertation successfully.

It is my honour to have this kind of opportunity to deliver my heartfelt appreciation to my caring and supportive supervisors, Adj. Prof. Datin Dr. Zaharah binti Ibrahim, Dr. Norahim bin Ibrahim, and Prof. Dr. Azmi bin Aris. Thank you very much for your endless encouragement and priceless time in teaching and guiding me from the beginning until the end of my study in here. Not forgotten, Dr. Chong Chun Siong for the contribution in helping me finalise my study in here, especially in my thesis completion. Without the knowledge and helping hands from all of you, I would be hard for me to reach this milestone achievement in my life.

Special appreciation also reserves to my best friends, Dr. Muhamad Hanif bin Md. Nor, Muhamad Firdaus bin Sabaruddin, Dr. Lam Chi Yong, Dr. Ang Siow Kuang, Dr. Zaratulnur binti Mohd Bohari, Dr. Farah Izana binti Abdullah, Syamimi binti Md. Jamal, and Birintha d/o Ganapathy for their endless helps for me to reach this milestone achievement. A million thanks to post-doctoral, Dr. Ivy Bay Hui Han and Dr. Neoh Chin Hong for their unforgettable encouragement and never-ending assistance. Not forgotten, my laboratory mates, Dr. Fareh Nunizawati binti Daud, and Dr. Siti Halimah binti Hasmoni for their worthy help and guidance in completing my research in here.

Besides that, I would like to take this opportunity to express my gratefulness to all the staff of the Department of Biosciences, Faculty of Science, UTM, especially, Mr. Yusnizam bin Samsudin, Mr. Mohd Hairol Anuar bin Shahari, Mr. Mohd Afiezy bin Burhandin and Ms. Wan Aznida binti Wan Mohd Anuar. Not forgotten, all personnel from Kilang Sawit Bukit Besar, Kulai for helping me either directly or indirectly. Their cooperation and guidance throughout my research time in here run smoothly.

Last but not least, my parents and individuals that involved directly or not, in my entire time completing my study here. Thus, in this piece of writing, I want to give my gratitude to all of you in lending me a hand to make my study in here worthwhile. Thank you very much again.

May Allah bless for all your contributions.

ABSTRACT

The global dependency towards fossil fuels as an energy source has escalated resulting in rapid depletion of oil reservoir and global warming. The oil palm industry, the largest agricultural sector in the country, is expected to generate approximately 70−110 million tonnes of solid and liquid wastes by the year 2020. The large quantities of liquid waste, or palm oil mill effluent (POME), is highly polluting due to its high content of biological and chemical oxygen demand. Since POME is rich in substrates such as carbohydrates and fatty acids, this study investigated the application of bacteria from POME anaerobic sludge for hydrogen gas (H_2) production in a hybrid system of anaerobic sequencing batch reactor (AnSBR) and microbial electrolysis cell (MEC). Five pre-treatment methods (heat-shock, acid, alkaline, chemical, and aeration) were tested for selecting H_2-producers from POME anaerobic sludge. Out of the five methods, heat-shock showed the highest H_2 production. Several factors influencing H_2 production was determined using one-factor-at-a-time (OFAT) method. The results showed highest H_2 production at initial pH 6.0, incubation temperature of 55.0°C, and 10.0% (v/v) inoculum size. Further study on the optimisation of H_2 production using Box−Behnken Design (BBD) showed that all factors significantly contributed towards H_2 production. The combination of initial pH (6.4), incubation temperature (58.0°C), and inoculum size (8.0% v/v) enhanced the H_2 production up to 2.57-fold higher (239.0 mL) compared to before optimisation. Subsequently, these optimised conditions were applied in a 1.2 L AnSBR together with two factors: hydraulic retention time (HRT) and organic loading rate (OLR). The results showed that 12 h HRT and 36 g/L/d OLR were the best condition with maximum H_2 production recorded at >2.80 L H_2/L POME and almost 65% COD removal achieved in 16 cycles of operation. Single chamber MEC was then fed with the AnSBR treated POME. Voltage of 1.0 V was applied to operate the MEC with cumulative H_2 production of 3.63 ± 0.16 L H_2/L POME over a duration of seven days. The maximum Coulombic efficiency, C_E (83.9 ± 3.3%), maximum H_2 recovery, r_{cat} (99.1 ± 4.7%), and total energy recovery, η_{E+S} (103.9 ± 8.9%) were also recorded. To determine the microbial communities of the hybrid system, genomic bacterial DNA from AnSBR sludge and both bioanode of MFC and MEC were extracted and subjected to 16S rRNA gene amplicon sequencing. In the top 10 phyla of the three samples, phyla *Firmicutes* are predominant for AnSBR sludge while phyla *Proteobacteria* were dominant for both MFC and MEC bioanode, representing approximately 40% and 80% of the total gene fragment, respectively. Predictive functional metagenome profiles based on 16S rRNA marker genes showed that the most abundant metabolic functions in the three samples were related to central metabolisms and substrate utilisation, with “energy metabolism”, “carbohydrate metabolism”, and “amino acid metabolism” were the top three abundant pathways. Findings from this study showed effluent from POME AnSBR contains highly valuable volatile fatty acids (VFAs) that could be recycled and maximised to produce H_2 in MEC. This study showed high potential of turning highly polluting POME as source to generate clean and renewable H_2 energy.

ABSTRAK

Kebergantungan global terhadap bahan api fosil sebagai sumber tenaga telah meningkat menyebabkan pengurangan simpanan minyak dan pemanasan global. Industri kelapa sawit, sektor pertanian terbesar di negara ini, dijangka menghasilkan kira-kira 70−110 juta tan sisa pepejal dan cecair menjelang tahun 2020. Sisa cecair ini, dikenali juga sebagai efluen sisa minyak sawit (POME), dalam jumlah besar dianggap sangat mencemarkan kerana kandungan permintaan oksigen biologikal dan kimia yang tinggi. Oleh kerana POME kaya dengan substrat seperti karbohidrat dan asid lemak, kajian ini dijalankan untuk menyiasat penggunaan bakteria dari enapcemar anaerobik POME bagi menghasilkan gas hidrogen (H_2) di dalam sistem hibrid yang menggabungkan reaktor kelompok urutan anaerobik (AnSBR) dan sel elektrolisis mikrob (MEC). Lima kaedah pra-rawatan (kejutan haba, asid, alkali, kimia, dan pengudaraan) telah diuji bagi memilih kaedah terbaik. Daripada lima kaedah tersebut, kejutan haba menunjukkan penghasilan H_2 tertinggi. Seterusnya, beberapa faktor yang mempengaruhi penghasilan H_2 ditentukan menggunakan kaedah satu-faktor-pada-satu-masa (OFAT). Keputusan menunjukkan penghasilan H_2 tertinggi adalah pada pH permulaan 6.0, suhu eraman 55.0°C, dan 10.0% (v/v) saiz inokulum. Kajian lanjut bagi mengoptimum penghasilan H_2 menggunakan Reka Bentuk Box−Behnken (BBD) menunjukkan bahawa semua faktor menyumbang secara signifikan terhadap penghasilan H_2. Kombinasi pH permulaan 6.4, suhu eraman 58.0°C, dan saiz inokulum 8.0% v/v meningkatkan penghasilan H_2 2.57 kali ganda lebih tinggi (239.0 mL) berbanding sebelum pengoptimuman. Seterusnya, keadaan yang dioptimumkan ini dikaji secara meluas dalam AnSBR 1.2 L dengan dua faktor: masa tahanan hidraulik (HRT) dan kadar muatan organik (OLR). Keputusan menunjukkan 12 jam HRT dan 36 g/L/d OLR adalah keadaan terbaik dengan penghasilan maksima H_2 dicatatkan pada >2.80 L H_2/L POME dan penyingkiran COD hampir 65% dicapai semasa 16 kitaran operasi. Sel tunggal MEC kemudiannya disalurkan dengan POME terawat AnSBR. Voltan 1.0 V telah digunakan bagi operasi MEC memberikan jumlah kumulatif penghasilan H_2 3.63 ± 0.16 L H_2/L POME sepanjang tempoh tujuh hari. Kecekapan Coulomb maksimum, C_E (83.9 ± 3.3%), pungutan H_2 maksimum, r_{cat} (99.1 ± 4.7%), dan jumlah pungutan tenaga, η_{E+S} (103.9 ± 8.9%) juga direkodkan. Bagi menentukan komuniti mikrob sistem hibrid, genom DNA bakteria dari enapcemar AnSBR dan kedua-dua bioanod MFC dan MEC telah diekstrak dan dilakukan jujukan gen amplikon 16S rRNA. Di antara 10 filum teratas daripada ketiga-tiga sampel, filum *Firmicutes* adalah dominan di dalam enapcemar AnSBR, sementara filum *Proteobacteria* dominan untuk kedua-dua bioanod MFC dan MEC, masing-masing mewakili sekitar 40% dan 80% dari keseluruhan serpihan gen. Fungsi ramalan profil metagenom berdasarkan gen penanda 16S rRNA menunjukkan fungsi metabolisme yang paling banyak dalam ketiga-tiga sampel tersebut adalah berkaitan dengan metabolisme pusat dan penggunaan substrat, dengan “metabolisme tenaga”, “metabolisme karbohidrat”, dan “metabolisme asid amino” sebagai tiga kumpulan besar yang teratas. Hasil kajian ini menunjukkan efluen POME yang dikeluarkan dari AnSBR mengandungi asid organik yang sangat berharga dan boleh dikitar semula serta dimaksimakan untuk menghasilkan H_2 dalam MEC. Kajian ini menunjukkan potensi yang tinggi untuk penukaran POME yang sangat mencemar sebagai sumber tenaga H_2 yang bersih dan boleh diperbaharui.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

2-LFD	–	2-level factorial design
ADMI	–	American Dye Manufacturers Institute
AIM	–	Agensi Inovasi Malaysia
AnSBR	–	Anaerobic sequencing batch reactor
APHA	–	American Public Health Association
ATP	–	Adenosine triphosphate
BBD	–	Box−Behnken Design
BES	–	Bio-electrochemical system
BLAST	–	Basic Local Alignment Search Tool
BOD	–	Biochemical oxygen demand
bp	–	Base pair
CCD	–	Central Composite Design
CCV	–	Closed circuit voltage
CPO	–	Crude palm oil
COD	–	Chemical oxygen demand
DAD	–	Diode array detector
DC	–	Decanter cake
DNA	–	Deoxyribonucleic acid
DNS	–	Dinitrosalicylic acid
DO	–	Dissolved oxygen
DOE	–	Department of Environment
EIA	–	Energy Information Administration
EFB	–	Empty fruit bunch
EPS	–	Extracellular polymeric substances
EUMCCI	–	EU-Malaysia Chamber of Commerce and Industry
FIB−SEM	–	Focused Ion Beam−Scanning Electron Microscopy
FELCRA	–	Federal Land Consolidation and Rehabilitation Authority
FELDA	–	Federal Land Development Authority
FFB	–	Fresh fruit bunch
FTIR	–	Fourier Transform Infra-red

GC – Gas Chromatography
GDP – Gross domestic product
GHG – Greenhouse gaseous
HPLC – High-Performance Liquid Chromatography
HRT – Hydraulic retention time
ID – Internal diameter
IQR – Interquartile range
MEC – Microbial electrolysis cell
MF – Mesocarp fibre
MFC – Microbial fuel cell
MLSS – Mixed liquor suspended solids
MLVSS – Mixed liquor volatile suspended solids
MPOB – Malaysian Palm Oil Board
MPOC – Malaysian Palm Oil Council
Mtoe – Million tonnes of equivalent
NADH – Nicotinamide adenine dinucleotide
NAD(P)H – Nicotinamide adenine dinucleotide phosphate
NGO – Non-governmental organisation
NKEA – National Key Economic Areas
OCV – Open circuit voltage
OD – Optical density
OFAT – One-factor-at-a-time
OLR – Organic loading rate
OPF – Oil palm frond
OPT – Oil palm trunk
PCR – Polymerase chain reaction
PEM – Proton exchange membrane
PHA – Polyhydroxyalkanoate
PKC – Palm kernel cake
PKS – Palm kernel shell
POME – Palm oil mill effluent
r_{cat} – H_2 recovery
R_{in} – Internal resistance

RSM	–	Response surface methodology
rRNA	–	Ribosomal RNA
SDR	–	Substrate degradation rate
TCD	–	Thermal conductivity detector
TSS	–	Total suspended solids
USA	–	United States of America
USD	–	US Dollar
UV-Vis	–	Ultraviolet-visible
VFA	–	Volatile fatty acid

LIST OF SYMBOLS

A – Ampere

A – Surface area

C_E – Coulombic efficiency

E_{ap} – Applied voltage

F – Faraday’s constant

g – Gravitational force

g/L – Gram per litre

H – Cumulative H_2 production

I – Current

K – Kelvin

M – Molarity

ml/min – Millilitre per minute

mM – Millimolar

m – Median

$\mathrm{mA/m^2}$ – Current density

$\mathrm{max_p}$ – Maximum point

$\mathrm{min_p}$ – Minimum point

$\mathrm{mW/m^2}$ – Power density

$\mathrm{N_{cycle}}$ – Number of cycles per day

P – Maximum H_2 production, power, pressure

Q – Charge (Coulomb)

$\mathrm{Q_1}$ – Lower quartile

$\mathrm{Q_3}$ – Upper quartile

R – External resistance, constant Ideal Gas Law

R_m – Maximum H_2 production rate

rpm – Rotation per minute

S – Conductivity

V – Voltage

v_r – Volume of liquid in the reactor

% v/v – percentage of volume over volume

e – Euler number

Δ – Differences

Ω – Ohm

e_E – Electrical energy input

e_S – Substrate energy input

η_E – Electrical energy recovery

η_{E+S} – Total energy recovery

η_S – Substrate energy recovery

λ – Lag-phase time

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Research Background

The production of palm oil has introduced vast interest globally due to its advantages, especially in dealing with other competing oils, such as sunflower, olives and vegetable oils that have low-cost production, the capability to yield high amount and trans-fatty acid-free. The demand and value for palm oil has increased drastically because of its multi-purpose benefits in both food and non-food industries (Abdullah *et al*., 2013; Hansen *et al*., 2012). It was reported that the total production of palm oil alone has accounted for 40.0% which makes it the leading exploited vegetable oil in the world (Hansen *et al*., 2015; Oosterveer *et al*., 2015).

Malaysia's oil palm industry has grown over the years and, Malaysia is well-known as the second-biggest producer of palm oil in the world, accounting for 33.0% of the global oils and fats production in 2017 (Kushairi *et al.*, 2017; Tan and Lim, 2019). Nowadays, Malaysia remained a significant player in the palm oil industry with its export market accounts for 33.6% of the global palm oil trade, which is approximately 16.56 million tonnes in 2017 compared to the previous year of 3.2% increment (Kushairi *et al*., 2017; MPOC, 2017; Tan and Lim, 2019). Malaysia, Indonesia, and Thailand accounted for more than 80.0% of the worldwide distribution of palm oil production annually (Amiruddin *et al*., 2005; Awalludin *et al*., 2015). The industry served as a crucial backbone to the economy of the country and improved the living standards of its communities considerably (Yusoff and Hansen, 2007). This situation supported by the national gross output, which the oil palm industry in Malaysia has contributed over RM 53 billion, coming as fourth largest sources of national income since 2014, making it is an enormous contributor to the economic growth (AIM, 2015). In 2017 alone, Malaysia has recorded more than 16 million tonnes of palm oil products which accounted for approximately 34% of global export in palm oil trade (MPOC, 2017).

Since the rapid development of the palm oil industry in Malaysia, the risks of pollution produced by the industry have intensified. The risks discovered primarily in surface water pollution are due to either insufficient or inappropriate disposal of solid and liquid waste. These justified further evaluation of the potential contribution to improving the sector's environmental performance in Malaysia by the cleaner palm oil industry. Besides, life cycle assessments of palm oil waste treatment have been implemented to evaluate the potential use of palm oil residues (Hansen *et al*., 2012). The amount of palm oil mill effluent (POME) also produced increases in proportion to the world demand for edible oil (Ahmed *et al*., 2015; Bala *et al*., 2015). The extraction of CPO involves the boiling of fresh fruit bunch (FFB), which requires a significantly huge amount of water during the process. It was estimated that each tonne of CPO produced required 5.0–7.5 tonnes of water, with more than 50.0% of this water ends up as POME (Wu *et al*., 2009; Yacob *et al*., 2006).

In general, raw POME is an acid brownish colloidal suspension consisting of high polluting properties with an average level of chemical oxygen demand (COD, 50,000 mg/L), biochemical oxygen demand (BOD, 25,000 mg/L), total solids (40,500 mg/L), suspended solids (18,000 mg/L), and oil and grease (6,000 mg/L) (Ahmad *et al*., 2003), which were produced from the steriliser condensate, separator sludge, and hydrocyclone waster (Wu *et al*., 2010). It also contained cellulosic material, fat, oil, and grease (Iskandar *et al*., 2018; Rupani *et al*., 2010). The excessive level of COD and BOD in POME could severely harm the aquatic life forms in rivers and water stream (Borja *et al*., 1996; Loh *et al*., 2013; Neoh *et al*., 2013). Moreover, the intense colour of POME would prevent sunlight from penetrating the water and thus threatening photosynthetic organisms in the water (Azreen *et al*., 2017; Okwute and Isu, 2007). Although the effluent is non-toxic as no chemicals are added during the extraction process of CPO from FFB, it generates polluted wastewater that not only impacts the aquatic niche but also causes odour issues for the local community. Hence, the palm oil mill industry is increasingly requiring sustainable treatment of POME to minimise pollution. With over 453 palm oil mills across the country, producing POME in large amount every day (MPOB, 2018), the discharge of POME into the rivers present a potential threat to the ecosystem and environment.

Malaysia is also blessed with fossil fuels which make them well-known for the producers of petroleum oil and natural gas. The primary energy sources in Malaysia, besides oil and gas, come from coal and a small percentage of renewable energy sources such as hydroelectricity, biomass and solar energy (Oh *et al*., 2018; Shaikh *et al*., 2017). Like many other developing countries, development and economic growth continue to impact the nation's increasing demand for energy consumption. With the anticipated need for future energy to develop at an annual pace of 5.0–8.0% over the next two decades, energy security is becoming a serious problem as fossil fuels are non-renewable energies and will deplete eventually soon (Bhattacharya *et al*., 2016; Ong *et al*., 2011). Hence, energy-related policy measures have been a top priority to ensure energy security and sustainability in the country (Bong *et al*., 2017; Yatim *et al*., 2016).

The excessive, sole dependency on fossil fuels in thriving the nation has resulted in a severe global climate change, apart from possible depletion of oil reservoir from the global perspective point (Guo *et al*., 2010; Shafiee and Topal, 2009; Singh and Singh, 2012). With the subject of Montreal Protocol 1972 and Kyoto Protocol 1997, the Malaysian Government recognised the use of green technology as a long-term and practical alternative towards climate change and energy security (Mekhilef *et al*., 2014; Shi *et al*., 2013). Furthermore, the Malaysian Government also actively engaged in research and development (R&D) by using multiple renewable energy sources including biomass wastes, hydropower, solar power, and wind energy to sustain its energy demand and consumption (Kardooni *et al*., 2016; Shekarchian *et al*., 2011).

Hydrogen gas (H_2) can be classified as an ideal, green and sustainable energy carrier. Compared to any hydrocarbon fuel, it contains the highest gravimetric energy density. It can be seen as an alternative source of renewable energy to fossil fuel since the combustion of H_2 generates no emissions of greenhouse gases (GHG) (Azwar *et* *al*., 2014; Chong *et al*., 2009; Rezania *et al*., 2017). H_2 has been suggested as the ultimate transport gas for vehicles and boats due to its non-polluting properties and offers the use of highly efficient fuel cells to transform chemical energy into electricity (Forsberg, 2007). This energy is high in demand for various applications of numerous sectors, such as the transportation industry, as a coolant in power plants and rocket propulsion (Goyal *et al*., 2006).

Even though H_2 can be produced directly from fossil fuels, however, the dependency towards it will be unlikely to be a future energy source. Thus, microbial H_2 production was introduced to divert the attention of fossil fuels dependency. A wide diversity of potential substrates, wastes, and biomass are present in abundance to make a significant impact on achieving energy demands if they are efficiently converted to H_2 by fermentation (Hallenbeck, 2011; Hallenbeck and Ghosh, 2009; Hallenbeck *et al*., 2012; Kumar *et al*., 2018). Thus, the production of H_2 by utilising these wastes and biomass have achieved new milestones in this area of research, including biophotolysis and electrohydrogenesis using microbial electrolysis cell (MEC). Recently, a study of biophotolysis was conducted by Kossalbayev *et al*. (2020) in order to determine promising H_2-producers among cyanobacteria and understand the mechanisms along with the conditions for increasing H_2 production. As for fermentation, the application of bioreactor in the study is a must in order to obtain higher volumetric and yield of H_2 with the utilisation of wastes and biomass as substrates. Recent studies including photo-bioreactor (Gao *et al*., 2017; Sun *et al*., 2016), membrane bioreactor (Buitrón *et al*., 2019; Ramírez-Morales *et al*., 2019), anaerobic sequencing batch reactor (AnSBR) (Intanoo *et al*., 2019; Maaroff *et al*., 2019), continuous stirred tank reactor (CSTR) (El-Qelish *et al*., 2019; Srirugsa *et al*., 2019), and upflow anaerobic sludge blanket bioreactor (UASB) (Jiraprasertwong *et al*., 2019; Mahmod *et al*., 2019). Even though MEC is still novel research in this H_2 production, researchers are enthusiastically putting up their efforts in realising this prospect for the future application. Presently, most of the studies were focusing on biocathode development (Jafary *et al*., 2019) and reactor design improvement (Jwa *et al*., 2019) for higher production of H_2.

1.2 Problem Statement

Although Malaysia's palm oil industry has been a success story for its economic growth for decades, it still troubled with the environmental issue, especially the amount of POME being produced (Bala *et al.*, 2015; Mumtaz *et al.*, 2010). As a result, more than 400 palm oil mills across the country, which results in the increase of POME discharge into the water bodies consequently are polluting the environment. In fact, in the year of 2014 alone, POME was generated approximately 64 million tonnes (EUMCCI, 2017; Loh, 2017; Loh *et al.*, 2013). Nevertheless, there are almost 90% of these palm oil mills in Malaysia treating POME by applying the low-cost ponding system treatment. Besides the disadvantage of the large area required for the ponding system to be established, the escaping GHG to the atmosphere is another serious environmental issue risen from this treatment system (Choong *et al.*, 2018). This whole scenario directs to a demanding sustainable treatment of POME, which is to avoid any lengthy consequences. Several reports remarked that the discharge of POME during the palm oil mill processing in Malaysia was recognised as a significant contribution to pollution in the country's rivers (Wu *et al.*, 2009; Ahmed *et al.*, 2015). Therefore, POME is considered highly polluting and could achieve more than 100 times polluted than domestic sewage in terms of BOD and COD limit, which exceed the value of 25,000 mg/L and 50,000 mg/L, respectively (Mumtaz *et al.*, 2010). Besides, the high level of oil and grease together with the suspended solids could clog fish gills, thus potentially harming the aquatic life (Hameed *et al.*, 2003; Jameel and Olanrewaju, 2011). The palm oil mill industry is now facing an uphill challenge to meet the requirement of increasingly stringent environmental standards (Wu *et al.*, 2009; Cheng *et al.*, 2010). Since then, researchers were highly emphasised and driven towards solving this issue by introducing several mechanisms and innovation, such as membrane bioreactors, anaerobic digestion, and physicochemical treatment (Lee *et al.*, 2019) which can successfully treat POME up to the acceptance level for discharge.

Even though those technologies have been proven successful to deal with POME, the enormous abundance of POME produced by the industry have triggered the related stakeholders and researchers to explore other usages of POME, by means converting it into valuable products such as bioenergy, biofuels, and bioplastics, not only focused on treating and disposing of it later on. Hence, the utilisation of POME as a substrate have paved the way towards sustainable, clean production of H_2. Various studies have embarked remarkable achievements of producing H_2 via biological methods in various technologies and applications since the early 2000s (Chan *et* al., 2010; Chong *et al*., 2009a; Ismail *et al*., 2010; Mohammadi *et al*., 2017; Vijayaraghavan and Ahmad, 2006). Although rapid signs of progress and achievements were obtained, studies have reported that the H_2 yield was far from convincing when it comes to up-scale the production and its practicality (Balachandar *et al*., 2020; Piemonte *et al*., 2014; Ren *et al*., 2006; Tapia-Venegas *et al*., 2015; Vatsala *et al*., 2008). The questionable problem lies within the substrate. In general, the substrates being used are only partially hydrolysed to produce H_2, which leave the by-products as wastes (Das and Veziroglu, 2008; Kumar *et al*., 2018). This would be a wasteful resource if the substrate could not be maximised to deliver the acceptable production yield of H_2, particularly those valuable by-products with volatile fatty acids (VFAs) that could be converted and used as backbones of alcohols, aldehydes, ketones, esters, and olefins, not only for H_2 production (Boboescu *et al*., 2016; Kumar *et al*., 2018; Lee *et al*., 2014) but could also for the renewable bio-refinery industry (Eggeman and Verser, 2005, Singhania *et al*., 2013).

Since the production of H_2 from the non-renewable sources were hampered with the uncertainty of global oil prices, the depletion of oil reservoirs soon, and the environmental issues including the rise of global warming and climate change (Sharma *et al*., 2020; Sheth and Babu, 2010), the researchers are currently intensified their efforts in exploring the renewable sources as substrates for green, clean, and sustainable production of H_2. Apparently, the microbial H_2 production can be divided into three mechanisms which are biophotolysis, fermentation, and electrohydrogenesis (Mishra *et al*., 2019). However, each of these mechanisms hampered with difficulties: low light conversion efficiency causing low yields of H_2 for biophotolysis (Kosourov *et al*., 2002; Rahman *et al*., 2016), low conversion of substrates from wastes and biomass with only 15% of energy to be converted to H_2 from fermentation (Logan, 2004; Hallenback and Ghosh, 2009; Rahman *et al*., 2016; Zainal *et al*., 2018). As for MEC, substrates with less complexity are suitable to be used (Kadier *et al*., 2014; Sleutels *et al*., 2011) and its reactor design practicality especially the external voltage and energy losses during MEC process (Kadier *et al*., 2016; Mishra *et al*., 2019) have been the main hurdle for its progressing forward into a real application. Even though fermentation still not capable to achieve a higher yield of H_2, but, compared to other mechanisms, it is the only one that can manage to convert a variety of substrates with fewer difficulties. Hence, several strategies have been suggested to overcome the difficulties such as developing two-stage mechanisms or systems derived from the fermentation by-products such as organic acids which later could be reused and recycled (Adessi *et al*., 2012; Hallenbeck, 2011; Hallenbeck *et al*., 2012; Kumar *et al*., 2018).

The introduction of the hybrid system for H_2 production has established a breakthrough among researchers due to the low yield of H_2 obtained via biological methods. This hybrid system, also known as an integrated system involving the two-stage process (Boboescu *et al*., 2016; Hallenbeck and Ghosh, 2009), which: i) the fermentation of the substrate to H_2 and organic acids takes place in a process that has been optimised using one or several of the advanced technologies in the first-stage and followed by ii) the additional H_2 is extracted from the effluent of the first-stage reactor, happens in the second-stage. This not only could overcome the bottle-necks facing for H_2 production but can be a bonus towards the use of wastewaters as substrates which allow the technology to become economically feasible by combining bioenergy production with wastewater treatment (Boboescu *et al*., 2016). Thus, this could be the answer for the oil palm industry in handling the current issue it is facing on treating POME discharge.

Thus, this research was conducted to develop a hybrid system using POME as the source of the substrate, for efficient production of H_2 as converting the abundance waste produced into bioenergy, simultaneously could solve treatment process which enormously hampered the industry itself. With the incorporation of anaerobic sequencing batch reactor (AnSBR) and microbial electrolysis cell (MEC) in a hybrid system, it would be an ideal for optimising the POME as a substrate for H_2 production, especially the effluent from AnSBR which contains highly valuable organic acids after first-stage wastewater treatment. Hence, the barrier of H_2 production would be overcome and could improve the current wastewater treatment process for POME at the palm oil mills. This proposal could be a defining moment in the era of clean, renewable energy produced from the abundance of wastes available to overcome yield efficiencies, which hinders the larger-scale development of H_2 production.

1.3 Objectives of Research

The main objective of this research was to maximise the production of H_2, utilising raw POME as its substrate and simultaneously treat the undesirable characteristics of POME. The objectives were as follows:

i. To compare the H_2 production and microbial composition between different pre-treatment methods for H_2-producers from POME anaerobic sludge

ii. To optimise the H_2 production of raw POME using statistical approach under batch condition

iii. To investigate the best initial start-up of bioanode development for the microbial fuel cell (MFC) before being used in MEC setup using heat-shock pre-treated POME anaerobic sludge as inoculum

iv. To develop an AnSBR−MEC hybrid system for efficient H_2 production and wastewater treatment of raw POME under the optimised condition

v. To monitor and identify microbial diversity in the AnSBR−MEC hybrid system using a metagenomics approach

1.4 Scope of Research

The scope for this research was divided into several parts which were as follows:

i. This research would compare the H_2 production and microbial composition between different pre-treatment methods from POME anaerobic sludge. Methods of pre-treatment for the POME anaerobic sludge applied in this study were heat-shock, acid, alkaline, chemical, and aeration. This research would also perform wastewater and VFA analyses for each of the pre-treatment methods besides the H_2 production profile. Microbial composition/diversity for each of the pre-treatment method would be analysed using DNA cloning (Chapter 4)

ii. For the optimisation using OFAT, three significant factors based on the reported literature: the initial pH of the medium, incubation temperature, and inoculum size using raw POME as a substrate and pre-treated POME anaerobic sludge as a source of microorganisms. Results from OFAT approach was used to identify the factor levels that can produce maximum H_2 production as an input in 2-Level Factorial Design (2-LFD). This was followed by Box−Behnken Design (BBD) which was used to determine their optimal values by analysing the influence and interactions of factors identified on the 2-LFD (Chapter 5)

iii. The best initial start-up of bioanode development based on indirect enrichment approach via a dual-chambered MFC setup. Pre-treated POME anaerobic sludge was used as inoculum for the development of bioanode. To ensure the successful development of biofilm on the surface of bioanode, several factors were optimised in MFC – external resistance, electrode surface area, ionic concentration of salt bridge, anodic initial pH, and substrate concentration. The results from this research were converted into electricity generation i.e. power generation, the current generation, polarisation curve, and internal resistance (Chapter 6)

iv. The performance of AnSBR–MEC hybrid system was based on H_2 production and water quality parameter analyses. Other factors such as hydraulic retention time (HRT), organic loading rate (OLR), applied voltage (E_{ap}), and different types of POME applied were determined with the aim to produce a high yield of H_2 (Chapter 7)

v. The microbial diversity of AnSBR–MEC hybrid system was analysed using metagenomics approach, choosing 16S gene amplicon sequencing as the platform analysis. Metabolic profiling was also determined in better knowledge and understanding, especially in H_2 production (Chapter 8)

1.5 Significance of Research

This research is anticipated to contribute to a significant milestone in solving the environmental issues related to the palm oil industry in Malaysia, especially POME and concomitantly introduce the H_2, which reflects as clean, sustainable energy for the future. By implementing the hybrid system technology in the palm oil industry, POME will be utilised to produce H_2 and facilitate the treatment of POME. Aforementioned, the H_2 will make our dependency on fossil fuels lesser and solve other issues related to the environment such as GHG and global warming.

REFERENCES

Ab Kadir, M.Z.A. and Rafeeu, Y., 2010. A Review on Factors for Maximizing Solar Fraction Under Wet Climate Environment in Malaysia. *Renewable and Sustainable Energy Reviews*, 14(8), pp.2243−2248.

Abdel-Aal, H.K., Sadik, M., Bassyouni, M., and Shalabi, M., 2005. A New Approach to Utilize Hydrogen as a Safe Fuel. *International Journal of Hydrogen Energy*, 30(13-14), pp.1511−1514.

Abdullah, A.Z., Salamatinia, B., Mootabadi, H., and Bhatia, S., 2009. Current Status and Policies on Biodiesel Industry in Malaysia as the World's Leading Producer of Palm Oil. *Energy Policy*, 37(12), pp.5440−5448.

Abdullah, N. and Sulaiman, F., 2013. *The Oil Palm Wastes in Malaysia*. In Biomass Now-Sustainable Growth and Use. IntechOpen.

Abdullah, N., Yuzir, A., Curtis, T.P., Yahya, A., and Ujang, Z., 2013. Characterization of Aerobic Granular Sludge Treating High Strength Agro-Based Wastewater at Different Volumetric Loadings. *Bioresource Technology*, 127, pp.181−187.

Abdul-Wahab, S.A., and Abdo, J., 2007. Optimization of Multistage Flash Desalination Process by using a Two-Level Factorial Design. *Applied Thermal Engineering*, 27(2-3), pp.413−421.

Abo-Hashesh, M., Ghosh, D., Tourigny, A., Taous, A., and Hallenbeck, P.C., 2011. Single Stage Photofermentative Hydrogen Production from Glucose: An Attractive Alternative to Two Stage Photofermentation or Co-culture Approaches. *International Journal of Hydrogen Energy*, 36(21), pp.13889−13895.

Acosta-Martínez, V., Dowd, S., Sun, Y., and Allen, V., 2008. Tag-Encoded Pyrosequencing Analysis of Bacterial Diversity in a Single Soil Type as Affected by Management and Land Use. *Soil Biology and Biochemistry*, 40(11), pp.2762−2770.

Adams, M.W. and Hall, D.O., 1979. Purification of the Membrane-Bound Hydrogenase of *Escherichia coli*. *Biochemical Journal*, 183(1), pp.11−22.

Adessi, A., Torzillo, G., Baccetti, E., and De Philippis, R., 2012. Sustained Outdoor H_2 Production with *Rhodopseudomonas palustris* Cultures in a 50 L Tubular Photobioreactor. *International Journal of Hydrogen Energy*, 37(10), pp.8840−8849.

Aelterman, P., Rabaey, K., Pham, H.T., Boon, N., and Verstraete, W., 2006. Continuous Electricity Generation at High Voltages and Currents using Stacked Microbial Fuel Cells. *Environmental Science & Technology*, 40(10), pp.3388−3394.

Aelterman, P., Versichele, M., Marzorati, M., Boon, N., and Verstraete, W., 2008. Loading Rate and External Resistance Control the Electricity Generation of Microbial Fuel Cells with Different Three-Dimensional Anodes. *Bioresource Technology*, 99(18), pp.8895−8902.

Ahmad, A.L., Ismail, S., and Bhatia, S., 2003. Water Recycling from Palm Oil Mill Effluent (POME) using Membrane Technology. *Desalination*, 157(1−3), pp.87−95.

Ahmad, A.L., Sumathi, S., and Hameed, B.H., 2006. Coagulation of Residue Oil and Suspended Solid in Palm Oil Mill Effluent by Chitosan, Alum and PAC. *Chemical Engineering Journal*, 118(1-2), pp.99−105.

Ahmad, S., Ab Kadir, M.Z.A., and Shafie, S., 2011. Current Perspective of The Renewable Energy Development in Malaysia. *Renewable and Sustainable Energy Reviews*, 15(2), pp.897−904.

Ahmad, S. and Tahar, R.M., 2014. Selection of Renewable Energy Sources for Sustainable Development of Electricity Generation System using Analytic Hierarchy Process: A Case of Malaysia. *Renewable Energy*, 63, pp.458−466.

Ahmed, Y., Yaakob, Z., Akhtar, P., and Sopian, K., 2015. Production of Biogas and Performance Evaluation of Existing Treatment Processes in Palm Oil Mill Effluent (POME). *Renewable and Sustainable Energy Reviews*, 42, pp.1260−1278.

Ahn, J.H., Choi, M.Y., Kim, B.Y., Lee, J.S., Song, J., Kim, G.Y., and Weon, H.Y., 2014. Effects of Water-Saving Irrigation on Emissions of Greenhouse Gases and Prokaryotic Communities in Rice Paddy Soil. *Microbial Ecology*, 68(2), pp.271−283.

AIM., 2015. National Biomass Strategy 2020: New Wealth Creation for Malaysia's Biomass Industry: Version 2.0, retrieved on 13 December 2015 from http://etp.pemandu.gov.my/upload/Biomass_Strategy_2013.

Aja, O.C. and Al-Kayiem, H.H., 2014. Review of Municipal Solid Waste Management Options in Malaysia, With an Emphasis on Sustainable Waste-To-Energy Options. *Journal of Material Cycles and Waste Management*, 16(4), pp.693−710.

Akar, S.T., Gorgulu, A., Kaynak, Z., Anilan, B., and Akar, T., 2009. Biosorption of Reactive Blue 49 Dye Under Batch and Continuous Mode using a Mixed Biosorbent of Macro-Fungus *Agaricus bisporus* and *Thuja orientalis* Cones. *Chemical Engineering Journal*, 148(1), pp.26−34.

Akkerman, I., Janssen, M., Rocha, J.M.S., Reith, J.H., Wijffels, R.H., 2003. *Photobiological Hydrogen Production: Photochemical Efficiency and Bioreactor Design*. In Reith, J.H., Wijffels, R.H., Barten, H. (eds.) *Biomethane and Biohydrogen: Status and Perspectives of Biological Methane and Hydrogen Production*. The Hague, Netherlands: Dutch Biological Hydrogen Foundation, pp. 124–145.

Alam, M.Z., Ameem, E.S., Muyibi, S.A., and Kabbashi, N.A., 2009. The Factors Affecting the Performance of Activated Carbon Prepared from Oil Palm Empty Fruit Bunches for Adsorption of Phenol. *Chemical Engineering Journal*, 155(1–2), pp.191–198.

Alam, M.Z., Jamal, P., and Nadzir, M.M., 2008. Bioconversion of Palm Oil Mill Effluent for Citric Acid Production: Statistical Optimization of Fermentation Media and Time by Central Composite Design. *World Journal of Microbiology and Biotechnology*, 24(7), pp.1177−1185.

Alam, M.Z., Karim, M.I.A., and Mespuan, M.T., 2006b. *Statistical Optimization of Physicochemical Factors for Lignin Peroxidase Production using POME as Substrate*. Proceedings of the 20th Symposium of Malaysian Chemical Engineers (SOMChE 2006). Shah Alam, Malaysia, pp. 151−156.

Alam, M.Z., Karim, M.I.A., Hamisan, A.F., Jamal, P., and Jalal, K.C.A., 2006a. *Liquid State Bioconversion of Palm Oil Mill Effluent for Cellulase Production*: Statistical Optimization of Process Conditions. Proceedings of the 1st

International Conference on Natural Resources Engineering & Technology. Putrajaya, Malaysia, pp. 226−232.

Ali, R., Daut, I., and Taib, S., 2012. A Review on Existing and Future Energy Sources for Electrical Power Generation in Malaysia. *Renewable and Sustainable Energy Reviews*, 16(6), pp.4047−4055.

Alavijeh, M.K., Mardanpour, M.M., and Yaghmaei, S., 2015. One-Dimensional Conduction-Based Modeling of Bioenergy Production in a Microbial Fuel Cell Engaged with Multi-Population Biocatalysts. *Electrochimica Acta*, 184, pp.151−163.

Aliyu, A.S., Ramli, A.T., and Saleh, M.A., 2013. Nigeria Electricity Crisis: Power Generation Capacity Expansion and Environmental Ramifications. *Energy*, 61, pp.354−367.

Altschul, S.F., Gish, W., Miller, W., Myers, E.W., and Lipman, D.J., 1990. Basic Local Alignment Search Tool. *Journal of Molecular Biology*, 215(3), pp.403−410.

Amat, N.A., Tan, Y.H., Lau, W.J., Lai, G.S., Ong, C.S., Mokhtar, N.M., Sani, N.A.A., Ismail, A.F., Goh, P.S., Chong, K.C., and Lai, S.O., 2015. Tackling Colour Issue of Anaerobically-Treated Palm Oil Mill Effluent using Membrane Technology. *Journal of Water Process Engineering*, 8, pp.221−226.

Amiruddin, M.N., Abrahman, A.K., and Shariff, F., 2005. Market Potential and Challenges for The Malaysian Palm Oil Industry in Facing Competition from Other Vegetable Oils. *Oil Palm Industry Economic Journal*, 5(1), pp.17−27.

Anderson, M.J. and Whitcomb, P.J., 2000. *DOE Simplified: Practical Tools for Effective Experimentation*. Portland, OR, USA: Productivity Inc.

Anderson, M.J. and Whitcomb, P.J., 2005. *RSM Simplified: Optimizing Processes using Response Surface Methods for Design of Experiments*. Portland, OR, USA: Productivity Inc.

Annous, B.A., Shieh, J.S., Shen, G.J., Jain, M.K., and Zeikus, J.G., 1996. Regulation of Hydrogen Metabolism in Butyribacterium methylotrophicum by Substrate and pH. *Applied Microbiology and Biotechnology*, 45(6), pp.804−810.

Antonopoulou, G., Stamatelatou, K., Venetsaneas, N., Kornaros, M., and Lyberatos, G., 2008. Biohydrogen and Methane Production from Cheese Whey in a Two-Stage Anaerobic Process. *Industrial & Engineering Chemistry Research*, 47(15), pp.5227−5233.

Anuradha, J.S. and Valli, N.C., 2011. Utilization of Pretreated Bagasse for the Sustainable Bioproduction of Cellulase by *Aspergillus nidulans* MTCC344 using Response Surface Methodology. *Industrial Crops and Products*, 34, pp.1564−1571.

APHA., 2012. *Standard Methods for the Examination of Water and Wastewater* (22nd ed.). Washington, DC, USA: American Public Health Association, American Water Works Association and Water Environment Federation.

Appels, L., Baeyens, J., Degrève, J., and Dewil, R., 2008. Principles and Potential of the Anaerobic Digestion of Waste-Activated Sludge. *Progress in Energy and Combustion Science*, 34(6), pp.755−781.

Arimi, M.M., Knodel, J., Kiprop, A., Namango, S.S., Zhang, Y., and Geißen, S.U., 2015. Strategies for Improvement of Biohydrogen Production from Organic-Rich Wastewater: A Review. *Biomass and Bioenergy*, 75, pp.101−118.

Aris, A.M., 2008. *Optimization of Microbial Fuel Cell using Locally Isolated Electrochemical-Active Bacterial Strains*. MSc Thesis, Universiti Teknologi Malaysia.

Arjan, D., Heijne, A.T., Saakes, M., Hamelers, H.V., and Buisman, C.J., 2009. Analysis and Improvement of a Scaled-Up and Stacked Microbial Fuel Cell. *Environmental Science & Technology*, 43(23), pp.9038−9042.

Arooj, M.F., Han, S.K., Kim, S.H., Kim, D.H., and Shin, H.S., 2008. Effect of HRT on ASBR Converting Starch into Biological Hydrogen. *International Journal of Hydrogen Energy*, 33(22), pp.6509−6514.

Asmawi, M.Z., Din, A.M., Sshamsuddin, N.F., and Paiman, T., 2012. Financing Coastal Land Use Planning: A Case Study of LUAS, Malaysia. *APCBEE Procedia*, 1, pp.325−330.

Asnicar, F., Weingart, G., Tickle, T.L., Huttenhower, C., and Segata, N., 2015. Compact Graphical Representation of Phylogenetic Data and Metadata with GraPhlAn. *PeerJ*, 3, p.e1029.

Atif, A.A.Y., Fakhru'l-Razi, A., Ngan, M.A., Morimoto, M., Iyuke, S.E., and Veziroglu, N.T., 2005. Fed Batch Production of hydrogen from Palm Oil Mill Effluent using Anaerobic Microflora. *International Journal of Hydrogen Energy*, 30(13-14), pp.1393−1397.

Awalludin, M.F., Sulaiman, O., Hashim, R., and Nadhari, W.N.A.W., 2015. An Overview of The Oil Palm Industry in Malaysia and Its Waste Utilization Through Thermochemical Conversion, Specifically Via Liquefaction. *Renewable and Sustainable Energy Reviews*, 50, pp.1469−1484.

Awotoye, O.O., Dada, A.C., and Arawomo, G.A.O., 2011. Impact of Palm Oil Processing Effluent Discharge on the Quality of Receiving Soil and River in South Western Nigeria. *Journal of Applied Sciences Research*, 7(2), pp.111−118.

Azman, N.F., Abdeshahian, P., Al-Shorgani, N.K.N., Hamid, A.A., and Kalil, M.S., 2016c. Production of Hydrogen Energy from Dilute Acid-Hydrolyzed Palm Oil Mill Effluent in Dark Fermentation using an Empirical Model. *International Journal of Hydrogen Energy*, 41(37), pp.16373−16384.

Azman, N.F., Abdeshahian, P., Kadier, A., Al-Shorgani, N.K.N., Salih, N.K., Lananan, I., Hamid, A.A., and Kalil, M.S. 2016a. Biohydrogen Production from De-Oiled Rice Bran as Sustainable Feedstock in Fermentative Process. *International Journal of Hydrogen Energy*, 41(1), pp.145−156.

Azman, N.F., Abdeshahian, P., Kadier, A., Shukor, H., Al-Shorgani, N.K.N., Hamid, A.A., and Kalil, M.S., 2016b. Utilization of Palm Kernel Cake as a Renewable Feedstock for Fermentative Hydrogen Production. *Renewable Energy*, 93, pp.700−708.

Azreen, I., Zahrim, A.Y., Chong, S.H., and Ng, S.W., 2017. Estimation of Melanoidin Concentration in Palm Oil Mill Effluent Ponding System and Its Treatment using Calcium Lactate. *IOP Conference Series: Materials Science and Engineering*, 206(1), p. 012078).

Azwar, M.Y., Hussain, M.A., and Abdul-Wahab, A.K., 2014. Development of Biohydrogen Production by Photobiological, Fermentation and Electrochemical Processes: A Review. *Renewable and Sustainable Energy Review*, 31, pp.158−173.

Badiei, M., Jahim, J.M., Anuar, N., and Abdullah, S.R.S., 2011. Effect of Hydraulic Retention Time on Biohydrogen Production from Palm Oil Mill Effluent in Anaerobic Sequencing Batch Reactor. *International Journal of Hydrogen Energy*, 36(10), pp.5912−5919.

Baharuddin, A.S., Wakisaka, M., Shirai, Y., Abd-Aziz, S., Abdul Rahman, N.A., and Hassan, M.A., 2009. Co-composting of Empty Fruit Bunches and Partially

Treated Palm Oil Mill Effluents in Pilot Scale. *International Journal of Agricultural Research*, 4(2), pp.69−78.

Bakker, S., van Lente, H., and Meeus, M.T., 2012. Credible Expectations—The US Department of Energy's Hydrogen Program as Enactor and Selector of Hydrogen Technologies. *Technological Forecasting and Social Change*, 79(6), pp.1059−1071.

Bakonyi, P., Borza, B., Orlovits, K., Simon, V., Nemestóthy, N., and Bélafi-Bakó, K., 2014. Fermentative Hydrogen Production by Conventionally and Unconventionally Heat Pretreated Seed Cultures: A Comparative Assessment. *International Journal of Hydrogen Energy*, 39(11), pp.5589−5596.

Bakonyi, P., Nemestóthy, N., Simon, V., and Bélafi-Bakó, K., 2014. Review on the Start-Up Experiences of Continuous Fermentative Hydrogen Producing Bioreactors. *Renewable and Sustainable Energy Reviews*, 40, pp.806−813.

Bakonyi, P., Kumar, G., Koók, L., Tóth, G., Rózsenberszki, T., Bélafi-Bakó, K., and Nemestóthy, N., 2018. Microbial Electrohydrogenesis Linked to Dark Fermentation as Integrated Application for Enhanced Biohydrogen Production: A Review on Process Characteristics, Experiences and Lessons. *Bioresource Technology*, 251, pp.381−389.

Bala, J.D., Lalung, J., and Ismail, N., 2014. Biodegradation of Palm Oil Mill Effluent (POME) by Bacterial. *International Journal of Scientific and Research Publications*, 4(3), pp.502−511.

Bala, J.D., Lalung, J., and Ismail, N., 2015. Studies on the Reduction of Organic Load from Palm Oil Mill Effluent (POME) by Bacterial Strains. *International Journal of Recycling of Organic Waste in Agriculture*, 4(1), pp.1−10.

Balachandar, G., Khanna, N., and Das, D., 2013. *Biohydrogen Production from Organic Wastes by Dark Fermentation*. In Pandey, A., Chang, J.S., Hallenbeck, P.C., and Larroche, C. (eds.) *Biohydrogen*. San Diego, CA, USA: Elsevier.

Balachandar, G., Varanasi, J.L., Singh, V., Singh, H., and Das, D., 2020. Biological Hydrogen Production via Dark Fermentation: A Holistic Approach from Lab-Scale to Pilot-Scale. *International Journal of Hydrogen Energy*, 45(8), pp.5202−5215.

Balat, M., 2008. Potential Importance of Hydrogen as A Future Solution to Environmental and Transportation Problems. *International Journal of Hydrogen Energy*, 33(15), pp.4013−4029.

Bao, M., Su, H., and Tan, T., 2012. Biohydrogen Production by Dark Fermentation of Starch using Mixed Bacterial Cultures of *Bacillus* sp and *Brevumdimonas* sp. *Energy & Fuels*, 26(9), pp.5872−5878.

Baranitharan, E., Khan, M.R., Prasad, D.M.R., and Salihon, J.B., 2013. Bioelectricity Generation from Palm Oil Mill Effluent in Microbial Fuel Cell using Polacrylonitrile Carbon Felt as Electrode. *Water, Air, & Soil Pollution*, 224(5), pp.1533−1544.

Barbir, F., 2009. Transition to Renewable Energy Systems with Hydrogen as an Energy Carrier. *Energy*, 34(3), pp.308−312.

Basiron, Y., 2008. Malaysian Palm Oil: Dynamics and Prospects. *Malaysia-India Palm Oil Trade Fair and Seminar*. 28−29 May. Mumbai, India.

Basiron, Y. and Simeh, M., 2005. Vision 2020: The Palm Oil Phenomenon. *Oil Palm Industry Economic Journal*, 5(2), pp.1−10.

Basri, N.A., Ramli, A.T., and Aliyu, A.S., 2015. Malaysia Energy Strategy Towards Sustainability: A Panoramic Overview of The Benefits and Challenges. *Renewable and Sustainable Energy Reviews*, 42, pp.1094−1105.

Batlle-Vilanova, P., Puig, S., Gonzalez-Olmos, R., Vilajeliu-Pons, A., Bañeras, L., Balaguer, M.D., and Colprim, J., 2014. Assessment of Biotic and Abiotic Graphite Cathodes for Hydrogen Production in Microbial Electrolysis Cells. *International Journal of Hydrogen Energy*, 39(3), pp.1297−1305.

Bay, H.H., 2014. *Decolourisation and Degradation of Acid Orange 7 using an Acclimatised BAC-ZS Mixed Bacterial Culture*. PhD Thesis, Universiti Teknologi Malaysia.

Behrendt, L., Larkum, A.W., Trampe, E., Norman, A., Sørensen, S.J., and Kühl, M., 2012. Microbial Diversity of Biofilm Communities in Microniches Associated with the Didemnid Ascidian *Lissoclinum patella*. *The ISME Journal*, 6(6), pp.1222−1237.

Bello, M.M., Nourouzi, M.M., and Abdullah, L.C., 2014. Tertiary Treatment of Biologically Treated POME in Fixed-BedC: Color and COD Removal. *Advances in Environmental Biology*, pp.565−572.

Bello, M.M., Nourouzi, M.M., Abdullah, L.C., Choong, T.S., Koay, Y.S., and Keshani, S., 2013. POME is Treated for Removal of Color from Biologically Treated POME in Fixed Bed Column: Applying Wavelet Neural Network (WNN). *Journal of Hazardous Materials*, 262, pp.106−113.

Beltran-Heredia, J., Torregrosa, J., Dominguez, J.R., and Garcia, J., 2000. Treatment of Black-Olive Wastewaters by Ozonation and Aerobic Biological Degradation. *Water Research*, 34(14), pp.3515−3522.

Bengtsson, S., Werker, A., and Welander, T., 2008. Production of Polyhydroxyalkanoates by Glycogen Accumulating Organisms Treating a Paper Mill Wastewater. *Water Science and Technology*, 58(2), pp.323−330.

Benson, D.A., Clark, K., Karsch-Mizrachi, I., Lipman, D.J., Ostell, J., and Sayers, E.W., 2013. GenBank. *Nucleic Acids Research*, 42(D1), pp.D32−D37.

Berry, D., Mahfoudh, K.B., Wagner, M., and Loy, A., 2011. Barcoded Primers Used in Multiplex Amplicon Pyrosequencing Bias Amplification. *Applied and Environmental Microbiology*, 77(21), pp.7846−7849.

Bhatia, S.K. and Yang, Y.H., 2017. Microbial Production of Volatile Fatty Acids: Current Status and Future Perspectives. *Reviews in Environmental Science and Bio/Technology*, 16(2), pp.327−345.

Bhattacharya, M., Paramati, S.R., Ozturk, I., and Bhattacharya, S., 2016. The Effect of Renewable Energy Consumption on Economic Growth: Evidence from Top 38 Countries. *Applied Energy*, 162, pp.733−741.

Bleijlevens, B., Buhrke, T., Van der Linden, E., Friedrich, B., and Albracht, S.P., 2004. The Auxiliary Protein HypX Provides Oxygen Tolerance to the Soluble [NiFe]-Hydrogenase of *Ralstonia eutropha* H16 by Way of a Cyanide Ligand to Nickel. *Journal of Biological Chemistry*, 279(45), pp.46686−46691.

Boboescu, I.Z., Gherman, V.D., Lakatos, G., Pap, B., Bíró, T., and Maróti, G., 2016. Surpassing the Current Limitations of Biohydrogen Production Systems: The Case for a Novel Hybrid Approach. *Bioresource Technology*, 204, pp.192−201.

Bong, C.P.C., Lim, L.Y., Ho, W.S., Lim, J.S., Klemeš, J.J., Towprayoon, S., Ho, C.S., and Lee, C.T., 2017. A Review on The Global Warming Potential of Cleaner Composting and Mitigation Strategies. *Journal of Cleaner Production*, 146, pp.149−157.

Booneimsri, P., Kubaha, K., and Chullabodhi, C., 2018. Increasing Power Generation with Enhanced Cogeneration using Waste Energy in Palm Oil Mills. *Energy Science & Engineering,* 6(3), pp.154−173.

Borhanazad, H., Mekhilef, S., Saidur, R., and Boroumandjazi, G., 2013. Potential Application of Renewable Energy for Rural Electrification in Malaysia. *Renewable Energy*, 59, pp.210−219.

Borja, R., Banks, C.J., and Sánchez, E., 1996. Anaerobic Treatment of Palm Oil Mill Effluent in A Two-Stage Up-Flow Anaerobic Sludge Blanket (UASB) System. *Journal of Biotechnology*, 45(2), pp.125−135.

Borole, A.P., Hamilton, C.Y., and Vishnivetskaya, T.A., 2011. Enhancement in Current Density and Energy Conversion Efficiency of 3-Dimensional MFC Anodes using Pre-Enriched Consortium and Continuous Supply of Electron Donors. Bioresource Technology, 102(8), pp.5098−5104.

Borole, A.P., Hamilton, C.Y., Vishnivetskaya, T., Leak, D., and Andras, C., 2009. Improving Power Production in Acetate-Fed Microbial Fuel Cells via Enrichment of Exoelectrogenic Organisms in flow-Through Systems. *Biochemical Engineering Journal*, 48(1), pp.71−80.

Borole, A.P., O'Neill, H., Tsouris, C., and Cesar, S., 2008. A Microbial Fuel Cell Operating at Low pH using the Acidophile *Acidiphilium cryptum*. *Biotechnology Letters,* 30(8), pp.1367−1372.

Bowles, L.K. and Ellefson, W.L., 1985. Effects of Butanol on *Clostridium acetobutylicum*. *Applied and Environmental Microbiology,* 50(5), pp.1165−1170.

Brenner, D.J., Staley, J.T. and Krieg, N.R., 2005. Classification of Procaryotic Organisms and the Concept of Bacterial Speciation. In Brenner D.J., Krieg N.R., Staley J.T., and Garrity G.M. (eds.) *Bergey's Manual of Systematic Bacteriology*. (Vol. 2). Boston, MA, USA: Springer, pp. 27−32.

Breuil, C. and Saddler, J.N., 1985. Comparison of the 3,5-Dinitrosalicylic Acid and Nelson-Somogyi Methods of Assaying for Reducing Sugars and Determining Cellulase Activity. *Enzyme and Microbial Technology*, 7(7), pp.327−332.

British Petroleum., 2018. *British Petroleum Statistical Review of World Energy*. London, UK: British Petroleum Corporate Communications Services.

Brown, R.K., Harnisch, F., Wirth, S., Wahlandt, H., Dockhorn, T., Dichtl, N., and Schröder, U., 2014. Evaluating the Effects of Scaling Up on the Performance of Bioelectrochemical Systems using a Technical Scale Microbial Electrolysis Cell. *Bioresource Technology*, 163, pp.206−213.

Buitrón, G. and Carvajal, C., 2010. Biohydrogen Production from *Tequila vinasses* in an Anaerobic Sequencing Batch Reactor: Effect of Initial Substrate Concentration, Temperature and Hydraulic Retention Time. *Bioresource Technology*, 101(23), pp.9071−9077.

Buitrón, G., Muñoz-Páez, K.M., and Hernández-Mendoza, C.E., 2019. Biohydrogen Production using a Granular Sludge Membrane Bioreactor. *Fuel,* 241, pp.954−961.

Bujang, A.S., Bern, C.J., and Brumm, T.J., 2016. Summary of Energy Demand and Renewable Energy Policies in Malaysia. *Renewable and Sustainable Energy Reviews*, 53, pp.1459−1467.

Bundhoo, Z.M., 2017. Coupling Dark Fermentation with Biochemical or Bioelectrochemical Systems for Enhanced Bio-Energy Production: A Review. *International Journal of Hydrogen Energy,* 42(43), pp.26667−26686.

Bundhoo, M.Z. and Mohee, R., 2016. Inhibition of Dark Fermentative Bio-hydrogen Production: A Review. *International Journal of Hydrogen Energy*, 41(16), pp.6713−6733.

Cai, J., Wu, Q., Wang, G., and Deng, C., 2013. Fermentative Hydrogen Production by a New Mesophilic Bacterium *Clostridium* sp. 6A-5 Isolated from the Sludge of a Sugar Mill. *Renewable Energy*, 59, pp.202−209.

Call, D. and Logan, B.E., 2008. Hydrogen Production in a Single Chamber Microbial Electrolysis Cell Lacking a Membrane. *Environmental Science & Technology*, 42(9), pp.3401−3406.

Campanaro, S., Treu, L., Kougias, P.G., De Francisci, D., Valle, G., and Angelidaki, I., 2016. Metagenomic Analysis and Functional Characterization of the Biogas Microbiome using High Throughput Shotgun Sequencing and a Novel Binning Strategy. *Biotechnology for Biofuels*, 9(1), p.26.

Cao, G.L., Guo, W.Q., Wang, A.J., Zhao, L., Xu, C.J., Zhao, Q.L., and Ren, N.Q., 2012. Enhanced Cellulosic Hydrogen Production from Lime-Treated Cornstalk Wastes using Thermophilic Anaerobic Microflora. *International Journal of Hydrogen Energy*, 37(17), pp.13161−13166.

Cao, X., Liu, X., and Dong, X., 2003. *Alkaliphilus crotonatoxidans* sp. nov., a Strictly Anaerobic, Crotonate-Dismutating Bacterium Isolated from a Methanogenic Environment. *International Journal of Systematic and Evolutionary Microbiology*, 53(4), pp.971−975.

Cao, Y., Meng, D.J., Lu, J., and Long, J., 2008. Statistical Optimization of Xylanase Production by *Aspergillus niger* AN-13 Under Submerged Fermentation using Response Surface Methodology. *African Journal of Biotechnology*, 7(5), pp.631−638.

Caporaso, J.G., Lauber, C.L., Walters, W.A., Berg-Lyons, D., Huntley, J., Fierer, N., Owens, S.M., Betley, J., Fraser, L., Bauer, M., and Gormley, N., 2012. Ultra-High-Throughput Microbial Community Analysis on the Illumina HiSeq and MiSeq Platforms. *The ISME Journal*, 6(8), pp.1621−1624.

Cardenas, E. and Tiedje, J.M., 2008. New Tools for Discovering and Characterizing Microbial Diversity. *Current Opinion in Biotechnology*, 19(6), pp.544−549.

Carrillo-Reyes, J., Celis, L.B., Alatriste-Mondragón, F., and Razo-Flores, E., 2012. Different Start-Up Strategies to Enhance Biohydrogen Production from Cheese Whey in UASB Reactors. *International Journal of Hydrogen Energy*, 37(7), pp.5591−5601.

Castelló, E., y Santos, C.G., Iglesias, T., Paolino, G., Wenzel, J., Borzacconi, L., and Etchebehere, C., 2009. Feasibility of Biohydrogen Production from Cheese Whey using a UASB Reactor: Links between Microbial Community and Reactor Performance. *International Journal of Hydrogen Energy*, 34(14), pp.5674−5682.

Cha, G.C. and Noike, T., 1997. Effect of Rapid Temperature Change and HRT on Anaerobic Acidogenesis. *Water Science and Technology*, 36(6−7), pp.247−253.

Chae, K.J., Choi, M.J., Lee, J.W., Kim, K.Y., and Kim, I.S., 2009. Effect of Different Substrates on the Performance, Bacterial Diversity, and Bacterial Viability in Microbial Fuel Cells. *Bioresource Technology*, 100(14), pp.3518−3525.

Chaikitkaew, S., Kongjan, P., and Sompong, O., 2015. Biogas Production from Biomass Residues of Palm Oil Mill by Solid State Anaerobic Digestion. *Energy Procedia*, 79, pp.838−844.

Chan, Y.J., Chong, M.F., and Law, C.L., 2010. Biological Treatment of Anaerobically Digested Palm Oil Mill Effluent (POME) using a Lab-Scale Sequencing Batch Reactor (SBR). *Journal of Environmental Management*, 91(8), pp.1738−1746.

Chan, Y.J., Chong, M.F., Law, C.L., and Hassell, D.G., 2009. A Review on Anaerobic–Aerobic Treatment of Industrial and Municipal Wastewater. *Chemical Engineering Journal*, 155(1-2), pp.1−18.

Chandra, R. and Mohan, S.V., 2011. Microalgal Community and Their Growth Conditions Influence Biohydrogen Production During Integration of Dark-Fermentation and Photo-Fermentation Processes. International Journal of Hydrogen Energy, 36(19), pp.12211−12219.

Chandrasekhar, K., Lee, Y.J., and Lee, D.W., 2015. Biohydrogen Production: Strategies to Improve Process Efficiency Through Microbial Routes. *International Journal of Molecular Sciences*, 16(4), pp.8266−8293.

Chang, F.Y. and Lin, C.Y., 2004. Biohydrogen Production using an Up-Flow Anaerobic Sludge Blanket Reactor. *International Journal of Hydrogen Energy,* 29(1), pp.33−39.

Chang, I.S., Le Clech, P., Jefferson, B., and Judd, S., 2002. Membrane Fouling in Membrane Bioreactors for Wastewater Treatment. *Journal of Environmental Engineering*, 128(11), pp.1018−1029.

Chang, J.S., Lin, C.Y., and Miyake, J., 2008. Asian BioH_2 Symposium 2006. *International Journal of Hydrogen Energy*, 33(5), pp.1459−1459.

Chang, S., Li, J.Z., and Liu, F., 2011. Evaluation of Different Pretreatment Methods for Preparing Hydrogen-Producing Seed Inocula from Waste Activated Sludge. *Renewable Energy*, 36(5), pp.1517−1522.

Chang, S.H., Wu, C.H., Chang, D.K., and Lin, C.W., 2014. Effects of Mediator Producer and Dissolved Oxygen on electricity generation in a baffled Stacking Microbial Fuel Cell Treating High Strength Molasses Wastewater. *International Journal of Hydrogen Energy*, 39(22), pp.11722−11730.

Chaudhuri, S.K. and Lovley, D.R., 2003. Electricity Generation by Direct Oxidation of Glucose in Mediatorless Microbial Fuel Cells. *Nature Biotechnology*, 21(10), pp.1229−1232.

Chavalparit, O., Rulkens, W.H., Mol, A.P.J., and Khaodhair, S., 2006. Options for Environmental Sustainability of the Crude Palm Oil Industry in Thailand Through Enhancement of Industrial Ecosystems. *Environment, Development and Sustainability*, 8(2), pp.271−287.

Chen, C.C. and Lin, C.Y., 2003. using Sucrose as a Substrate in an Anaerobic Hydrogen-Producing Reactor. *Advances in Environmental Research*, 7(3), pp.695−699.

Chen, C.C., Sen, B., Chuang, Y.S., Tsai, C.J., and Lay, C.H., 2012. Effect of Effluent Recycle Ratio in a Continuous Anaerobic Biohydrogen Production System. *Journal of Cleaner Production*, 32, pp.236−243.

Chen, C.Y., Saratale, G.D., Lee, C.M., Chen, P.C., and Chang, J.S., 2008. Phototrophic hydrogen production in Photobioreactors Coupled with Solar-Energy-Excited Optical Fibers. *International Journal of Hydrogen Energy,* 33(23), pp.6886−6895.

Chen, C.Y., Yeh, K.L., Lo, Y.C., Wang, H.M., and Chang, J.S., 2010. Engineering Strategies for the Enhanced Photo-H_2 Production using Effluents of Dark Fermentation Processes as Substrate. *International Journal of Hydrogen Energy*, 35(24), pp.13356−13364.

Chen, H., Meng, H., Nie, Z., and Zhang, M., 2013. Polyhydroxyalkanoate Production from Fermented Volatile Fatty Acids: Effect of pH and Feeding Regimes. *Bioresource Technology*, 128, pp.533−538.

Chen, S. and Dong, X., 2005. *Proteiniphilum acetatigenes* gen. nov., sp. nov., from a UASB Reactor Treating Brewery Wastewater. *International Journal of Systematic and Evolutionary Microbiology*, 55(6), pp.2257−2261.

Chen, S.D., Lee, K.S., Lo, Y.C., Chen, W.M., Wu, J.F., Lin, C.Y., and Chang, J.S., 2008. Batch and Continuous Biohydrogen Production from Starch Hydrolysate by *Clostridium* species. *International Journal of Hydrogen Energy*, 33(7), pp.1803−1812.

Chen, W.H., Chen, S.Y., Khanal, S.K., and Sung, S., 2006. Kinetic Study of Biological Hydrogen Production by Anaerobic Fermentation. *International Journal of Hydrogen Energy*, 31(15), pp.2170−2178.

Chen, W.M., Tseng, Z.J., Lee, K.S., and Chang, J.S., 2005. Fermentative Hydrogen Production with *Clostridium butyricum* CGS5 Isolated from Anaerobic Sewage Sludge. *International Journal of Hydrogen Energy*, 30(10), pp.1063−1070.

Cheng, C.K., Derahman, M.R., and Khan, M.R., 2015. Evaluation of the Photocatalytic Degradation of Pre-Treated Palm Oil Mill Effluent (POME) over Pt-Loaded Titania. *Journal of Environmental Chemical Engineering*, 3(1), pp.261−270.

Cheng, J., Torkamani, A., Grover, R.K., Jones, T.M., Ruiz, D.I., Schork, N.J., Quigley, M.M., Hall, F.W., Salomon, D.R., and Lerner, R.A., 2011. Ectopic B-Cell Clusters That Infiltrate Transplanted Human Kidneys are Clonal. *Proceedings of the National Academy of Sciences*, 108(14), pp.5560−5565.

Cheng, J., Zhu, X., Ni, J., and Borthwick, A., 2010. Palm Oil Mill Effluent Treatment using a Two-Stage Microbial Fuel Cells System Integrated with Immobilized Biological Aerated Filters. *Bioresource Technology*, 101(8), pp.2729−2734.

Cheng, K.K., Cai, B.Y., Zhang, J.A., Ling, H.Z., Zhou, Y.J., Ge, J.P., and Xu, J.M., 2008. Sugarcane Bagasse Hemicellulose Hydrolysate for Ethanol Production by Acid Recovery Process. *Biochemical Engineering Journal*, 38(1), pp.105−109.

Cheng, Q., Wang, S., Rials, T.G., and Lee, S.H., 2007. Physical and Mechanical Properties of Polyvinyl Alcohol and Polypropylene Composite Materials Reinforced with Fibril Aggregates Isolated from Regenerated Cellulose Fibers. *Cellulose*, 14(6), pp.593−602.

Cheng, S. and Logan, B.E., 2011. Increasing Power Generation for Scaling Up Single-Chamber Air Cathode Microbial Fuel Cells. *Bioresource Technology*, 102(6), pp.4468−4473.

Chidthaisong, A. and Conrad, R., 2000. Turnover of Glucose and Acetate Coupled to Reduction Of Nitrate, Ferric Iron and Sulfate and to Methanogenesis in Anoxic Rice Field Soil. *FEMS Microbiology Ecology*, 31(1), pp.73−86.

Chin, K.L., H’ng, P.S., Chai, E.W., Tey, B.T., Chin, M.J., Paridah, M.T., Luqman, A.C., and Maminski, M., 2013a. Fuel Characteristics of Solid Biofuel Derived from Oil Palm Biomass and Fast Growing Timber Species in Malaysia. *Bioenergy Research*, 6(1), pp.75−82.

Chin, M.J., Poh, P.E., Tey, B.T., Chan, E.S., and Chin, K.L., 2013b. Biogas from palm oil mill effluent (POME): Opportunities and challenges from Malaysia's perspective. *Renewable and Sustainable Energy Reviews*, 26, pp.717−726.

Chittibabu, G., Nath, K., and Das, D., 2006. Feasibility Studies on the Fermentative Hydrogen Production by Recombinant *Escherichia coli* BL-21. *Process Biochemistry*, 41(3), pp.682−688.

Chong, H.Y. and Lam, W.H., 2013. Ocean Renewable Energy in Malaysia: The Potential of the Straits of Malacca. *Renewable and Sustainable Energy Reviews*, 23, pp.169−178.

Chong, M.L., Rahim, R.A., Shirai, Y., and Hassan, M.A., 2009a. Biohydrogen Production by *Clostridium butyricum* EB6 from Palm Oil Mill Effluent. *International Journal of Hydrogen Energy*, 34(2), pp.764−771.

Chong, M.L., Sabaratnam, V., Shirai, Y., and Hassan, M.A., 2009b. Biohydrogen Production from Biomass and Industrial Wastes by Dark Fermentation. *International Journal of Hydrogen Energy*, 34(8), pp.3277−3287.

Chong, P.S., Jahim, J.M., Harun, S., Lim, S.S., Mutalib, S.A., Hassan, O., and Nor, M.T.M., 2013. Enhancement of Batch Biohydrogen Production from Prehydrolysate of Acid Treated Oil Palm Empty Fruit Bunch. *International Journal of Hydrogen Energy*, 38(22), pp.9592−9599.

Chookaew, T., Prasertsan, P., and Ren, Z.J., 2014. Two-Stage Conversion of Crude Glycerol to Energy using Dark Fermentation Linked with Microbial Fuel Cell or Microbial Electrolysis Cell. *New Biotechnology*, 31(2), pp.179−184.

Choong, Y.Y., Chou, K.W., and Norli, I., 2018. Strategies for Improving Biogas Production of Palm Oil Mill Effluent (POME) Anaerobic Digestion: A Critical Review. *Renewable & Sustainable Energy Review*, 82(3), pp.2993−3006.

Choorit, W. and Wisarnwan, P., 2007. Effect of Temperature on the Anaerobic Digestion of Palm Oil Mill Effluent. *Electronic Journal of Biotechnology*, 10(3), pp.376−385.

Choudhuri, S., 2014. *Bioinformatics for Beginners: Genes, Genomes, Molecular Evolution, Databases and Analytical Tools*. San Diego, CA, USA: Elsevier.

Chowdhury, A.J.K., Alam, M.Z., and Shahlizah, S.H., 2006. *Isolation, Purification and Screening of Fungal Strain for Effective Bioconversion of Palm Oil Mill Effluent*. Proceedings of the 1st International Conference on Natural Resources Engineering & Technology. Putrajaya, Malaysia, pp. 167−175.

Chua, S.C. and Oh, T.H., 2010. Review on Malaysia's National Energy Developments: Key Policies, Agencies, Programmes and International Involvements. *Renewable and Sustainable Energy Reviews*, 14(9), pp.2916−2925.

Chuah, T.G., Wan Azlina, A.G.K., Robiah, Y., and Omar, R., 2006. Biomass as the Renewable Energy Sources in Malaysia: An Overview. *International Journal of Green Energy*, 3(3), pp.323−346.

Ciranna, A., Ferrari, R., Santala, V., and Karp, M., 2014. Inhibitory Effects of Substrate and Soluble End Products on Biohydrogen Production of the Alkalithermophile *Caloramator celer*: Kinetic, Metabolic and Transcription Analyses. *International Journal of Hydrogen Energy*, 39(12), pp.6391−6401.

Cisneros-Pérez, C., Carrillo-Reyes, J., Celis, L.B., Alatriste-Mondragón, F., Etchebehere, C., and Razo-Flores, E., 2015. Inoculum Pretreatment Promotes Differences in Hydrogen Production Performance in EGSB Reactors. *International Journal of Hydrogen Energy*, 40(19), pp.6329−6339.

Clarridge, J.E., 2004. Impact of 16S rRNA Gene Sequence Analysis for Identification of Bacteria on Clinical Microbiology and Infectious Diseases. *Clinical Microbiology Reviews*, 17(4), pp.840−862.

Clauwaert, P., Aelterman, P., De Schamphelaire, L., Carballa, M., Rabaey, K., and Verstraete, W., 2008. Minimizing Losses in Bio-electrochemical Systems: The

Road to Applications. *Applied Microbiology and Biotechnology*, 79(6), pp.901−913.

Copcia, V., Hristodor, C., Luchian, C., Bilba, N., and Sandu, I., 2010. Ammonium Nitrogen Removal from Aqueous Solution by Natural Clay. *Revista de Chimie (Bucharest)*, 61, pp.1192−1196.

Cord-Ruwisch, R., Law, Y., and Cheng, K.Y., 2011. Ammonium as a Sustainable Proton Shuttle in Bioelectrochemical Systems. *Bioresource Technology*, 102(20), pp.9691−9696.

Cusick, R.D., Bryan, B., Parker, D.S., Merrill, M.D., Mehanna, M., Kiely, P.D., Liu, G., and Logan, B.E., 2011. Performance of a Pilot-Scale Continuous Flow Microbial Electrolysis Cell Fed Winery Wastewater. *Applied Microbiology and Biotechnology*, 89(6), pp.2053−2063.

Dareioti, M.A. and Kornaros, M., 2014. Effect of Hydraulic Retention Time (HRT) on the Anaerobic Co-Digestion of Agro-Industrial Wastes in a Two-Stage CSTR System. *Bioresource Technology*, 167, pp.407−415.

Darus, Z.M., Hashim, N.A., Manan, S.N.A., Rahman, M.A.A., Maulud, K.N.A., and Karim, O.A., 2008. *Potential of Wind Energy in Sustainable Development of Resort Island in Malaysia: A Case Study of Pulau Perhentian (Perhentian Island).* Paper presented at the Proceedings of the 10th WSEAS international conference on Mathematical Methods, Computational Techniques and Intelligent Systems, Corfu, Greece, pp.431−435.

Das, D. and Veziroğlu, T.N., 2001. Hydrogen Production by Biological Processes: A Survey of Literature. *International Journal of Hydrogen Energy*, 26(1), pp.13−28.

Das, D. and Veziroglu, T.N., 2008. Advances in Biological Hydrogen Production Processes. *International Journal of Hydrogen Energy*, 33(21), pp.6046−6057.

Das, D., Khanna, N., and Veziroğlu, T.N., 2008. Recent Developments in Biological Hydrogen Production Processes. *Chemical Industry and Chemical Engineering Quarterly/CICEQ*, 14(2), pp.57−67.

Das, H.S., Tan, C.W., Yatim, A.H.M., and Lau, K.Y., 2017. Feasibility Analysis of Hybrid Photovoltaic/Battery/Fuel Cell Energy System for an Indigenous Residence in East Malaysia. *Renewable and Sustainable Energy Reviews*, 76(Supplement C), pp.1332−1347.

Das, S. and Dash, H., 2015. *Application of Molecular Microbiology*. In: Microbial Biotechnology—A Laboratory Manual for Bacterial Systems. New Delhi: Springer.

Fereidonian Dashti, A., Adlan, M.N., Abdul Aziz, H., and Ibrahim, A.H., 2018. Application of Response Surface Methodology (RSM) for Optimization of Ammoniacal Nitrogen Removal from Palm Oil Mill Wastewater using Limestone Roughing Filter. *Journal of Applied Research in Water and Wastewater*, 5(1), pp.411−416.

Davila-Vazquez, G., Alatriste-Mondragon, F., de León-Rodríguez, A., and Razo-Flores, E., 2008. Fermentative Hydrogen Production in Batch Experiments using Lactose, Cheese Whey and Glucose: Influence of Initial Substrate Concentration and pH. *International Journal of Hydrogen Energy*, 33(19), pp.4989−4997.

Davila-Vazquez, G., Cota-Navarro, C.B., Rosales-Colunga, L.M., de León-Rodríguez, A., and Razo-Flores, E., 2009. Continuous Biohydrogen Production using Cheese Whey: Improving the Hydrogen Production Rate. *International Journal of Hydrogen Energy*, 34(10), pp.4296−4304.

Defnoun, S., Labat, M., Ambrosio, M., Garcia, J.L., and Patel, B.K., 2000. *Papillibacter cinnamivorans* gen. nov., sp. nov., a Cinnamate-Transforming Bacterium from a Shea Cake Digester. International *Journal of Systematic and Evolutionary Microbiology*, 50(3), pp.1221−1228.

de Barros, D.P., Lemos, F., Fonseca, L.P., and Cabral, J.M., 2010. Kinetic Cutinase-Catalyzed Esterification of Caproic Acid in Organic Solvent System. *Journal of Molecular Catalysis B: Enzymatic*, 66(3−4), pp.285−293.

De Gioannis, G., Muntoni, A., Polettini, A., and Pomi, R., 2013. A Review of Dark Fermentative Hydrogen Production from Biodegradable Municipal Waste Fractions. *Waste Management*, 33(6), pp.1345−1361.

De Sá, L.R.V., De Oliveira, T.C., Dos Santos, T.F., Matos, A., Cammarota, M.C., Oliveira, E.M.M., and Ferreira-Leitao, V.S., 2011. Hydrogenase Activity Monitoring in the Fermentative Hydrogen Production using Heat Pretreated Sludge: A Useful Approach to Evaluate Bacterial Communities Performance. *International Journal of Hydrogen Energy*, 36(13), pp.7543−7549.

de Vrije, T. and Claassen, P.A.M., 2003. *Dark Hydrogen Fermentations*. In Reith, J.H., Wijffels, R.H., and Barten, H. (eds.) *Bio-methane & Bio-hydrogen*. The Hague, Netherlands: Dutch Biological Hydrogen Foundation.

DeLuchi, M.A., 1989. Hydrogen Vehicles: An Evaluation of Fuel Storage, Performance, Safety, Environmental Impacts, and Cost. *International Journal of Hydrogen Energy*, 14(2), pp.81−130.

Demirel, B. and Yenigün, O., 2002. Two-Phase Anaerobic Digestion Processes: A Review. *Journal of Chemical Technology and Biotechnology*, 77(7), pp.743−755.

Department of Statistics Malaysia, 2019a. Population Statistics 2018. *Department of Statistics Malaysia*. Retrieved 10 July 2019, from https://www.dosm.gov.my/v1/index.php?r=column/cthree&menu_id=UmtzQ1pKZHBjY1hVZE95R3RnR0Y4QT09

Department of Statistics Malaysia, 2019b. Rebasing of Malaysia's Gross Domestic Product to Base Year 2015. *Department of Statistics Malaysia*. Retrieved 10 July 2019, from https://www.dosm.gov.my/v1/index.php?r=column/cthemeByCat&cat=153&bul_id=SlhtdWs0UzY4M2ZyWGVRRTlXcXlrQT09&menu_id=TE5CRUZCblh4ZTZMODZIbmk2aWRRQT09

Devendra, C., 2004. Integrated Tree Crops–Ruminants Systems: Potential Importance of the Oil Palm. *Outlook on Agriculture*, 33(3), pp.157−166.

Dewayanto, N., Isha, R., and Nordin, M.R., 2014. Use of Palm Oil Decanter Cake as a New Substrate for the Production of Bio-Oil by Vacuum Pyrolysis. *Energy Conversion and Management*, 86, pp.226−232.

Dhar, B.R., Elbeshbishy, E., Hafez, H., and Lee, H.S., 2015. Hydrogen Production from Sugar Beet Juice using an Integrated Biohydrogen Process of Dark Fermentation and Microbial Electrolysis Cell. *Bioresource Technology*, 198, pp.223−230.

Dhariwal, A., Chong, J., Habib, S., King, I.L., Agellon, L.B., and Xia, J., 2017. MicrobiomeAnalyst: A Web-Based Tool for Comprehensive Statistical, Visual and Meta-Analysis of Microbiome Data. *Nucleic Acids Research*, 45(W1), pp.W180−W188.

Di Lorenzo, M., Scott, K., Curtis, T.P., and Head, I.M., 2010. Effect of Increasing Anode Surface Area on the Performance of a Single Chamber Microbial Fuel Cell. *Chemical Engineering Journal*, 156(1), pp.40−48.

Dietrich, G., Weiss, N., and Winter, J., 1988. *Acetothermus paucivorans*, gen. nov., sp. nov., A Strictly Anaerobic, Thermophilic Bacterium from Sewage Sludge, Fermenting Hexoses to Acetate, CO_2 and H_2. *Systematic and Applied Microbiology*, 10(2), pp.174−179.

Dinesh, G.K., Chauhan, R., and Chakma, S., 2018. Influence and Strategies For Enhanced Biohydrogen Production From Food Waste. *Renewable and Sustainable Energy Reviews*, 92, pp.807−822.

DOE, 2011. *Annual Report 2011, Report 983-9119-77-X*. Putrajaya, Malaysia: Department of Environment, Ministry of Natural Resources and Environment.

Drake, H., G ößner, A., and Daniel, S., 2008. Old Acetogens, New Light. *Annals of the New York Academy of Sciences*, 1125(1), pp.100−128.

Du, Z., Li, H., and Gu, T., 2007. A State of the Art Review on Microbial Fuel Cells: A Promising Technology for Wastewater Treatment and Bioenergy. *Biotechnology Advances*, 25(5), pp.464−482.

Dueber, J.E., Wu, G.C., Malmirchegini, G.R., Moon, T.S., Petzold, C.J., Ullal, A.V., Prather, K.L., and Keasling, J.D., 2009. Synthetic Protein Scaffolds Provide Modular Control Over Metabolic Flux. *Nature Biotechnology*, 27(8), pp.753−759.

Dunn, S., 2002. Hydrogen Futures: Toward A Sustainable Energy System. *International Journal of Hydrogen Energy*, 27(3), pp.235−264.

Dutta, A. and Sarkar, S., 2015. Sequencing Batch Reactor for Wastewater Treatment: Recent Advances. *Current Pollution Reports*, 1(3), pp.177−190.

EC., 2012. *National Energy Balance 2011*. Putrajaya, Malaysia: Suruhanjaya Tenaga (Energy Commission).

EC., 2016. *National Energy Balance 2015*. Putrajaya, Malaysia: Suruhanjaya Tenaga (Energy Commission).

EC., 2017. *National Energy Balance 2016*. Putrajaya, Malaysia: Suruhanjaya Tenaga (Energy Commission).

Edgar, R.C., 2004. MUSCLE: Multiple Sequence Alignment with High Accuracy and High Throughput. *Nucleic Acids Research*, 32(5), pp.1792−1797.

Edgar, R.C., Haas, B.J., Clemente, J.C., Quince, C., and Knight, R., 2011. UCHIME Improves Sensitivity and Speed of Chimera Detection. *Bioinformatics*, 27(16), pp.2194−2200.

Eggeman, T. and Verser, D., 2005. Recovery of Organic Acids from Fermentation Broths. *Applied Biochemistry and Biotechnology*, 122, pp. 605−618.

Elbeshbishy, E., Hafez, H., and Nakhla, G., 2010. Enhancement of Biohydrogen Producing using Ultrasonication. *International Journal of Hydrogen Energy*, 35(12), pp.6184−6193.

Eleventh Malaysia Plan., 2016. Anchoring Growth on People. *Economic Planning Unit, Prime Minister Department*. Retrieved 13 January 2018, from http://epu.gov.my/en/rmk/eleventh-malaysia-plan-2016-2020

El-Qelish, M., Chatterjee, P., Dessì, P., Kokko, M., El-Gohary, F., Abo-Aly, M., and Rintala, J., 2019. Bio-Hydrogen Production from Sewage Sludge: Screening for Pretreatments and Semi-continuous Reactor Operation. *Waste and Biomass Valorization*, pp.1−10.

Elsamadony, M. and Tawfik, A., 2015. Dry Anaerobic Co-Digestion of Organic Fraction of Municipal Waste with Paperboard Mill Sludge and Gelatin Solid Waste for Enhancement of Hydrogen Production. *Bioresource Technology*, 191, pp.157−165.

Eltsova, Z.A., Vasilieva, L.G., and Tsygankov, A.A., 2010. Hydrogen Production by Recombinant Strains of *Rhodobacter sphaeroides* using a Modified Photosynthetic Apparatus. *Applied Biochemistry and Microbiology*, 46(5), pp.487−491.

EMD, 2006. *Calbiochem Buffers*. Darmstadt, Germany: Merck.

Er, A.C., Nor, A.R., and Rostam, K., 2011. Palm Oil Milling Wastes and Sustainable Development. *American Journal of Applied Sciences*, 8(5), pp.436−440.

Eroglu, E., Gunduz, U., Yucel, M., and Eroglu, I., 2010. Photosynthetic Bacterial Growth and Productivity Under Continuous Illumination or Diurnal Cycles with Olive Mill Wastewater as Feedstock. *International Journal of Hydrogen Energy*, 35(11), pp.5293−5300.

Eroglu, E., Gunduz, U., Yucel, M., and Eroglu, I., 2011. Effect of Iron and Molybdenum Addition on Photofermentative Hydrogen Production from Olive Mill Wastewater. *International Journal of Hydrogen Energy*, 36(10), pp.5895−5903.

Escapa, A., Mateos, R., Martínez, E.J., and Blanes, J., 2016. Microbial Electrolysis Cells: An Emerging Technology for Wastewater Treatment and Energy Recovery. From Laboratory to Pilot Plant and Beyond. *Renewable and Sustainable Energy Reviews*, 55, pp.942−956.

Espinoza-Escalante, F.M., Pelayo-Ortíz, C., Navarro-Corona, J., González-García, Y., Bories, A., and Gutiérrez-Pulido, H., 2009. Anaerobic Digestion of The Vinasses from the Fermentation of *Agave tequilana* Weber to Tequila: The Effect of pH, Temperature and Hydraulic Retention Time on the Production of Hydrogen and Methane. *Biomass and Bioenergy*, 33(1), pp.14−20.

EUMCCI, 2017. *Oil Palm Biomass & Biogas in Malaysia—Potentials for European SMEs*. Kuala Lumpur, Malaysia: EU−Malaysia Chamber of Commerce and Industry.

Evens, T.J., Chapman, D.J., Robbins, R.A., and D'asaro, E.A., 2000. An Analytical Flat-Plate Photobioreactor with a Spectrally Attenuated Light Source for the Incubation of Phytoplankton under Dynamic Light Regimes. *Hydrobiologia*, 434(1-3), pp.55−62.

Fan, K.S., Kan, N.R., and Lay, J.J., 2006. Effect of Hydraulic Retention Time on Anaerobic Hydrogenesis in CSTR. *Bioresource Technology*, 97(1), pp.84−89.

Fan, Y., Li, C., Lay, J.J., Hou, H., and Zhang, G., 2004. Optimization of Initial Substrate and pH Levels for Germination of Sporing Hydrogen-Producing Anaerobes in Cow Dung Compost. *Bioresource Technology*, 91(2), pp.189−193.

Fang, H.H. and Liu, H., 2002. Effect of pH on Hydrogen Production from Glucose by A Mixed Culture. *Bioresource Technology*, 82(1), pp.87−93.

Fang, H.H., Zhu, H., and Zhang, T., 2006. Phototrophic Hydrogen Production from Glucose by Pure and Co-Cultures of *Clostridium butyricum* and *Rhodobacter sphaeroides*. *International Journal of Hydrogen Energy*, 31(15), pp.2223−2230.

Fauziah, S.H., Simon, C., and Agamuthu, P., 2004. Municipal Solid Waste Management in Malaysia- Possibility of Improvement? *Malaysian Journal of Science*, 23(2), pp.61−70.

Felsenstein, J., 1985. Confidence Limits on Phylogenies: An Approach using the Bootstrap. *Evolution*, 39(4), pp.783−791.

Feng, Q., Song, Y.C., and Bae, B.U., 2016. Influence of Applied Voltage on the Performance of Bioelectrochemical Anaerobic Digestion of Sewage Sludge and Planktonic Microbial Communities at Ambient Temperature. *Bioresource Technology*, 220, pp.500−508.

Ferchichi, M., Crabbe, E., Gil, G.H., Hintz, W., and Almadidy, A., 2005. Influence of Initial pH on Hydrogen Production from Cheese Whey. *Journal of Biotechnology*, 120(4), pp.402−409.

Fernandes, B.S., Peixoto, G., Albrecht, F.R., del Aguila, N.K.S., and Zaiat, M., 2010. Potential to Produce Biohydrogen from Various Wastewaters. *Energy for Sustainable Development*, 14(2), pp.143−148.

Fernandes, T.R., Pimenta, R., Correas, L., Garcia-Camùs, J.M., Cabral, A.M., Reyes, F.D., Grano, B., Guerra, R., Couhert, C., and Chacón, E., 2013. Platform for Promoting a Hydrogen Economy in Southwest Europe: The HYRREG Project. *International Journal of Hydrogen Energy*, 38(18), pp.7594−7598.

Fischbach, M.A. and Walsh, C.T., 2006. Assembly-Line Enzymology for Polyketide and Nonribosomal Peptide Antibiotics: Logic, Machinery, and Mechanisms. *Chemical Reviews*, 106(8), pp.3468−3496.

Fiset, E. and Puig Broch, S., 2014. Modified Carbon Electrodes: A New Approach for Bioelectrochemical Systems. *Journal of Bioremediation and Biodegradation*, 6, pp.1−2.

Flores, G.E., Henley, J.B., and Fierer, N., 2012. A Direct PCR Approach to Accelerate Analyses of Human-Associated Microbial Communities. *PloS One*, 7(9), p.e44563.

Foo, K.Y., 2015. A Vision on the Opportunities, Policies and Coping Strategies for the Energy Security and Green Energy Development in Malaysia. *Renewable and Sustainable Energy Reviews*, 51, pp.1477−1498.

Forsberg, C.W., 2007. Future Hydrogen Markets for Large-Scale Hydrogen Production Systems. *International Journal of Hydrogen Energy*, 32(4), pp.431−439.

Forsberg, K.J., Patel, S., Gibson, M.K., Lauber, C.L., Knight, R., Fierer, N., and Dantas, G., 2014. Bacterial Phylogeny Structures Soil Resistomes Across Habitats. *Nature*, 509(7502), pp.612−616.

Fouts, D.E., Pieper, R., Szpakowski, S., Pohl, H., Knoblach, S., Suh, M.J., Huang, S.T., Ljungberg, I., Sprague, B.M., Lucas, S.K., and Torralba, M., 2012. Integrated Next-Generation Sequencing of 16S rDNA and Metaproteomics Differentiate the Healthy Urine Microbiome from Asymptomatic Bacteriuria in Neuropathic Bladder Associated with Spinal Cord Injury. *Journal of Translational Medicine*, 10(1), p.174.

Frey, M., 2002. Hydrogenases: Hydrogen-Activating Enzymes. *ChemBioChem*, 3(2−3), pp.153−160.

Gadhamshetty, V., Arudchelvam, Y., Nirmalakhandan, N., and Johnson, D.C., 2010. Modeling Dark Fermentation for Biohydrogen Production: ADM1-Based Model vs. Gompertz Model. *International Journal of Hydrogen Energy*, 35(2), pp.479−490.

Gadhe, A., Sonawane, S.S., and Varma, M.N., 2013. Optimization of Conditions for Hydrogen Production from Complex Dairy Wastewater by Anaerobic Sludge using Desirability Function Approach. *International Journal of Hydrogen Energy*, 38(16), pp.6607−6617.

Gadkari, S., Shemfe, M., and Sadhukhan, J., 2019. Microbial Fuel Cells: A Fast Converging Dynamic Model for Assessing System Performance Based on Bioanode Kinetics. *International Journal of Hydrogen Energy*, 44(29), pp.15377−15386.

Gadow, S.I., Li, Y.Y., and Liu, Y., 2012. Effect of Temperature on Continuous Hydrogen Production of Cellulose. *International Journal of Hydrogen Energy*, 37(20), pp.15465−15472.

Gan, P.Y., Komiyama, R., and Li, Z., 2013. A Low Carbon Society Outlook for Malaysia to 2035. *Renewable and Sustainable Energy Reviews*, 21, pp.432−443.

Gao, J., Liu, G., Li, H., Xu, L., Du, L., and Yang, B., 2016. Predictive Functional Profiling using Marker Gene Sequences and Community Diversity Analyses of Microbes in Full-Scale Anaerobic Sludge Digesters. *Bioprocess and Biosystems Engineering*, 39(7), pp.1115−1127.

Gao, X., Kong, B., and Vigil, R.D., 2018. Multiphysics Simulation of Algal Growth in an Airlift Photobioreactor: Effects of Fluid Mixing and Shear Stress. *Bioresource Technology*, 251, pp.75−83.

Garai, D. and Kumar, V., 2013. A Box–Behnken Design Approach for the Production of Xylanase by Aspergillus Candidus Under Solid State Fermentation and Its Application in Saccharification of Agro Residues and *Parthenium hysterophorus* L. *Industrial Crops and Products*, 44, pp.352−363.

Gebicki, J., Modigell, M., Schumacher, M., van der Burg, J., and Roebroeck, E., 2010. Comparison of Two Reactor Concepts for Anoxygenic H_2 Production by *Rhodobacter capsulatus*. *Journal of Cleaner Production*, 18, pp.S36−S42.

Ghafari, S., Hasan, M., and Aroua, M.K., 2009. Nitrate Remediation in a Novel Upflow Bio-Electrochemical Reactor (UBER) using Palm Shell Activated Carbon as Cathode Material. *Electrochimica Acta*, 54(17), pp.4164−4171.

Ghasemi, M., Shahgaldi, S., Ismail, M., Kim, B.H., Yaakob, Z., and Daud, W.R.W., 2011. Activated Carbon Nanofibers as an Alternative Cathode Catalyst to Platinum in a Two-Chamber Microbial Fuel Cell. *International Journal of Hydrogen Energy*, 36(21), pp.13746−13752.

Ghimire, A., Frunzo, L., Pirozzi, F., Trably, E., Escudie, R., Lens, P.N., and Esposito, G., 2015. A Review on Dark Fermentative Biohydrogen Production from Organic Biomass: Process Parameters and Use of By-Products. *Applied Energy*, 144, pp.73−95.

Gil, G.C., Chang, I.S., Kim, B.H., Kim, M., Jang, J.K., Park, H.S., and Kim, H.J., 2003. Operational Parameters Affecting the Performance of a Mediator-less Microbial Fuel Cell. *Biosensors and Bioelectronics*, 18(4), pp.327−334.

Gilbert, J.C. and Martin, S.F., 2011. *Experimental Organic Chemistry: A Miniscale & Microscale Approach*. 5th Edition. Boston: Cengage Learning.

Gil-Carrera, L., Mehta, P., Escapa, A., Morán, A., García, V., Guiot, S.R., and Tartakovsky, B., 2011. Optimizing the Electrode Size and Arrangement in a Microbial Electrolysis Cell. *Bioresource Technology*, 102(20), pp.9593−9598.

Gobi, K. and Vadivelu, V.M., 2013. By-Products of Palm Oil Mill Effluent Treatment Plant—A Step Towards Sustainability. *Renewable and Sustainable Energy Reviews*, 28, pp.788−803.

Goh, C.S., Lee, K.T., and Bhatia, S., 2010. Hot Compressed Water Pretreatment of Oil Palm Fronds to Enhance Glucose Recovery for Production of Second Generation Bio-Ethanol. *Bioresource Technology*, 101(19), pp.7362−7367.

Golomysova, A., Gomelsky, M., and Ivanov, P.S., 2010. Flux Balance Analysis of Photoheterotrophic Growth of Purple Nonsulfur Bacteria Relevant to Biohydrogen Production. *International Journal of Hydrogen Energy*, 35(23), pp.12751−12760.

Gonzalez-Fernandez, C., Sialve, B., and Molinuevo-Salces, B., 2015. Anaerobic Digestion of Microalgal Biomass: Challenges, Opportunities and Research Needs. *Bioresource Technology*, 198, pp.896−906.

Goodstein, D.L. 2005. *Out of Gas: The End of The Age of Oil*. WW Norton & Company.

Gottipati, R. and Mishra, S., 2010. Process Optimization of Adsorption of Cr (VI) on Activated Carbons Prepared from Plant Precursors by a Two-Level Full Factorial Design. *Chemical Engineering Journal*, 160, 99−107.

Goud, R.K., Arunasri, K., Yeruva, D.K., Krishna, K.V., Dahiya, S., and Mohan, S.V., 2017. Impact of Selectively Enriched Microbial Communities on Long-Term Fermentative Biohydrogen Production. *Bioresource Technology,* 242, pp.253−264.

Goyal, H.B., Seal, D., and Saxena, R.C., 2008. Bio-Fuels from Thermochemical Conversion of Renewable Resources: A Review. *Renewable and Sustainable Energy Reviews*, 12(2), pp.504−517.

Grabowski, A., Tindall, B.J., Bardin, V., Blanchet, D., and Jeanthon, C., 2005. *Petrimonas sulfuriphila* gen. nov., sp. nov., a Mesophilic Fermentative Bacterium Isolated from a Biodegraded Oil Reservoir. *International Journal of Systematic and Evolutionary Microbiology*, 55(3), pp.1113−1121.

Guiochon, G. and Guillemin, C.L., 1988. Quantitative Gas Chromatography for Laboratory Analyses and On-line Process Control, *Journal of Chromatography Library*, 42, pp.629−659.

Guo, J., Peng, Y., Ni, B.J., Han, X., Fan, L., and Yuan, Z., 2015. Dissecting Microbial Community Structure and Methane-Producing Pathways of a Full-Scale Anaerobic Reactor Digesting Activated Sludge from Wastewater Treatment by Metagenomic Sequencing. *Microbial Cell Factories*, 14(1), p.33.

Guo, K., Freguia, S., Dennis, P.G., Chen, X., Donose, B.C., Keller, J., Gooding, J.J., and Rabaey, K., 2013. Effects of Surface Charge and Hydrophobicity on Anodic Biofilm Formation, Community Composition, and Current Generation in Bioelectrochemical Systems. *Environmental Science & Technology*, 47(13), pp.7563−7570.

Guo, X.M., Trably, E., Latrille, E., Carrere, H., and Steyer, J.P., 2010. Hydrogen Production from Agricultural Waste by Dark Fermentation: A Review. *International Journal of Hydrogen Energy*, 35(19), pp.10660−10673.

Gupta, V.K., Mittal, A., Kurup, L., and Mittal, J., 2006. Adsorption of a Hazardous Dye, Erythrosine, Over Hen Feathers. *Journal of Colloid and Interface Science*, 304(1), pp.52−57.

Gursoy-Haksevenler, B.H., and Arslan-Alaton, I., 2015. Evidence of Inert Fractions in Olive Mill Wastewater by Size and Structural Fractionation Before and After Thermal Acid Cracking Treatment. *Separation and Purification Technology*, 154, pp.176−185.

Habib, M.A.B., Yusoff, F.M., Phang, S.M., Ang, K.J., and Mohamed, S., 1997. Nutritional Values of Chironomid Larvae Grown in Palm Oil Mill Effluent and Algal Culture. *Aquaculture*, 158(1−2), pp.95−105.

HACH., 2012. *Water Analysis Handbook* (7th ed.). Loveland, CO, USA: Hach Company.

Hafez, H., Nakhla, G., and El Naggar, H., 2010. An Integrated System for Hydrogen and Methane Production During Landfill Leachate Treatment. *International Journal of Hydrogen Energy*, 35(10), pp.5010−5014.

Hahn-Hägerdal, B., Galbe, M., Gorwa-Grauslund, M.F., Lidén, G., and Zacchi, G., 2006. Bio-Ethanol–The Fuel of Tomorrow from the Residues of Today. *Trends in Biotechnology*, 24(12), pp.549−556.

Hahnke, S., Langer, T., Koeck, D.E., and Klocke, M., 2016. Description of *Proteiniphilum saccharofermentans* sp. nov., *Petrimonas mucosa* sp. nov. and *Fermentimonas caenicola* gen. nov., sp. nov., Isolated from Mesophilic Laboratory-Scale Biogas Reactors, and Emended Description of the Genus *Proteiniphilum*. *International Journal of Systematic and Evolutionary Microbiology*, 66(3), pp.1466−1475.

Hall, T.A., 1999. BioEdit: A User-Friendly Biological Sequence Alignment Editor and Analysis Program for Windows 95/98/NT. *Nucleic Acids Symposium Series*, 41(41), pp. 95−98.

Hallenbeck, P.C., 2005. Fundamentals of the Fermentative Production of Hydrogen. *Water Science and Technology*, 52(1−2), pp.21−29.

Hallenbeck, P.C., 2009. Fermentative Hydrogen Production: Principles, Progress, and Prognosis. *International Journal of Hydrogen Energy*, 34(17), pp.7379−7389.

Hallenbeck, P.C., 2011. Microbial Paths to Renewable Hydrogen Production. *Biofuels*, 2(3), pp.285−302.

Hallenbeck, P.C., Abo-Hashesh, M., and Ghosh, D., 2012. Strategies for Improving Biological Hydrogen Production. *Bioresource Technology*, 110, pp.1−9.

Hallenbeck, P.C. and Benemann, J.R., 2002. Biological Hydrogen Production; Fundamentals and Limiting Processes. *International Journal of Hydrogen Energy*, 27(11-12), pp.1185−1193.

Hallenbeck, P.C. and Ghosh, D., 2009. Advances in Fermentative Biohydrogen Production: The Way Forward?. *Trends in Biotechnology*, 27(5), pp.287−297.

Hameed, B.H., Ahmad, A.L., and Ng, A.H., 2003. Removal of Residual Oil from Palm Oil Mill Effluent using Solvent Extraction Method. *Jurnal Teknologi*, 38(1), pp.33−42.

Han, T.H., Cho, M.H., and Lee, J., 2014. Indole Oxidation Enhances Electricity Production in an *E. coli*-Catalyzed Microbial Fuel Cell. *Biotechnology and Bioprocess Engineering*, 19(1), pp.126−131.

Han, W., Wang, B., Zhou, Y., Wang, D.X., Wang, Y., Yue, L.R., Li, Y.F., and Ren, N.Q., 2012. Fermentative Hydrogen Production from Molasses Wastewater in a Continuous Mixed Immobilized Sludge Reactor. *Bioresource Technology*, 110, pp.219−223.

Handelsman, J., 2004. Metagenomics: Application of Genomics to Uncultured Microorganisms. *Microbiology and Molecular Biology Reviews*, 68(4), pp.669−685.

Hania, W.B., Postec, A., Aüllo, T., Ranchou-Peyruse, A., Erauso, G., Brochier-Armanet, C., Hamdi, M., Ollivier, B., Saint-Laurent, S., Magot, M., and Fardeau, M.L., 2013. *Mesotoga infera* sp. nov., a Mesophilic Member of the Order *Thermotogales*, Isolated from an Underground Gas Storage Aquifer. *International Journal of Systematic and Evolutionary Microbiology*, 63(8), pp.3003−3008.

Hansen, J., Sato, M., and Ruedy, R., 2012. Perception of Climate Change. *Proceedings of the National Academy of Sciences*, 109(37), pp.E2415−E2423.

Hansen, S.B., Padfield, R., Syayuti, K., Evers, S., Zakariah, Z., and Mastura, S., 2015. Trends in Global Palm Oil Sustainability Research. *Journal of Cleaner Production*, 100, pp.140−149.

Hansen, U.E. and Nygaard, I., 2014. Sustainable Energy Transitions in Emerging Economies: The Formation of a Palm Oil Biomass Waste-to-Energy Niche in Malaysia 1990–2011. *Energy Policy*, 66, pp.666−676.

Haris, A. 2010. Introduction and the Malaysian Feed-In Tariff Scenario. *Malakoff Community Partnerships Energy Expert Series*. 29 June. Australia.

Harnisch, F. and Schröder, U., 2009. Selectivity Versus Mobility: Separation of Anode and Cathode in Microbial Bioelectrochemical Systems. *ChemSusChem: Chemistry & Sustainability Energy & Materials*, 2(10), pp.921−926.

Hasan, A.F., 2012. Sustainability of Energy Sources. *Economic Research Institute for ASEAN and East Asia (ERIA)*. Retrieved 18 December 2017, from http://www.eria.org/events/Sustainability%20of%20Energy%20Sources.pdf

Hashim, H. and Ho, W.S., 2011. Renewable Energy Policies and Initiatives for a Sustainable Energy Future in Malaysia. *Renewable and Sustainable Energy Reviews*, 15(9), pp.4780−4787.

Hashim, R., Saari, N., Sulaiman, O., Sugimoto, T., Hiziroglu, S., Sato, M., and Tanaka, R., 2010. Effect of Particle Geometry on the Properties of Binderless Particleboard Manufactured from Oil Palm Trunk. *Materials & Design*, 31(9), pp.4251−4257.

Hassan, H.F., El-Shafie, A., and Karim, O.A., 2012. Tidal Current Turbines Glance at The Past and Look into Future Prospects in Malaysia. *Renewable and Sustainable Energy Reviews*, 16(8), pp.5707−5717.

Hassan, M.A., Karim, M.I.A., Shirai, Y., Inagaki, M., Nakanishi, K., and Hashimoto, K., 1997. Economic Analysis on Production of Bacterial Polyhydroxyalkanoates from Palm Oil Mill Effluent. *Journal of Chemical Engineering of Japan*, 30(4), pp.751−755.

Hassan, M.A., Nawata, O., Shirai, Y., Rahman, N.A.A., Yee, P.L., Ariff, A.B., and Karim, M.I.A., 2002. A Proposal for Zero Emission from Palm Oil Industry Incorporating the Production of Polyhydroxyalkanoates from Palm Oil Mill Effluent. *Journal of Chemical Engineering of Japan*, 35(1), pp.9−14.

Hassan, M.A., Shirai, Y., Kusubayashi, N., Karim, M.I.A., Nakanishi, K., and Hashimoto, K., 1996. Effect of Organic Acid Profiles During Anaerobic Treatment of Palm Oil Mill Effluent on the Production of Polyhydroxyalkanoates by *Rhodobacter sphaeroides*. *Journal of Fermentation and Bioengineering*, 82(2), pp.151−156.

Hawkes, F.R., Hussy, I., Kyazze, G., Dinsdale, R., and Hawkes, D.L., 2007. Continuous Dark Fermentative Hydrogen Production by Mesophilic Microflora: Principles and Progress. *International Journal of Hydrogen Energy*, 32(2), pp.172−184.

He, Z., Huang, Y., Manohar, A.K., and Mansfeld, F., 2008. Effect of Electrolyte pH on the Rate of the Anodic and Cathodic Reactions in an Air-Cathode Microbial Fuel Cell. *Bioelectrochemistry*, 74(1), pp.78−82.

Heidrich, E.S., Dolfing, J., Scott, K., Edwards, S.R., Jones, C., and Curtis, T.P., 2013. Production of Hydrogen from Domestic Wastewater in a Pilot-Scale Microbial Electrolysis Cell. *Applied Microbiology and Biotechnology*, 97(15), pp.6979−6989.

Heidrich, E.S., Edwards, S.R., Dolfing, J., Cotterill, S.E., and Curtis, T.P., 2014. Performance of a Pilot Scale Microbial Electrolysis Cell Fed on Domestic Wastewater at Ambient Temperatures for a 12 Month Period. *Bioresource Technology*, 173, pp.87−95.

Helder, M., Strik, D.P., Hamelers, H.V., and Buisman, C.J., 2012. The Flat-Plate Plant-Microbial Fuel Cell: The Effect of a New Design on Internal Resistances. *Biotechnology for Biofuels*, 5(1), p.70.

Her, J. and Kim, J., 2013. *Rummeliibacillus suwonensis* sp. nov., Isolated from Soil Collected in a Mountain Area of South Korea. *Journal of Microbiology*, 51(2), pp.268−272.

Hernández-Fernández, F.J., de los Ríos, A.P., Mateo-Ramírez, F., Godínez, C., Lozano-Blanco, L.J., Moreno, J.I., and Tomás-Alonso, F., 2015. New Application of Supported Ionic Liquids Membranes as Proton Exchange Membranes in Microbial Fuel Cell for Wastewater Treatment. *Chemical Engineering Journal*, 279, pp.115−119.

Hernández-Fernández, F.J., de los Ríos, A.P., Mateo-Ramírez, F., Juarez, M.D., Lozano-Blanco, L.J., and Godínez, C., 2016. New Application of Polymer Inclusion Membrane Based on Ionic Liquids as Proton Exchange Membrane in Microbial Fuel Cell. *Separation and Purification Technology*, 160, pp.51−58.

Hinshaw, J.V., 2006. The Thermal Conductivity Detector. *LC GC North America*, 24(1), pp.38−45.

Ho, K.P., 1976. Malaysia: Sup the Wastes. *Planter*, 52, pp.296−297.

Hoerl, R., 2012. *Statistics Roundtable: The Reality of Residual Analysis*. Milwaukee, WI, USA: Quality Progress.

Holben, W.E., Jansson, J.K., Chelm, B.K., and Tiedje, J.M., 1988. DNA Probe Method for the Detection of Specific Microorganisms in the Soil Bacterial Community. *Applied and Environmental Microbiology*., 54(3), pp.703−711.

Holladay, J.D., Hu, J., King, D.L., and Wang, Y., 2009. An Overview of Hydrogen Production Technologies. *Catalysis Today*, 139(4), pp.244−260.

Hoon, S., Zhou, B., Janda, K.D., Brenner, S., and Scolnick, J., 2011. Aptamer Selection by High-Throughput Sequencing and Informatic Analysis. *Biotechniques*, 51(6), pp.413−416.

Hord, J., 1978. Is Hydrogen a Safe Fuel?. *International Journal of Hydrogen Energy*, 3(2), pp.157−176.

Hossain, A.K. and Badr, O., 2007. Prospects of Renewable Energy Utilisation for Electricity Generation in Bangladesh. *Renewable and Sustainable Energy Reviews*, 11(8), pp.1617−1649.

Hossain, F.M., Hasanuzzaman, M., Rahim, N.A., and Ping, H.W., 2015. Impact of Renewable Energy on Rural Electrification in Malaysia: A Review. *Clean Technologies and Environmental Policy*, 17(4), pp.859−871.

Hosseini, S.E. and Wahid, M.A., 2013. Feasibility Study of Biogas Production and Utilization as a Source of Renewable Energy in Malaysia. *Renewable and Sustainable Energy Reviews*, 19, pp.454−462.

Hou, J., Liu, Z., and Zhang, P., 2013. A New Method for Fabrication of Graphene/Polyaniline Nanocomplex Modified Microbial Fuel Cell Anodes. *Journal of Power Sources*, 224, pp.139−144.

Hou, J., Liu, Z., Yang, S., and Zhou, Y., 2014. Three-Dimensional Macroporous Anodes Based on Stainless Steel Fiber Felt for High-Performance Microbial Fuel Cells. *Journal of Power Sources*, 258, pp.204−209.

Hu, B. and Chen, S.L., 2007. Pretreatment of Methanogenic Granules for Immobilized Hydrogen Fermentation. *International Journal of Hydrogen Energy*, 32, pp.3266−3273.

Hu, H., Fan, Y., and Liu, H., 2008. Hydrogen Production using Single-Chamber Membrane-Free Microbial Electrolysis Cells. *Water Research*, 42(15), pp.4172−4178.

Huang, L. and Logan, B.E., 2008. Electricity Generation and Treatment of Paper Recycling Wastewater using a Microbial Fuel Cell. *Applied Microbiology and Biotechnology*, 80(2), pp.349−355.

Huang, W.E., Ferguson, A., Singer, A.C., Lawson, K., Thompson, I.P., Kalin, R.M., Larkin, M.J., Bailey, M.J., and Whiteley, A.S., 2009. Resolving Genetic Functions within Microbial Populations: In Situ Analyses using rRNA and mRNA Stable Isotope Probing Coupled with Single-Cell Raman-Fluorescence In Situ Hybridization. *Applied and Environmental Microbiology*, 75(1), pp.234−241.

Hugenholtz, P. and Tyson, G.W., 2008. Microbiology: Metagenomics. *Nature*, 455(7212), pp.481−483.

Hughes, J.B., Hellmann, J.J., Ricketts, T.H., and Bohannan, B.J., 2001. Counting the Uncountable: Statistical Approaches to Estimating Microbial Diversity. *Applied and Environmental Microbiology*, 67(10), pp.4399−4406.

Husain, Z., Zainal, Z.A., and Abdullah, M.Z., 2003. Analysis of Biomass-Residue-Based Cogeneration System in Palm Oil Mills. *Biomass and Bioenergy*, 24(2), pp.117−124.

Hüsemann, M.H. and Papoutsakis, E.T., 1988. Solventogenesis in *Clostridium acetobutylicum* Fermentations Related to Carboxylic Acid and Proton Concentrations. *Biotechnology and Bioengineering*, 32(7), pp.843−852.

Huson, D.H., Auch, A.F., Qi, J., and Schuster, S.C., 2007. MEGAN Analysis of Metagenomic Data. *Genome Research*, 17(3), pp.377−386.

Hussy, I., Hawkes, F.R., Dinsdale, R., and Hawkes, D.L., 2003. Continuous Fermentative Hydrogen Production from a Wheat Starch Co-Product by Mixed Microflora. *Biotechnology and Bioengineering*, 84(6), pp.619−626.

Ibrahim, A.H., Dahlan, I., and Dasti, A.F., 2012. Comparative Study on Characterization of Malaysian Palm Oil Mill Effluent. *Research Journal of Chemical Sciences*, 2(12), pp.1−5.

Imam, S., Yilmaz, S., Sohmen, U., Gorzalski, A.S., Reed, J.L., Noguera, D.R., and Donohue, T.J., 2011. iRsp1095: A Genome-Scale Reconstruction of the Rhodobacter sphaeroides Metabolic Network. *BMC Systems Biology*, 5(1), p.116.

İnceoğlu, Ö., Al-Soud, W.A., Salles, J.F., Semenov, A.V., and van Elsas, J.D., 2011. Comparative Analysis of Bacterial Communities in a Potato Field as Determined by Pyrosequencing. *PLoS One*, 6(8), p.e23321.

Infantes, D., Del Campo, A.G., Villaseñor, J., and Fernández, F.J., 2011. Influence of pH, Temperature and Volatile Fatty Acids on Hydrogen Production by Acidogenic Fermentation. *International Journal of Hydrogen Energy*, 36(24), pp.15595−15601.

Intanoo, P., Watcharanurak, T., and Chavadej, S., 2020. Evolution of Methane and Hydrogen from Ethanol Wastewater with Maximization of Energy Yield by Three-Stage Anaerobic Sequencing Batch Reactor System. *International Journal of Hydrogen Energy*, 45(16), pp.9469−9483.

Irvine, R.L. and Busch, A.W., 1979. Sequencing Batch Biological Reactors. *Journal of the Water Pollution Control Federation*, 51, pp.235−243.

Irvine, R.L. and Davis, W.B., 1971. Use of Sequencing Batch Reactors for Waste Treatment. *Proc. 26th Industrial Waste Conference*. Purdue University, West Lafayette, IN, USA, pp. 450−462.

Iskandar, M.J., Baharum, A., Anuar, F.H., and Othaman, R., 2018. Palm Oil Industry in South East Asia and The Effluent Treatment Technology—A Review. *Environmental Technology & Innovation*, 9, pp.169−185.

Islam, M.R., Saidur, R., Rahim, N.A., and Solangi, K.H., 2009. Renewable Energy Research in Malaysia. *Engineering e-Transaction*, 4(2), pp.69−72.

Ismail, F., Rahman, A., Abd-Aziz, S., Mei Ling, C., and Hassan, M.A., 2009. Statistical Optimization of Biohydrogen Production using Food Waste Under Thermophilic Conditions. *The Open Renewable Energy Journal*, 2(1), pp.124−131.

Ismail, I., Hassan, M.A., Rahman, N.A., and Soon, C.S., 2011. Effect of Retention Time on Biohydrogen Production by Microbial Consortia Immobilised in Polydimethylsiloxane. *African Journal of Biotechnology*, 10(4), pp.601−609.

Izadyar, N., Ong, H.C., Chong, W.T., and Leong, K.Y., 2016. Resource Assessment of The Renewable Energy Potential for a Remote Area: A Review. *Renewable and Sustainable Energy Reviews*, 62, pp.908−923.

Jadhav, G.S. and Ghangrekar, M.M., 2009. Performance of Microbial Fuel Cell Subjected to Variation in pH, Temperature, External Load and Substrate Concentration. *Bioresource Technology*, 100(2), pp.717−723.

Jafar, A.H., Al-Amin, A.Q., and Siwar, C., 2008. Environmental Impact of Alternative Fuel Mix in Electricity Generation in Malaysia. *Renewable Energy*, 33(10), pp.2229−2235.

Jafary, T., Daud, W.R.W., Ghasemi, M., Bakar, M.H.A., Sedighi, M., Kim, B.H., Carmona-Martínez, A.A., Jahim, J.M., and Ismail, M., 2019. Clean Hydrogen Production in a Full Biological Microbial Electrolysis Cell. *International Journal of Hydrogen Energy*, 44(58), pp.30524−30531.

Jalilluddin, A.M., Chia-Chay, T., and Abdul-Talib, S., 2015. Performance of Two-Chambered Microbial Fuel Cell (MFC) at Different pH Anode Microenvironment using Palm Oil Mill Effluent (POME) as Substrate. *Applied Mechanics and Materials*, 773−774, pp. 511−519.

Jamal, P., Alam, M.Z., Ramlan, M., Salleh, M., and Nadzir, M.M., 2005. Screening of *Aspergillus* for Citric Acid Production from Palm Oil Mill Effluent. *Biotechnology*, 4(4), pp.275−278.

Jameel, A.T. and Abass Olanrewaju, A., 2011. *Aerobic Biodegradation of Oil and Grease in Palm Oil Mill Effluent using Consortium of Microorganisms*. In Alam, M., Jameel, A., and Amid, A. (eds.) *Current Research and Development in Biotechnology Engineering at International Islamic University Malaysia* (3rd ed., Vol. 2). Kuala Lumpur: IIUM Press, pp. 43−51.

Jamil, Z., Annuar, M.S.M., Ibrahim, S., and Vikineswary, S., 2009. Optimization of Phototrophic Hydrogen Production by *Rhodopseudomonas palustris* PBUM001 via Statistical Experimental Design. *International Journal of Hydrogen Energy*, 34(17), pp.7502−7512.

Janda, J.M. and Abbott, S.L., 2007. 16S rRNA Gene Sequencing for Bacterial Identification in the Diagnostic Laboratory: Pluses, Perils, and Pitfalls. *Journal of Clinical Microbiology*, 45(9), pp.2761−2764.

Jayashree, C., Sweta, S., Arulazhagan, P., Yeom, I.T., Iqbal, M.I.I., and Banu, J.R., 2015. Electricity Generation from Retting Wastewater Consisting of

Recalcitrant Compounds using Continuous Upflow Microbial Fuel Cell. *Biotechnology and Bioprocess Engineering*, 20(4), pp.753−759.

Jayasinghe, N., Franks, A., Nevin, K.P., and Mahadevan, R., 2014. Metabolic Modeling of Spatial Heterogeneity of Biofilms in Microbial Fuel Cells Reveals Substrate Limitations in Electrical Current Generation. *Biotechnology Journal*, 9(10), pp.1350−1361.

Jayed, M.H., Masjuki, H.H., Kalam, M.A., Mahlia, T.M.I., Husnawan, M., and Liaquat, A.M., 2011. Prospects of Dedicated Biodiesel Engine Vehicles in Malaysia and Indonesia. *Renewable and Sustainable Energy Reviews*, 15(1), pp.220−235.

Jia, Y.H., Choi, J.Y., Ryu, J.H., Kim, C.H., Lee, W.K., Tran, H.T., Zhang, R.H., and Ahn, D.H., 2010. Hydrogen Production from Wastewater using a Microbial Electrolysis Cell. *Korean Journal of Chemical Engineering*, 27(6), pp.1854−1859.

Jiraprasertwong, A., Maitriwong, K., and Chavadej, S., 2019. Production of Biogas from Cassava Wastewater using a Three-Stage Upflow Anaerobic Sludge Blanket (UASB) Reactor. *Renewable Energy*, 130, pp.191−205.

Jones, D.T., and Woods, D.R., 1986. Acetone-Butanol Fermentation Revisited. *Microbiological Reviews*, 50(4), pp.484−524.

Jones, P.R., 2008. Improving Fermentative Biomass-Derived H_2-Production by Engineering Microbial Metabolism. *International Journal of Hydrogen Energy*, 33(19), pp.5122−5130.

Jong, B.C., Liew, P.W.Y., Juri, M.L., Kim, B.H., Mohd. Dzomir, A.Z., Leo, K.W., and Awang, M.R., 2011. Performance and Microbial Diversity of Palm Oil Mill Effluent Microbial Fuel Cell. *Letters in Applied Microbiology*, 53(6), pp.660−667.

Jönsson, L.J., Alriksson, B., and Nilvebrant, N.O., 2013. Bioconversion of Lignocellulose: Inhibitors and Detoxification. *Biotechnology for Biofuels*, 6(1), p.16.

Juang, C.P., Whang, L.M., and Cheng, H.H., 2011. Evaluation of Bioenergy Recovery Processes Treating Organic Residues from Ethanol Fermentation Process. *Bioresource Technology*, 102(9), pp.5394−5399.

Junaidah, M.J., Norizzah, A.R., Zaliha, O., and Mohamad, S., 2015. Optimisation of Sterilisation Process for Oil Palm Fresh Fruit Bunch at Different Ripeness. *International Food Research Journal*, 22(1), pp.275−282.

Jung, K.W., Kim, D.H., and Shin, H.S., 2010. Continuous Fermentative Hydrogen Production from Coffee Drink Manufacturing Wastewater by Applying UASB Reactor. *International Journal of Hydrogen Energy*, 35(24), pp.13370−13378.

Junghare, M., Subudhi, S., and Lal, B., 2012. Improvement of Hydrogen Production Under Decreased Partial Pressure by Newly Isolated Alkaline Tolerant Anaerobe, *Clostridium butyricum* TM-9A: Optimization of Process Parameters. *International Journal of Hydrogen Energy*, 37(4), pp.3160−3168.

Jwa, E., Yun, Y.M., Kim, H., Jeong, N., Park, S.C., and Nam, J.Y., 2019. Domestic Wastewater Treatment in a Tubular Microbial Electrolysis Cell with a Membrane Electrode Assembly. *International Journal of Hydrogen Energy*, 44(2), pp.652−660.

Kadere, T.T., Miyamotoo, T., Oniango, R.K., Kutima, P.M., and Njoroge, S.M., 2008. Isolation and Identification of the Genera *Acetobacter* and *Gluconobacter* in Coconut Toddy (Mnazi). *African Journal of Biotechnology*, 7(16), pp.2963−2971.

Kadier, A., Simayi, Y., Kalil, M.S., Abdeshahian, P., and Hamid, A.A., 2014. A Review of the Substrates Used in Microbial Electrolysis Cells (MECs) for Producing Sustainable and Clean Hydrogen Gas. *Renewable Energy*, 71, pp.466−472.

Kaewkannetra, P., Chiwes, W., and Chiu, T.Y., 2011. Treatment of Cassava Mill Wastewater and Production of Electricity Through Microbial Fuel Cell Technology. *Fuel*, 90(8), pp.2746−2750.

Kalathil, S., Khan, M.M., Lee, J., and Cho, M.H., 2013. Production of Bioelectricity, Bio-hydrogen, High Value Chemicals and Bioinspired Nanomaterials by Electrochemically Active Biofilms. *Biotechnology Advances*, 31(6), pp.915−924.

Kalil, M.S., Pang, W.K., Sadazo, Y., Rakmi, A.R., and Wan, M., 2003. Direct Fermentation of Palm Oil Mill Effluent to Acetone-Butanol-Ethanol by Solvent Producing Clostridia. *Pakistan Journal of Biological Sciences*, 6, pp.1273−1275.

Kamaruddin, S.B., 2015. Tun Mahathir Test Drove Malaysia’s First Hydrogen Fuel Cell Vehicle. *UKM News Portal*. Retrieved 10 April 2016, from http://www.ukm.my/news/Latest_News/tun-mahathir-test-drove-malaysias-first-hydrogen-fuel-cell-vehicle/

Kanai, T., Imanaka, H., Nakajima, A., Uwamori, K., Omori, Y., Fukui, T., Atomi, H., and Imanaka, T., 2005. Continuous Hydrogen Production by the Hyperthermophilic Archaeon, *Thermococcus kodakaraensis* KOD1. *Journal of Biotechnology*, 116(3), pp.271−282.

Kanchanasuta, S. and Pisutpaisal, N., 2016. Waste Utilization of Palm Oil Decanter Cake on Biogas Fermentation. *International Journal of Hydrogen Energy*, 41(35), pp.15661−15666.

Kang, Y.L., Pichiah, S., and Ibrahim, S., 2017. Facile Reconstruction of Microbial Fuel Cell (MFC) Anode with Enhanced Exoelectrogens Selection for Intensified Electricity Generation. *International Journal of Hydrogen Energy*, 42(3), pp.1661−1671.

Kapdan, I.K. and Kargi, F., 2006. Bio-hydrogen Production from Waste Materials. *Enzyme and Microbial Technology*, 38(5), pp.569−582.

Kapdan, I.K., Kargi, F., Oztekin, R., and Argun, H., 2009. Bio-Hydrogen Production from Acid Hydrolyzed Wheat Starch by Photo-Fermentation using Different *Rhodobacter* sp. *International Journal of Hydrogen Energy*, 34(5), pp.2201−2207.

Karadag, D. and Puhakka, J.A., 2010. Direction of Glucose Fermentation Towards Hydrogen or Ethanol Production Through On-Line pH Control. *International Journal of Hydrogen Energy*, 35(19), pp.10245−10251.

Kardi, S.N., Ibrahim, N., Darzi, G.N., Rashid, N.A.A., and Villaseñor, J., 2017. Dye Removal of AR27 with Enhanced Degradation and Power Generation in a Microbial Fuel Cell using Bioanode of Treated Clinoptilolite-Modified Graphite Felt. *Environmental Science and Pollution Research*, 24(23), pp.19444−19457.

Kardooni, R., Yusoff, S.B., and Kari, F.B., 2016. Renewable Energy Technology Acceptance in Peninsular Malaysia. *Energy Policy*, 88, pp.1−10.

Kargi, F. and Catalkaya, E.C., 2011. Hydrogen Gas Production from Olive Mill Wastewater by Electrohydrolysis with Simultaneous COD Removal. *International Journal of Hydrogen Energy*, 36(5), pp.3457−3464.

Kargi, F., Eren, N.S., and Ozmihci, S., 2012. Bio-Hydrogen Production from Cheese Whey Powder (CWP) Solution: Comparison of Thermophilic and Mesophilic Dark Fermentations. *International Journal of Hydrogen Energy*, 37(10), pp.8338−8342.

Karthic, P. and Joseph, S., 2012. Comparison and Limitations of Biohydrogen Production Processes. *Research Journal of Biotechnology*, 7(2), pp.59−71.

Kato Marcus, A., Torres, C.I., and Rittmann, B.E., 2007. Conduction-Based Modeling of the Biofilm Anode of a Microbial Fuel Cell. *Biotechnology and Bioengineering*, 98(6), pp.1171−1182.

Katuri, K.P., Scott, K., Head, I.M., Picioreanu, C., and Curtis, T.P., 2011. Microbial Fuel Cells Meet with External Resistance. *Bioresource Technology*, 102(3), pp.2758−2766.

Keskin, T., Abo-Hashesh, M., and Hallenbeck, P.C., 2011. Photofermentative Hydrogen Production from Wastes. *Bioresource Technology*, 102(18), pp.8557−8568.

Ketchum, L.H., 1997. Design and Physical Features of Sequencing Batch Reactors. *Water Science and Technology*, 35(1), pp.11−18.

KeTTHA., 2009. *Dasar Teknologi Hijau Negara* (D. B. d. Pustaka, Trans. 1st ed.). Malaysia: Kementerian Tenaga, Teknologi Hijau Dan Air, Malaysia.

Khalid, N.A., Rajandas, H., Parimannan, S., Croft, L.J., Loke, S., Chong, C.S., Bruce, N.C., and Yahya, A., 2019. Insights into Microbial Community Structure and Diversity in Oil Palm Waste Compost. *3 Biotech*, 9(10), p.364.

Khamaiseh, E.I., Abdul Hamid, A., Abdeshahian, P., Wan Yusoff, W.M., and Kalil, M.S., 2014. Enhanced Butanol Production by *Clostridium acetobutylicum* NCIMB 13357 Grown on Date Fruit as Carbon Source in P2 Medium. *The Scientific World Journal*.

Khan, M.A., Ngo, H.H., Guo, W.S., Liu, Y., Nghiem, L.D., Hai, F.I., Deng, L.J., Wang, J., and Wu, Y., 2016. Optimization of Process Parameters for Production of Volatile Fatty Acid, Biohydrogen and Methane from Anaerobic Digestion. *Bioresource Technology*, 219, pp.738−748.

Khanal, S.K., Chen, W.H., Li, L., and Sung, S., 2004. Biological Hydrogen Production: Effects of pH and Intermediate Products. *International Journal of Hydrogen Energy*, 29(11), pp.1123−1131.

Khanna, N. and Das, D., 2013. Biohydrogen Production by Dark Fermentation. *Wiley Interdisciplinary Reviews: Energy and Environment*, 2(4), pp.401−421.

Khare, A.P., 2014. Voltage Produced by Different Salts Concentration on Single Chamber Microbial Fuel Cell. *The International Journal of Engineering Science*, 3(3), pp.1448−1452.

Khatib, T., Mohamed, A., and Sopian, K., 2012. Optimization of a PV/Wind Micro-Grid for Rural Housing Electrification using a Hybrid Iterative/Genetic Algorithm: Case Study of Kuala Terengganu, Malaysia. *Energy and Buildings*, 47, pp.321−331.

Khatun, R., Reza, M.I.H., Moniruzzaman, M., and Yaakob, Z., 2017. Sustainable Oil Palm Industry: The Possibilities. *Renewable and Sustainable Energy Reviews*, 76, pp.608−619.

Khongkliang, P., Kongjan, P., Utarapichat, B., Reungsang, A., and Sompong, O., 2017. Continuous Hydrogen Production from Cassava Starch Processing Wastewater by Two-Stage Thermophilic Dark Fermentation and Microbial Electrolysis. *International Journal of Hydrogen Energy*, 42(45), pp.27584−27592.

Khor, C.S. and Lalchand, G., 2014. A Review on Sustainable Power Generation in Malaysia to 2030: Historical Perspective, Current Assessment, and Future Strategies. *Renewable and Sustainable Energy Reviews*, 29, pp.952−960.

Kim, B.H., 2007. Challenges in Microbial Fuel Cell Development and Operation. *Applied Microbiology and Biotechnology,* 76(3), p.485−494.

Kim, D.H., Kim, S.H., Kim, H.W., Kim, M.S., and Shin, H.S., 2011a. Sewage Sludge Addition to Food Waste Synergistically Enhances Hydrogen Fermentation Performance. *Bioresource Technology*, 102(18), pp.8501−8506.

Kim, D.H., Kim, S.H., Kim, K.Y., and Shin, H.S., 2010. Experience of a Pilot-Scale Hydrogen-Producing Anaerobic Sequencing Batch Reactor (ASBR) Treating Food Waste. *International Journal of Hydrogen Energy*, 35(4), pp.1590−1594.

Kim, E.J., Kim, M.S., and Lee, J.K., 2008b. Hydrogen Evolution Under Photoheterotrophic and Dark Fermentative Conditions by Recombinant *Rhodobacter sphaeroides* Containing the Genes for Fermentative Pyruvate Metabolism of *Rhodospirillum rubrum*. *International Journal of Hydrogen Energy*, 33(19), pp.5131−5136.

Kim, E.J., Lee, M.K., Kim, M.S., and Lee, J.K., 2008a. Molecular Hydrogen Production by Nitrogenase of *Rhodobacter sphaeroides* and by Fe-Only Hydrogenase of *Rhodospirillum rubrum*. *International Journal of Hydrogen Energy*, 33(5), pp.1516−1521.

Kim, G.T., Webster, G., Wimpenny, J.W.T., Kim, B.H., Kim, H.J., and Weightman, A.J., 2006b. Bacterial Community Structure, Compartmentalization and Activity in a Microbial Fuel Cell. *Journal of Applied Microbiology*, 101(3), pp.698−710.

Kim, M., Yang, Y., Morikawa-Sakura, M.S., Wang, Q., Lee, M.V., Lee, D.Y., Feng, C., Zhou, Y., and Zhang, Z., 2012. Hydrogen Production by Anaerobic Co-Digestion of Rice Straw and Sewage Sludge. *International Journal of Hydrogen Energy*, 37(4), pp.3142−3149.

Kim, M.S., and Lee, D.Y., 2010. Fermentative Hydrogen Production from Tofu-Processing Waste and Anaerobic Digester Sludge using Microbial Consortium. *Bioresource Technology*, 101(1), pp.S48−S52.

Kim, S.H., Han, S.K., and Shin, H.S., 2006. Effect of Substrate Concentration on Hydrogen Production and 16S rDNA-Based Analysis of the Microbial Community in a Continuous Fermenter. *Process Biochemistry,* 41(1), pp.199−207.

Kim, S.J., Moon, J.Y., Hamada, M., Tamura, T., Weon, H.Y., Suzuki, K.I., and Kwon, S.W., 2013. *Rudaibacter terrae* gen. nov., sp. nov., Isolated from Greenhouse Soil. *International Journal of Systematic and Evolutionary Microbiology*, 63(11), pp.4052−4057.

Kim, W., Ryu, B.G., Kim, S., Heo, S.W., Kim, D., Kim, J., Jo, H., Kwon, J.H., and Yang, J.W., 2014. Quantitative Analysis of Microbial Community Structure in Two-Phase Anaerobic Digesters Treating Food Wastewater. *Korean Journal of Chemical Engineering*, 31(3), pp.381−385.

Kim, Y., Hatzell, M.C., Hutchinson, A.J., and Logan, B.E., 2011b. Capturing Power at Higher Voltages from Arrays of Microbial Fuel Cells Without Voltage Reversal. *Energy & Environmental Science*, 4(11), pp.4662−4667.

Kittikun, H., 1996. Thai German Project on Palm Oil Industry, *PN91,* p.2070.

Klinke, H.B., Ahring, B.K., Schmidt, A.S., and Thomsen, A.B., 2002. Characterization of Degradation Products from Alkaline Wet Oxidation of Wheat Straw. *Bioresource Technology*, 82(1), pp.15−26.

Kobayashi, T., Xu, K.Q., Li, Y.Y., and Inamori, Y., 2012. Effect of Sludge Recirculation on Characteristics of Hydrogen Production in a Two-Stage Hydrogen–Methane Fermentation Process Treating Food Wastes. *International Journal of Hydrogen Energy*, 37(7), pp.5602−5611.

Kok, C., 2009. Sunny Future. *The Star Online*. Retrieved 11 April 2009, from https://www.thestar.com.my/business/businessnews/2009/04/11/sunny/future

Kondo, T., Wakayama, T., and Miyake, J., 2006. Efficient Hydrogen Production using a Multi-Layered Photobioreactor and a Photosynthetic Bacterium Mutant with Reduced Pigment. *International Journal of Hydrogen Energy*, 31(11), pp.1522−1526.

Kong, S.H., Loh, S.K., Bachmann, R.T., Rahim, S.A., and Salimon, J., 2014. Biochar from Oil Palm Biomass: A Review of Its Potential and Challenges. *Renewable and Sustainable Energy Reviews*, 39, pp.729−739.

Kongjan, P. and Angelidaki, I., 2010. Extreme Thermophilic Biohydrogen Production from Wheat Straw Hydrolysate using Mixed Culture Fermentation: Effect of Reactor Configuration. *Bioresource Technology*, 101(20), pp.7789−7796.

Kongjan, P., Sompong, O., and Angelidaki, I., 2011. Performance and Microbial Community Analysis of Two-Stage Process with Extreme Thermophilic Hydrogen and Thermophilic Methane Production from Hydrolysate in UASB Reactors. *Bioresource Technology*, 102(5), pp.4028−4035.

Kosourov, S., Tsygankov, A., Seibert, M., and Ghirardi, M.L., 2002. Sustained Hydrogen Photoproduction by *Chlamydomonas reinhardtii*: Effects of Culture Parameters. *Biotechnology and Bioengineering*, 78(7), pp.731−740.

Kossalbayev, B.D., Tomo, T., Zayadan, B.K., Sadvakasova, A.K., Bolatkhan, K., Alwasel, S., and Allakhverdiev, S.I., 2020. Determination of the Potential of Cyanobacterial Strains for Hydrogen Production. *International Journal of Hydrogen Energy*, 45(4), pp.2627−2639.

Kothari, R., Kumar, V., Pathak, V.V., and Tyagi, V.V., 2017. Sequential Hydrogen and Methane Production with Simultaneous Treatment of Dairy Industry Wastewater: Bioenergy Profit Approach. *International Journal of Hydrogen Energy*, 42(8), pp.4870−4879.

Kothari, R., Singh, D.P., Tyagi, V.V., and Tyagi, S.K., 2012. Fermentative Hydrogen Production: An Alternative Clean Energy Source. *Renewable and Sustainable Energy Reviews*, 16(4), pp.2337−2346.

Kraber, S., Whitcomb, P.J., and Andersen, M.J., 2002. *Handbook for Experimenters*: Minneapolis, MN, USA: Stat-Ease.

Kumar, G., Lay, C.H., Chu, C.Y., Wu, J.H., Lee, S.C., and Lin, C.Y., 2012. Seed Inocula for Biohydrogen Production from Biodiesel Solid Residues. *International Journal of Hydrogen Energy*, 37(20), pp.15489−15495.

Kumar, G., Bakonyi, P., Periyasamy, S., Kim, S.H., Nemestóthy, N., and Bélafi-Bakó, K., 2015. Lignocellulose Biohydrogen: Practical Challenges and Recent Progress. *Renewable and Sustainable Energy Reviews*, 44, pp.728−737.

Kumar, G., Saratale, R.G., Kadier, A., Sivagurunathan, P., Zhen, G., Kim, S.H., and Saratale, G.D., 2017. A Review on Bio-Electrochemical Systems (BESs) for the Syngas and Value Added Biochemicals Production. *Chemosphere,* 177, pp.84−92.

Kumar, G., Shobana, S., Nagarajan, D., Lee, D.J., Lee, K.S., Lin, C.Y., Chen, C.Y., and Chang, J.S., 2018. Biomass Based Hydrogen Production by Dark Fermentation—Recent Trends and Opportunities for Greener Processes. *Current Opinion in Biotechnology*, 50, pp.136−145.

Kumar, N. and Das, D., 2000. Enhancement of Hydrogen Production by *Enterobacter cloacae* IIT-BT 08. *Process Biochemistry*, 35(6), pp.589−593.

Kundu, A., Sahu, J.N., Redzwan, G., and Hashim, M.A., 2013. An Overview of Cathode Material and Catalysts Suitable for Generating Hydrogen in Microbial Electrolysis Cell. *International Journal of Hydrogen Energy*, 38(4), pp.1745−1757.

Kurniawan, T.A., Lo, W.H., and Chan, G.Y., 2006. Physico-chemical Treatments for Removal of Recalcitrant Contaminants from Landfill Leachate. *Journal of Hazardous Materials*, 129(1−3), pp.80−100.

Kushairi, A., Loh, S.K., Azman, I., Hishamuddin, E., Ong-Abdullah, M., Izuddin, Z.B.M.N., Razmah, G., Sundram, S., and Parveez, G.K.A., 2018. Oil Palm Economic Performance in Malaysia and R&D Progress in 2017. *Journal of Oil Palm Research*, 30(2), pp.163−195.

Kutty, S.R.M., Almahbashi, N.M.Y., Nazrin, A.A.M., Malek, M.A., Noor, A., Baloo, L., and Ghaleb, A.A.S., 2019. Adsorption Kinetics of Colour Removal from Palm Oil Mill Effluent using Wastewater Sludge Carbon in Column Studies. *Heliyon,* 5(10), p.e02439.

Kyazze, G., Martinez-Perez, N., Dinsdale, R., Premier, G.C., Hawkes, F.R., Guwy, A.J., and Hawkes, D.L., 2006. Influence of Substrate Concentration on the Stability and Yield of Continuous Biohydrogen Production. *Biotechnology and Bioengineering*, 93(5), pp.971−979.

Lakshmidevi, R. and Muthukumar, K., 2010. Enzymatic Saccharification and Fermentation of Paper and Pulp Industry Effluent for Biohydrogen Production. *International Journal of Hydrogen Energy*, 35(8), pp.3389−3400.

Lalaurette, E., Thammannagowda, S., Mohagheghi, A., Maness, P.C., and Logan, B.E., 2009. Hydrogen Production from Cellulose in a Two-Stage Process Combining Fermentation and Electrohydrogenesis. *International Journal of Hydrogen Energy*, 34(15), pp.6201−6210.

Lam, M.K. and Lee, K.T., 2011. Renewable and Sustainable Bioenergies Production from Palm Oil Mill Effluent (POME): Win–Win Strategies Toward Better Environmental Protection. *Biotechnology Advances*, 29(1), pp.124−141.

Lam, M.K., Tan, K.T., Lee, K.T., and Mohamed, A.R., 2009. Malaysian Palm Oil: Surviving the Food Versus Fuel Dispute for a Sustainable Future. *Renewable and Sustainable Energy Reviews*, 13(6−7), pp.1456−1464.

Langille, M.G., Zaneveld, J., Caporaso, J.G., McDonald, D., Knights, D., Reyes, J.A., Clemente, J.C., Burkepile, D.E., Thurber, R.L.V., Knight, R., and Beiko, R.G., 2013. Predictive Functional Profiling of Microbial Communities using 16S rRNA Marker Gene Sequences. *Nature Biotechnology*, 31(9), pp.814−821.

Laohaprapanon, T. and Prasertsan, P., 2007. Screening of Thermotolerant Microorganisms and Application for Oil Separation from Palm Oil Mill Wastewater. *Songklanakarin Journal of Science and Technology,* 29(3), pp.801−808.

Larrosa-Guerrero, A., Scott, K., Head, I.M., Mateo, F., Ginesta, A., and Godinez, C., 2010. Effect of Temperature on the Performance of Microbial Fuel Cells. *Fuel,* 89(12), pp.3985−3994.

Lata, D.B. and Misra, A., 2010. Theoretical and Experimental Investigations on The Performance of Dual Fuel Diesel Engine with Hydrogen and LPG As Secondary Fuels. *International Journal of Hydrogen Energy*, 35(21), pp.11918−11931.

Lau, L.C., Tan, K.T., Lee, K.T., and Mohamed, A.R., 2009. A Comparative Study on the Energy Policies in Japan and Malaysia in Fulfilling Their Nations' Obligations Towards the Kyoto Protocol. *Energy Policy*, 37(11), pp.4771−4778.

Laurinavichene, T.V., Kosourov, S.N., Ghirardi, M.L., Seibert, M., and Tsygankov, A.A., 2008. Prolongation of H_2 Photoproduction by Immobilized, Sulfur-Limited *Chlamydomonas reinhardtii* Cultures. *Journal of Biotechnology*, 134(3−4), pp.275−277.

Lay, C.H., Wu, J.H., Hsiao, C.L., Chang, J.J., Chen, C.C., and Lin, C.Y., 2010. Biohydrogen Production from Soluble Condensed Molasses Fermentation using Anaerobic Fermentation. *International Journal of Hydrogen Energy*, 35(24), pp.13445−13451.

Lay, J.J., Lee, Y.J., and Noike, T., 1999. Feasibility of Biological Hydrogen Production from Organic Fraction of Municipal Solid Waste. *Water Research*, 33(11), pp.2579−2586.

Lazaro, C.Z., Varesche, M.B.A., and Silva, E.L., 2015. Effect of Inoculum Concentration, pH, Light Intensity and Lighting Regime on Hydrogen Production by Phototrophic Microbial Consortium. *Renewable Energy*, 75, pp.1−7.

Lefebvre, O., Shen, Y., Tan, Z., Uzabiaga, A., Chang, I.S., and Ng, H.Y., 2011. Full-Loop Operation and Cathodic Acidification of a Microbial Fuel Cell Operated on Domestic Wastewater. *Bioresource Technology*, 102(10), pp.5841−5848.

Lee, C.M., Hung, G.J., and Yang, C.F., 2011. Hydrogen Production by *Rhodopseudomonas palustris* WP 3-5 in a Serial Photobioreactor Fed with Hydrogen Fermentation Effluent. *Bioresource Technology,* 102(18), pp.8350−8356.

Lee, D.Y., Ebie, Y., Xu, K.Q., Li, Y.Y., and Inamori, Y., 2010. Continuous H_2 and CH_4 Production from High-Solid Food Waste in the Two-Stage Thermophilic Fermentation Process with the Recirculation of Digester Sludge. *Bioresource Technology*, 101(1), pp.S42−S47.

Lee, H.S., Dhar, B.R., and Hussain, A. 2019. Electron Transfer Kinetics in Biofilm Anodes: Conductive Extracellular Electron Transfer. In: Mohan, S.V., Varjani, S., and Pandey, A. (eds) *Microbial Electrochemical Technology*. Amsterdam, Netherlands: Elsevier.

Lee, K.S., Hsu, Y.F., Lo, Y.C., Lin, P.J., Lin, C.Y., and Chang, J.S., 2008. Exploring Optimal Environmental Factors for Fermentative Hydrogen Production from Starch using Mixed Anaerobic Microflora. *International Journal of Hydrogen Energy,* 33(5), pp.1565−1572.

Lee, S.J., Lee, S.J., and Lee, D.W., 2013. Design and Development of Synthetic Microbial Platform Cells for Bioenergy. *Frontiers in Microbiology*, 4, p.92.

Lee, S.H., Doherty, T.V., Linhardt, R.J., and Dordick, J.S., 2009. Ionic Liquid-Mediated Selective Extraction of Lignin from Wood Leading to Enhanced Enzymatic Cellulose Hydrolysis. *Biotechnology and Bioengineering,* 102(5), pp.1368−1376.

Lee, W.S., Chua, A.S.M., Yeoh, H.K., and Ngoh, G.C., 2014. A Review of The Production and Applications of Waste-Derived Volatile Fatty Acids. *Chemical Engineering Journal*, 235, pp.83−99.

Lee, Z.S., Chin, S.Y., Lim, J.W., Witoon, T., and Cheng, C.K., 2019. Treatment Technologies of Palm Oil Mill Effluent (POME) and Olive Mill Wastewater

(OMW): A Brief Review. *Environmental Technology & Innovation*, 15, p.100377.

Levin, D.B. and Chahine, R., 2010. Challenges for Renewable Hydrogen Production from Biomass. *International Journal of Hydrogen Energy,* 35(10), pp.4962−4969.

Levin, D.B., Pitt, L., and Love, M., 2004. Biohydrogen Production: Prospects and Limitations to Practical Application. *International Journal of Hydrogen Energy*, 29(2), pp.173−185.

Li, C.L. and Fang, H.H.P., 2007. Fermentative Hydrogen Production from Wastewater and Solid Wastes by Mixed Cultures. *Critical Reviews in Environmental Science and Technology*, 37, pp.1−39.

Li, J., Hu, L., Zhang, L., Ye, D.D., Zhu, X., and Liao, Q., 2017. Uneven Biofilm and Current Distribution in Three-Dimensional Macroporous Anodes of Bio-electrochemical Systems Composed of Graphite Electrode Arrays. *Bioresource Technology*, 228, pp.25−30.

Li, X., Zhang, R., Qian, Y., Angelidaki, I., and Zhang, Y., 2017. The Impact of Anode Acclimation Strategy on microbial Electrolysis Cell Treating Hydrogen Fermentation Effluent. *Bioresource Technology*, 236, pp.37−43.

Li, Y.C., Chu, C.Y., Wu, S.Y., Tsai, C.Y., Wang, C.C., Hung, C.H., and Lin, C.Y., 2012. Feasible Pretreatment of Textile Wastewater for Dark Fermentative Hydrogen Production. *International Journal of Hydrogen Energy*, 37(20), pp.15511−15517.

Li, Y.C., Wu, S.Y., Chu, C.Y., and Huang, H.C., 2011. Hydrogen Production from Mushroom Farm Waste with a Two-Step Acid Hydrolysis Process. *International Journal of Hydrogen Energy*, 36(21), pp.14245−14251.

Liang, B., Yang, C., Gong, M., Zhao, Y., Zhang, J., Zhu, C., Jiang, J., and Li, S., 2011. Adsorption and Degradation of Triazophos, Chlorpyrifos and Their Main Hydrolytic Metabolites in Paddy Soil from Chaohu Lake, China. *Journal of Environmental Management*, 92(9), pp.2229−2234.

Lide, D.R., 2010. *CRC Handbook of Chemistry and Physics* (91st ed.), Boca Raton, FL, USA: Taylor and Francis Group.

Lidula, N.W.A., Mithulananthan, N., Ongsakul, W., Widjaya, C., and Henson, R., 2007. ASEAN Towards Clean and Sustainable Energy: Potentials, Utilization and Barriers. *Renewable Energy*, 32(9), pp.1441−1452.

Lim, Y.S. and Koh, S.L., 2010. Analytical Assessments on the Potential of Harnessing Tidal Currents for Electricity Generation in Malaysia. *Renewable Energy*, 35(5), pp.1024−1032.

Lin, C.Y. and Chang, R.C., 1999. Hydrogen Production During the Anaerobic Acidogenic Conversion of Glucose. *Journal of Chemical Technology and Biotechnology*, 74(6), pp.498−500.

Lin, C.Y., and Chang, R.C., 2004. Fermentative Hydrogen Production at Ambient Temperature. *International Journal of Hydrogen Energy*, 29(7), pp.715−720.

Lin, C.Y., and Cheng, C.H., 2006. Fermentative Hydrogen Production from Xylose using Anaerobic Mixed Microflora. *International Journal of Hydrogen Energy*, 31(7), pp.832−840.

Lin, C.Y. and Hung, W.C., 2008. Enhancement of Fermentative Hydrogen/Ethanol Production from Cellulose using Mixed Anaerobic Cultures. *International Journal of Hydrogen Energy*, 33(14), pp.3660−3667.

Lin, C.Y. and Lay, C.H., 2004a. Carbon/Nitrogen-Ratio Effect on Fermentative Hydrogen Production by Mixed Microflora. *International Journal of Hydrogen Energy*, 29(1), pp.41−45.

Lin, C.Y. and Lay, C.H., 2004b. Effects of Carbonate and Phosphate Concentrations on Hydrogen Production using Anaerobic Sewage Sludge Microflora. *International Journal of Hydrogen Energy*, 29(3), pp.275−281.

Lin, C.Y., Chang, C.C., and Hung, C.H., 2008. Fermentative Hydrogen Production from Starch using Natural Mixed Cultures. *International Journal of Hydrogen Energy*, 33(10), pp.2445−2453.

Lin, C.Y., Lay, C.H., Sen, B., Chu, C.Y., Kumar, G., Chen, C.C., and Chang, J.S., 2012a. Fermentative Hydrogen Production from Wastewaters: A Review and Prognosis. *International Journal of Hydrogen Energy*, 37(20), pp.15632−15642.

Lin, C.Y., Wu, C.C., and Hung, C.H., 2008. Temperature Effects on Fermentative Hydrogen Production from Xylose using Mixed Anaerobic Cultures. *International Journal of Hydrogen Energy*, 33(1), pp.43−50.

Lin, P.J., Chang, J.S., Yang, L.H., Lin, C.Y., Wu, S.Y., and Lee, K.S., 2011. Enhancing the Performance of Pilot-Scale Fermentative Hydrogen Production by Proper Combinations of HRT and Substrate Concentration. *International Journal of Hydrogen Energy*, 36(21), pp.14289−14294.

Lin, X., McKinley, J., Resch, C.T., Kaluzny, R., Lauber, C.L., Fredrickson, J., Knight, R., and Konopka, A., 2012b. Spatial and Temporal Dynamics of the Microbial Community in the Hanford Unconfined Aquifer. *The ISME Journal*, 6(9), pp.1665−1676.

Liu, B.F., Ren, N.Q., Xie, G.J., Ding, J., Guo, W.Q., and Xing, D.F., 2010a. Enhanced Bio-Hydrogen Production by the Combination of Dark-and Photo-Fermentation in Batch Culture. *Bioresource Technology*, 101(14), pp.5325−5329.

Liu, C., Li, H., Zhang, Y., Si, D., and Chen, Q., 2016. Evolution of Microbial Community along with Increasing Solid Concentration during High-Solids Anaerobic Digestion of Sewage Sludge. *Bioresource Technology*, 216, pp.87−94.

Liu, F. and Fang, B., 2007. Optimization of Biohydrogen Production from Biodiesel Wastes by *Klebsiella pneumoniae*. *Biotechnology Journal: Healthcare Nutrition Technology*, 2(3), pp.374−380.

Liu, H., Cheng, S., and Logan, B.E., 2005. Production of Electricity from Acetate or Butyrate using a Single-Chamber Microbial Fuel Cell. *Environmental Science & Technology*, 39(2), pp.658−662.

Liu, H., Hu, H., Chignell, J., and Fan, Y., 2010b. Microbial Electrolysis: Novel Technology for Hydrogen Production from Biomass. *Biofuels*, 1(1), pp.129−142.

Liu, H., Wang, G., Zhu, D., and Pan, G., 2009. Enrichment of the Hydrogen-Producing Microbial Community from Marine Intertidal Sludge by Different Pretreatment Methods. *International Journal of Hydrogen Energy*, 34(24), pp.9696−9701.

Liu, J., Qiao, Y., Lu, Z.S., Song, H., and Li, C.M., 2012. Enhance Electron Transfer and Performance of Microbial Fuel Cells by Perforating the Cell Membrane. *Electrochemistry Communications*, 15(1), pp.50−53.

Liu, R.H., Sheng, G.P., Sun, M., Zang, G.L., Li, W.W., Tong, Z.H., Dong, F., Lam, M.H.W., and Yu, H.Q., 2011. Enhanced Reductive Degradation of Methyl

Orange in a Microbial Fuel Cell Through Cathode Modification with Redox Mediators. *Applied Microbiology and Biotechnology*, 89(1), pp.201−208.

Liu, S., Zhang, Z., and Ni, J., 2015. Behavior Detection and Activity Recovery of Damaged Anammox Bacteria Culture After Accidental Overheating. *Chemical Engineering Journal*, 259, pp.70−78.

Liu, Y., Yu, P., Song, X., and Qu, Y., 2008. Hydrogen Production from Cellulose by Co-Culture of *Clostridium thermocellum* JN4 and *Thermoanaerobacterium thermosaccharolyticum* GD17. *International Journal of Hydrogen Energy*, 33(12), pp.2927−2933.

Lo, Y.C., Chen, W.M., Hung, C.H., Chen, S.D., and Chang, J.S., 2008. Dark H_2 Fermentation from Sucrose and Xylose using H_2-Producing Indigenous Bacteria: Feasibility and Kinetic Studies. *Water Research*, 42(4-5), pp.827−842.

Lo, Y.C., Lee, K.S., Lin, P.J., and Chang, J.S., 2009b. Bioreactors Configured with Distributors and Carriers Enhance the Performance of Continuous Dark Hydrogen Fermentation. *Bioresource Technology*, 100(19), pp.4381−4387.

Lo, Y.C., Su, Y.C., Chen, C.Y., Chen, W.M., Lee, K.S., and Chang, J.S., 2009a. Biohydrogen Production from Cellulosic Hydrolysate Produced via Temperature-Shift-Enhanced Bacterial Cellulose Hydrolysis. *Bioresource Technology*, 100(23), pp.5802−5807.

Logan, B.E., 2004. Extracting Hydrogen and Electricity from Renewable Resources, *Environmental Science & Technology*, 38(9), pp.160A−167A.

Logan, B.E., 2008. *Microbial Fuel Cells*. Hoboken, NJ, USA: John Wiley & Sons, Inc.

Logan, B.E., 2009. Exoelectrogenic Bacteria That Power Microbial Fuel Cells. *Nature Reviews Microbiology*, 7(5), pp.375−381.

Logan, B.E., 2010. Scaling Up Microbial Fuel Cells and Other Bioelectrochemical Systems. *Applied Microbiology and Biotechnology*, 85(6), pp.1665−1671.

Logan, B.E., Oh, S.E., Kim, I.S., and van Ginkel, S., 2002. Biological Hydrogen Production Measured in Batch Anaerobic Respirometers. *Environmental Science & Technology*, 36(11), pp.2530−2535.

Logan, B.E. and Regan, J.M., 2006. Microbial Fuel Cells—Challenges and Applications. *Environmental Science & Technology*, 40(17), pp.5172−5180.

Logan, B.E., Call, D., Cheng, S., Hamelers, H.V., Sleutels, T.H.J.A, Jeremiasse, A.W., and Rozendal, R.A., 2008. Microbial Electrolysis Cells for High Yield Hydrogen Gas Production from Organic Matter. *Environmental Science & Technology*, 42(23), pp.8630−8640.

Logan, B.E., Hamelers, B., Rozendal, R., Schröder, U., Keller, J., Freguia, S., Aelterman, P., Verstraete, W., and Rabaey, K., 2006. Microbial Fuel Cells: Methodology and Technology. *Environmental Science & Technology*, 40(17), pp.5181−5192.

Logan, B.E., Rossi, R., Ragab, A.A., and Saikaly, P.E., 2019. Electroactive Microorganisms in Bioelectrochemical Systems. *Nature Reviews Microbiology*, 17, pp.307−319.

Loh, S.K., 2017. The Potential of The Malaysian Oil Palm Biomass as a Renewable Energy Source. *Energy Conversion and Management*, 141, pp.285−298.

Loh, S.K., Lai, M.E., Ngatiman, M., Lim, W.S., Choo, Y.M., Zhang, Z., and Salimon, J., 2013. Zero Discharge Treatment Technology of Palm Oil Mill Effluent. *Journal of Oil Palm Research*, 25(3), pp.273−281.

Lomans, B.P., Pol, A., and Op den Camp, H.J.M., 2002. Microbial Cycling of Volatile Organic Sulfur Compounds in Anoxic Environments. *Water Science and Technology*, 45(10), pp.55−60.

Long, C., Cui, J., Liu, Z., Liu, Y., Long, M., and Hu, Z., 2010. Statistical Optimization of Fermentative Hydrogen Production from Xylose by Newly Isolated *Enterobacter* sp. CN1. *International Journal of Hydrogen Energy,* 35(13), pp.6657−6664.

Loo, P.L., Vikineswary, S., and Chong, V.C., 2013. Nutritional Value and Production of Three Species of Purple Non-Sulphur Bacteria Grown in Palm Oil Mill Effluent and Their Application in Rotifer Culture. *Aquaculture Nutrition*, 19(6), pp.895−907.

Lozupone, C., Lladser, M.E., Knights, D., Stombaugh, J. and Knight, R., 2011. UniFrac: An Effective Distance Metric for Microbial Community Comparison. *The ISME Journal*, 5(2), pp.169−172.

Lozupone, C.A. and Knight, R., 2005. UniFrac: A New Phylogenetic Method for Comparing Microbial Communities. *Applied and Environmental Microbiology*, 71(12), pp.8228−8235.

Lozupone, C.A. and Knight, R., 2008. Species Divergence and the Measurement of Microbial Diversity. *FEMS Microbiology Reviews*, 32(4), pp.557−578.

Lozupone, C.A., Hamady, M., Kelley, S.T., and Knight, R., 2007. Quantitative and Qualitative β Diversity Measures Lead to Different Insights into Factors That Structure Microbial Communities. *Applied and Environmental Microbiology,* 73(5), pp.1576−1585.

Lu, L. and Ren, Z.J., 2016. Microbial Electrolysis Cells for Waste Biorefinery: A State of the Art Review. *Bioresource Technology*, 215, pp.254−264.

Lu, L., Ren, N., Xing, D., and Logan, B.E., 2009. Hydrogen Production with Effluent from an Ethanol–H_2-Coproducing Fermentation Reactor using a Single-Chamber Microbial Electrolysis Cell. *Biosensors and Bioelectronics*, 24(10), pp.3055−3060.

Lu, L., Xing, D., and Ren, N., 2012. Pyrosequencing Reveals Highly Diverse Microbial Communities in Microbial Electrolysis Cells Involved in Enhanced H_2 Production from Waste Activated Sludge. *Water Research*, 46(7), pp.2425−2434.

Luo, G., Xie, L., Zou, Z., Wang, W., and Zhou, Q., 2010. Evaluation of Pretreatment Methods on Mixed Inoculum for Both Batch and Continuous Thermophilic Biohydrogen Production from Cassava Stillage. *Bioresource Technology,* 101(3), pp.959−964.

Luo, J., Ding, L., Qi, B., Jaffrin, M.Y., and Wan, Y., 2011. A Two-Stage Ultrafiltration and Nanofiltration Process for Recycling Dairy Wastewater. *Bioresource Technology*, 102(16), pp.7437−7442.

Luo, J., Feng, L., Chen, Y., Sun, H., Shen, Q., Li, X., and Chen, H., 2015. Alkyl Polyglucose Enhancing Propionic Acid Enriched Short-Chain Fatty Acids Production During Anaerobic Treatment of Waste Activated Sludge and Mechanisms. *Water Research*, 73, pp.332−341.

Lutpi, N.A., Jahim, J.M., Mumtaz, T., Harun, S., and Abdul, P.M., 2016. Batch and Continuous Thermophilic Hydrogen Fermentation of Sucrose using Anaerobic Sludge from Palm Oil Mill Effluent via Immobilisation Technique. *Process Biochemistry*, 51(2), pp.297−307.

Lyon, D.Y., Buret, F., Vogel, T.M., and Monier, J.M., 2010. Is Resistance Futile? Changing External Resistance Does Not Improve Microbial Fuel Cell Performance. *Bioelectrochemistry*, 78(1), pp.2−7.

Ma, A.N., 2000. Environmental Management for the Palm Oil Industry. *Palm Oil Developments*, 30, pp.1−10.

Maaroff, R.M., Jahim, J.M., Azahar, A.M., Abdul, P.M., Masdar, M.S., Nordin, D., and Nasir, M.A.A., 2019. Biohydrogen Production from Palm Oil Mill Effluent (POME) by Two Stage Anaerobic Sequencing Batch Reactor (ASBR) System for Better Utilization of Carbon Sources in POME. *International Journal of Hydrogen Energy*, 44(6), pp.3395−3406.

Madaki, Y.S. and Seng, L., 2013. Palm Oil Mill Effluent (POME) from Malaysia Palm Oil Mills: Waste or Resource. *International Journal of Science, Environment and Technology*, 2(6), pp.1138−1155.

Maeda, T., Sanchez-Torres, V., and Wood, T.K., 2007. Enhanced Hydrogen Production from Glucose by Metabolically Engineered *Escherichia coli*. *Applied Microbiology and Biotechnology*, 77(4), pp.879−890.

Mahmod, S.S., Azahar, A.M., Tan, J.P., Jahim, J.M., Abdul, P.M., Mastar, M.S., Anuar, N., Yunus, M.F.M., Asis, A.J., and Wu, S.Y., 2019. Operation Performance of Up-Flow Anaerobic Sludge Blanket (UASB) Bioreactor for Biohydrogen Production by Self-Granulated Sludge using Pre-Treated Palm Oil Mill Effluent (POME) as Carbon Source. *Renewable Energy*, 134, pp.1262−1272.

Majumder, S., Sarabi, P., Radder, A., and Swamy, M., 2017. Effect of Mixed Microbial Culture, Mediator, Different Electrode Configuration and Wastewater Dilution on Power Generation in a Double Chambered Microbial Fuel Cell. *International Journal of Chemical Sciences and Applications*, 6(2), pp.42−55.

Mäkinen, A.E., Nissilä, M.E., and Puhakka, J.A., 2012. Dark Fermentative Hydrogen Production from Xylose by a Hot Spring Enrichment Culture. *International Journal of Hydrogen Energy*, 37(17), pp.12234−12240.

Malyshev, D.A., Dhami, K., Quach, H.T., Lavergne, T., Ordoukhanian, P., Torkamani, A., and Romesberg, F.E., 2012. Efficient and Sequence-Independent Replication of DNA Containing a Third Base Pair Establishes a Functional Six-Letter Genetic Alphabet. *Proceedings of the National Academy of Sciences*, 109(30), pp.12005−12010.

Mamimin, C., Chaikitkaew, S., Niyasom, C., Kongjan, P., and Sompong, O., 2015a. Effect of Operating Parameters on Process Stability of Continuous Biohydrogen Production from Palm Oil Mill Effluent under Thermophilic Condition. *Energy Procedia*, 79, pp.815−821.

Mamimin, C., Singkhala, A., Kongjan, P., Suraraksa, B., Prasertsan, P., Imai, T., and Sompong, O., 2015b. Two-Stage Thermophilic Fermentation and Mesophilic Methanogen Process for Biohythane Production from Palm Oil Mill Effluent. *International Journal of Hydrogen Energy*, 40(19), pp.6319−6328.

Mamimin, C., Thongdumyu, P., Hniman, A., Prasertsan, P., Imai, T., and Sompong, O., 2012. Simultaneous Thermophilic Hydrogen Production and Phenol Removal from Palm Oil Mill Effluent by *Thermoanaerobacterium*-rich Sludge. *International Journal of Hydrogen Energy*, 37(20), pp.15598−15606.

Manios, T., Stentiford, E.I., and Millner, P.A., 2002. The Removal of NH_3–N from Primary Treated Wastewater in Subsurface Reed Beds using Different

Substrates. *Journal of Environmental Science and Health, Part A*, 37(3), pp.297−308.

Manohar, A.K., Bretschger, O., Nealson, K.H., and Mansfeld, F., 2008. The Use of Electrochemical Impedance Spectroscopy (EIS) in the Evaluation of the Electrochemical Properties of a Microbial Fuel Cell. *Bioelectrochemistry*, 72(2), pp.149−154.

Marashi, S.K.F. and Kariminia, H.R., 2015. Performance of a Single Chamber Microbial Fuel Cell at Different Organic Loads and pH Values using Purified Terephthalic Acid Wastewater. *Journal of Environmental Health Science and Engineering*, 13(1), p.27.

Marashi, S.K.F., Kariminia, H.R., and Savizi, I.S.P., 2013. Bimodal Electricity Generation and Aromatic Compounds Removal from Purified Terephthalic Acid Plant Wastewater in a Microbial Fuel Cell. *Biotechnology Letters*, 35(2), pp.197−203.

Marcus, A.K., Torres, C.I., and Rittmann, B.E., 2011. Analysis of a Microbial Electrochemical Cell using the Proton Condition in Biofilm (PCBIOFILM) Model. *Bioresource Technology*, 102(1), pp.253−262.

Margaria, V., Tommasi, T., Pentassuglia, S., Agostino, V., Sacco, A., Armato, C., Chiodoni, A., Schilirò, T., and Quaglio, M., 2017. Effects of pH Variations on Anodic Marine Consortia in a Dual Chamber Microbial Fuel Cell. *International Journal of Hydrogen Energy*, 42(3), pp.1820−1829.

Mariakakis, I., Bischoff, P., Krampe, J., Meyer, C., and Steinmetz, H., 2011. Effect of Organic Loading Rate and Solids Retention Time on Microbial Population During Bio-hydrogen Production by Dark Fermentation in Large Lab-Scale. *International Journal of Hydrogen Energy*, 36(17), pp.10690−10700.

Marone, A., Ayala-Campos, O.R., Trably, E., Carmona-Martínez, A.A., Moscoviz, R., Latrille, E., Steyer, J.P., Alcaraz-Gonzalez, V., and Bernet, N., 2017. Coupling Dark Fermentation and Microbial Electrolysis to Enhance Bio-Hydrogen Production from Agro-Industrial Wastewaters and By-Products in a Bio-Refinery Framework. *International Journal of Hydrogen Energy*, 42(3), pp.1609−1621.

Maru, B.T., Constanti, M., Stchigel, A.M., Medina, F., and Sueiras, J.E., 2013. Biohydrogen Production by Dark Fermentation of Glycerol using *Enterobacter* and *Citrobacter* sp. *Biotechnology Progress*, 29(1), pp.31−38.

Maskin, M., Lanyau, T., Fazli Zakaria, M., Kassim, M., Nabil Ab Rahim, A., Tom, P., Fairus, A.F.M., and Huzair, H.M., 2012. Conceptual Design of Reactor TRIGA PUSPATI (RTP) Spent Fuel Pool Cooling System. *Nuclear Technical Convention*. 26−28 Sept. Selangor, Malaysia.

Masngut, N., 2007. *Aplikasi Reaktor Aliran Berayun Bagi Penghasilan Aseton-Butanol-Etanol oleh Clostridium acetobutylicum NCIMB 13357*. Master Thesis. Universiti Kebangsaan Malaysia.

Masset, J., Calusinska, M., Hamilton, C., Hiligsmann, S., Joris, B., Wilmotte, A., and Thonart, P., 2012. Fermentative Hydrogen Production from Glucose and Starch using Pure Strains and Artificial Co-Cultures of *Clostridium* spp. *Biotechnology for Biofuels*, 5(1), pp.35−49.

Mathews, J. and Wang, G., 2009. Metabolic Pathway Engineering for Enhanced Biohydrogen Production. *International Journal of Hydrogen Energy*, 34(17), pp.7404−7416.

Maus, I., Bremges, A., Stolze, Y., Hahnke, S., Cibis, K.G., Koeck, D.E., Kim, Y.S., Kreubel, J., Hassa, J., Wibberg, D., and Weimann, A., 2017. Genomics and

Prevalence of Bacterial and Archaeal Isolates from Biogas-Producing Microbiomes. *Biotechnology for Biofuels*, 10(1), p.264.

Mazloomi, K. and Gomes, C., 2012. Hydrogen as An Energy Carrier: Prospects and Challenges. *Renewable and Sustainable Energy Reviews*, 16(5), pp.3024−3033.

Mazzoli, R., 2012. Development of Microorganisms for Cellulose-Biofuel Consolidated Bioprocessings: Metabolic Engineers' Tricks. *Computational and Structural Biotechnology Journal*, 3(4), pp.1−9.

Mekhilef, S., Barimani, M., Safari, A., and Salam, Z., 2014. Malaysia’s Renewable Energy Policies and Programs with Green Aspects. *Renewable and Sustainable Energy Reviews*, 40, pp.497−504.

Mekhilef, S., Saidur, R., and Safari, A., 2011. A Review on Solar Energy Use in Industries. *Renewable and Sustainable Energy Reviews*, 15(4), pp.1777−1790.

Mendenhall, W., Beaver, R.J., and Beaver, B.M., 2008. *Introduction to Probability and Statistics*. Boston, MA, USA: Cengage Learning.

Merkey, B.V. and Chopp, D.L., 2012. The Performance of a Microbial Fuel Cell Depends Strongly on Anode Geometry: A Multidimensional Modeling Study. *Bulletin of Mathematical Biology*, 74(4), pp.834−857.

Metcalf, and Eddy, I., 2003. *Wastewater Engineering: Treatment and Reuse* (4th ed.). New York, NY, USA: McGraw-Hill Education.

Michie, I.S., Kim, J.R., Dinsdale, R.M., Guwy, A.J., and Premier, G.C., 2011. The Influence of Psychrophilic and Mesophilic Start-Up Temperature on Microbial Fuel Cell System Performance. *Energy & Environmental Science*, 4(3), pp.1011−1019.

Millat, T., Janssen, H., Thorn, G.J., King, J.R., Bahl, H., Fischer, R.J., and Wolkenhauer, O., 2013. A Shift in the Dominant Phenotype Governs the pH-Induced Metabolic Switch of *Clostridium acetobutylicumin* Phosphate-Limited Continuous Cultures. *Applied Microbiology and Biotechnology*, 97(14), pp.6451−6466.

Miller, G.L., Blum, R., Glennon, W.E., and Blurton, A.L., 1960. Measurement of Carboxymethylcellulase Activity. *Analytical Biochemistry*, 1, pp.127−132.

Min, B., Cheng, S., and Logan, B.E., 2005a. Electricity Generation using Membrane and Salt Bridge Microbial Fuel Cells. *Water Research*, 39(9), pp.1675−1686.

Min, B., Kim, J., Oh, S., Regan, J.M., and Logan, B.E., 2005b. Electricity Generation from Swine Wastewater using Microbial Fuel Cells. *Water Research*, 39(20), pp.4961−4968.

Minnan, L., Jinli, H., Xiaobin, W., Huijuan, X., Jinzao, C., Chuannan, L., Fengzhang, Z., and Liangshu, X., 2005. Isolation and Characterization of a High H_2-Producing Strain *Klebsiella oxytoca* HP1 from a Hot Spring. *Research in Microbiology*, 156(1), pp.76−81.

Mirzaei, A., Tangang, F., and Juneng, L., 2014. Wave Energy Potential Along the East Coast of Peninsular Malaysia. *Energy*, 68, pp.722−734.

Mishra, P., Krishnan, S., Rana, S., Singh, L., Sakinah, M., and Ab Wahid, Z., 2019. Outlook of Fermentative Hydrogen Production Techniques: An Overview of Dark, Photo and Integrated Dark-Photo Fermentative Approach to Biomass. *Energy Strategy Reviews*, 24, pp.27−37.

MNA., 2017. TRIGA PUSPATI Reactor. *Agensi Nuklear Malaysia*. Retrieved 6 December 2017, from http://www.nuclearmalaysia.gov.my/new/RnD/energy/reactor/reactorTech.php

Mohamed, A.R. and Lee, K.T., 2006. Energy for Sustainable Development in Malaysia: Energy Policy and Alternative Energy. *Energy Policy*, 34(15), pp.2388−2397.

Mohamed, R. 2009. Malaysia Energy Outlook 2010−2030. *3rd National Seminar on Public Information on Nuclear Energy (PINE3)*. 11 Sept. Kuala Lumpur, Malaysia.

Mohammad, A.W., Yeong, W.T., Md Jahim, J., and Anuar, N., 2008. Palm Oil Mill Effluent (POME) Treatment and Bioresource Recovery using Ultrafiltration Membrane: Effect of Pressure One Membrane Fouling. *Biochemical Engineering Journal*, 35(3), pp.309−17.

Mohammadi, P., Ibrahim, S., and Annuar, M.S.M., 2012b. Comparative Study on the Effect of Various Pretreatment Methods on the Enrichment of Hydrogen Producing Bacteria in Anaerobic Granulated Sludge from Brewery Wastewater. *Korean Journal of Chemical Engineering*, 29(10), pp.1347−1351.

Mohammadi, P., Ibrahim, S., Annuar, M.S.M., and Law, S., 2011. Effects of Different Pretreatment Methods on Anaerobic Mixed Microflora for Hydrogen Production and COD Reduction from Palm Oil Mill Effluent. *Journal of Cleaner Production*, 19(14), pp.1654−1658.

Mohammadi, P., Ibrahim, S., Annuar, M.S.M., Ghafari, S., Vikineswary, S., and Zinatizadeh, A.A., 2012a. Influences of Environmental and Operational Factors on Dark Fermentative Hydrogen Production: A Review. *CLEAN–Soil, Air, Water*, 40(11), pp.1297−1305.

Mohammadi, P., Ibrahim, S., Annuar, M.S.M., Khashij, M., Mousavi, S.A., and Zinatizadeh, A., 2017. Optimization of Fermentative Hydrogen Production from Palm Oil Mill Effluent in an Up-Flow Anaerobic Sludge Blanket Fixed Film Bioreactor. *Sustainable Environment Research*, 27(5), pp.238−244.

Mohan, S.V., 2009. Harnessing of Biohydrogen from Wastewater Treatment using Mixed Fermentative Consortia: Process Evaluation Towards Optimization. *International Journal of Hydrogen Energy*, 34(17), pp.7460−7474.

Mohan, S.V., Agarwal, L., Mohanakrishna, G., Srikanth, S., Kapley, A., Purohit, H.J., and Sarma, P.N., 2011. Firmicutes with Iron Dependent Hydrogenase Drive Hydrogen Production in Anaerobic Bioreactor using Distillery Wastewater. *International Journal of Hydrogen Energy*, 36(14), pp.8234−8242.

Mohan, S.V. and Babu, M.L., 2011. Dehydrogenase Activity in Association with Poised Potential During Biohydrogen Production in Single Chamber Microbial Electrolysis Cell. *Bioresource Technology*, 102(18), pp.8457−8465.

Mohan, S.V., Babu, V.L., and Sarma, P.N., 2008. Effect of Various Pretreatment Methods on Anaerobic Mixed Microflora to Enhance Biohydrogen Production Utilizing Dairy Wastewater as Substrate. *Bioresource Technology*, 99, pp.59−67.

Mohan, S.V., Chiranjeevi, P., and Mohanakrishna, G., 2012. A Rapid and Simple Protocol for Evaluating Biohydrogen Production Potential (BHP) of Wastewater with Simultaneous Process Optimization. *International Journal of Hydrogen Energy*, 37(4), pp.3130−3141.

Mohan, S.V., Mohanakrishna, G., Goud, R.K., and Sarma, P.N., 2009. Acidogenic Fermentation of Vegetable Based Market Waste to Harness Biohydrogen with Simultaneous Stabilization. *Bioresource Technology*, 100(12), pp.3061−3068.

Mohan, S.V., Mohanakrishna, G., Raghavulu, S.V., and Sarma, P.N., 2007. Enhancing Biohydrogen Production from Chemical Wastewater Treatment in Anaerobic Sequencing Batch Biofilm Reactor (AnSBBR) by Bioaugmenting with

Selectively Enriched Kanamycin Resistant Anaerobic Mixed Consortia. *International Journal of Hydrogen Energy*, 32(15), pp.3284−3292.

Mokhtar, A., Hassan, K., Astimar, A. A., and Basri Wahid, M., 2011. Plywood from Oil Palm Trunks. *Journal of Oil Palm Research*, 23, pp.1159−1165.

Momirlan, M. and Veziroglu, T.N., 2005. The Properties of Hydrogen as Fuel Tomorrow in Sustainable Energy System for A Cleaner Planet. *International Journal of Hydrogen Energy*, 30(7), pp.795−802.

Montgomery, D.C., 2009. *Design and Analysis of Experiments* (7th ed). New York, NY, USA: John Wiley & Sons, Inc.

Mook, W.T., Aroua, M.K.T., Chakrabarti, M.H., Noor, I.M., Irfan, M.F., and Low, C.T.J., 2013. A Review on the Effect of Bio-electrodes on Denitrification and Organic Matter Removal Processes in Bio-electrochemical Systems. *Journal of Industrial and Engineering Chemistry*, 19(1), pp.1−13.

Moosbrugger, R.E., Wentzel, M.C., Ekama, G.A., and Marais, G.V.R., 1993. A 5 pH Point Titration Method for Determining the Carbonate and SCFA Weak Acid/Bases in Anaerobic Systems. *Water Science and Technology*, 28(2), pp.237−245.

Morales, S.E. and Holben, W.E., 2011. Linking Bacterial Identities and Ecosystem Processes: Can ‘Omic’analyses Be More Than the Sum of Their Parts?. *FEMS Microbiology Ecology*, 75(1), pp.2−16.

Moreno, R., Escapa, A., Cara, J., Carracedo, B., and Gómez, X., 2015. A Two-Stage Process for Hydrogen Production from Cheese Whey: Integration of Dark Fermentation and Biocatalyzed Electrolysis. *International Journal of Hydrogen Energy*, 40(1), pp.168−175.

Morimoto, M., Atsuko, M., Atif, A.A.Y., Ngan, M.A., Fakhru'l-Razi, A., Iyuke, S.E., and Bakir, A.M., 2004. Biological Production of Hydrogen from Glucose by Natural Anaerobic Microflora. *International Journal of Hydrogen Energy*, 29(7), pp.709−713.

Morsy, F.M., 2011. Hydrogen Production from Acid Hydrolyzed Molasses by the Hydrogen Overproducing *Escherichia coli* Strain HD701 and Subsequent Use of the Waste Bacterial Biomass for Biosorption Of Cd (II) and Zn (II). *International Journal of Hydrogen Energy*, 36(22), pp.14381−14390.

Mounir, M., Shafiei, R., Zarmehrkhorshid, R., Hamouda, A., Alaoui, M.I., and Thonart, P., 2016. Simultaneous Production of Acetic and Gluconic Acids by a Thermotolerant *Acetobacter* Strain during Acetous Fermentation in a Bioreactor. *Journal of Bioscience and Bioengineering*, 121(2), pp.166−171.

MPOB., 2018. Oil Palm Planted Area 2018. *Economics and Industry Development Division, MPOB*. Retrieved 3 Mar. 2019, from http://bepi.mpob.gov.my/index.php/en/statistics/area/189-area-2018/857-oil-palm-planted-area-as-at-dec-2018.html

MPOC, 2017. *Malaysian Palm Oil Council 2017 Annual Report*. Selangor, Malaysia: Malaysian Palm Oil Council.

Mu, Y. and Yu, H.Q., 2006. Biological Hydrogen Production in a UASB Reactor with Granules. I: Physicochemical Characteristics of Hydrogen-Producing Granules. *Biotechnology and Bioengineering*, 94(5), pp.980−987.

Mu, Y., Teng, H., Zhang, D.J., Wang, W., and Xiu, Z.L., 2006. Microbial Production of 1, 3-Propanediol by *Klebsiella pneumoniae* using Crude Glycerol from Biodiesel Preparations. *Biotechnology Letters*, 28(21), pp.1755−1759.

Mu, Y., Yu, H.Q., and Wang, G., 2007. Evaluation of Three Methods for Enriching H_2 Producing Cultures from Anaerobic Sludge. *Enzyme and Microbial Technology*, 40, pp.947−953.

Mumtaz, T., Yahaya, N.A., Abd-Aziz, S., Yee, P.L., Shirai, Y., and Hassan, M.A., 2010. Turning Waste to Wealth-Biodegradable Plastics Polyhydroxyalkanoates from Palm Oil Mill Effluent—A Malaysian Perspective. *Journal of Cleaner Production*, 18(14), pp.1393−1402.

Muralidharan, A., Babu, O.A., Nirmalraman, K., and Ramya, M., 2011. Impact of Salt Concentration on Electricity Production in Microbial Hydrogen Based Salt Bridge Fuel Cells. *Indian Journal of Fundamental and Applied Life Science*, 1(2), pp.178−184.

Mushtaq, F., Abdullah, T.A.T., Mat, R., and Ani, F.N., 2015. Optimization and Characterization of Bio-Oil Produced by Microwave Assisted Pyrolysis of Oil Palm Shell Waste Biomass with Microwave Absorber. *Bioresource Technology*, 190, pp.442−450.

Muthukumar, M., Shanmuga Priya, S., and Sangeetha, T., 2014. Impact of Salt on Bioelectricity Generation in a Dual-Chambered Microbial Fuel Cell using Sago-Processing Wastewater. *Iranica Journal of Energy & Environment*, 5(4), pp.376−386.

Najafpour, G., Yieng, H.A., Younesi, H., and Zinatizadeh, A., 2005. Effect of Organic Loading on Performance of Rotating Biological Contactors using Palm Oil Mill Effluents. *Process Biochemistry*, 40(8), pp.2879−2884.

Najafpour, G.D., Zinatizadeh, A.A.L., Mohamed, A.R., Isa, M.H., and Nasrollahzadeh, H., 2006. High-Rate Anaerobic Digestion of Palm Oil Mill Effluent in an Upflow Anaerobic Sludge-Fixed Film Bioreactor. *Process Biochemistry*, 41(2), pp.370−379.

Najid, S.K., Zaharim, A., Razali, A.M., Zainol, M.S., Ibrahim, K., and Sopian, K., 2009. Analyzing the East Coast Malaysia Wind Speed Data. *International Journal of Energy and Environment*, 3(2), pp.53−60.

Nakamura, L.K., Shida, O., Takagi, H., and Komagata, K., 2002. *Bacillus pycnus* sp. nov. and *Bacillus neidei* sp. nov., Round-Spored Bacteria from Soil. *International Journal of Systematic and Evolutionary Microbiology*, 52(2), pp.501−505.

Nam, J.Y., Tokash, J.C., and Logan, B.E., 2011. Comparison of Microbial Electrolysis Cells Operated with Added Voltage or by Setting the Anode Potential. *International Journal of Hydrogen Energy*, 36(17), pp.10550−10556.

Nasir, M.A.A., Jahim, J.M., Abdul, P.M., Silvamany, H., Maaroff, R.M., and Yunus, M.F.M., 2019. The Use of Acidified Palm Oil Mill Effluent for Thermophilic Biomethane Production by Changing the Hydraulic Retention Time in Anaerobic Sequencing Batch Reactor. *International Journal of Hydrogen Energy*, 44(6), pp.3373−3381.

Nath, K. and Das, D., 2004. Improvement of Fermentative Hydrogen Production: Various Approaches. *Applied Microbiology and Biotechnology*, 65(5), pp.520−529.

Nath, K. and Das, D., 2011. Modeling and Optimization of Fermentative Hydrogen Production. *Bioresource Technology*, 102(18), pp.8569−8581.

Nayak, J. and Pal, P., 2013. Transforming Waste Cheese-Whey into Acetic Acid through a Continuous Membrane-Integrated Hybrid Process. *Industrial & Engineering Chemistry Research*, 52(8), pp.2977−2984.

Nazlina, H.Y., Aini, A.N., Ismail, F., Yusof, M.Z.M., and Hassan, M.A., 2009. Effect of Different Temperature, Initial pH and Substrate Composition on Biohydrogen Production from Food Waste in Batch Fermentation. *Asian Journal of Biotechnology*, 1(2), pp.42−50.

Nei, M. and Kumar, S., 2000. *Molecular Evolution and Phylogenetics*. New York, NY, USA: Oxford University Press, Inc.

Neoh, C.H., 2014. *Decolourisation of Palm Oil Mill Effluent using Curvularia clavata*. PhD Thesis, Universiti Teknologi Malaysia.

Neoh, C.H., Lam, C.Y., Ghani, S.M., Ware, I., Sarip, S.H.M., and Ibrahim, Z., 2016. Bioremediation of High-Strength Agricultural Wastewater using *Ochrobactrum* sp. Strain SZ1. *3 Biotech*, 6(2), p.143.

Neoh, C.H., Yahya, A., Adnan, R., Majid, Z.A., and Ibrahim, Z., 2013. Optimization of Decolorization of Palm Oil Mill Effluent (POME) by Growing Cultures of *Aspergillus fumigatus* using Response Surface Methodology. *Environmental Science and Pollution Research*, 20(5), pp.2912−2923.

Nester, E.W., Anderson, D.G., Roberts, C.E., Pearsall, N.N., and Nester, M.T., 2009. *Microbiology: A Human Perspective* (4th ed.). New York, NY, USA: McGraw-Hill Education.

Ng, F.Y., Yew, F.K., Basiron, Y., and Sundram, K., 2011. A Renewable Future Driven with Malaysian Palm Oil-Based Green Technology. *Journal of Oil Palm and The Environment*, 2, pp.1−7.

Ng, K.H., Lee, C.H., Khan, M.R., and Cheng, C.K., 2016. Photocatalytic Degradation of Recalcitrant POME Waste by using Silver Doped Titania: Photokinetics and Scavenging Studies. *Chemical Engineering Journal*, 286, pp.282−290.

Ng, W.P.Q., Lam, H.L., Ng, F.Y., Kamal, M., and Lim, J.H.E., 2012. Waste-to-Wealth: Green Potential from Palm Biomass in Malaysia. *Journal of Cleaner Production*, 34, pp.57−65.

Nik, W.W., Ahmad, M.F., Ibrahim, M.Z., Samo, K.B., and Muzathik, A.M., 2011. Wind Energy Potential at East Coast of Peninsular Malaysia. *International Journal of Applied Engineering Research*, 2(2), pp.360−366.

Nimje, V.R., Chen, C.C., Chen, H.R., Chen, C.Y., Tseng, M.J., Cheng, K.C., Shih, R.C., and Chang, Y.F., 2012. A Single-Chamber Microbial Fuel Cell without an Air Cathode. *International Journal of Molecular Sciences*, 13(3), pp.3933−3948.

Nishihara, H., Miyashita, Y., Aoyama, K., Kodama, T., Igarashi, Y., and Takamura, Y., 1997. Characterization of an Extremely Thermophilic and Oxygen-Stable Membrane-Bound Hydrogenase from a Marine Hydrogen-Oxidizing Bacterium *Hydrogenovibrio marinus*. *Biochemical and Biophysical Research Communications*, 232(3), pp.766−770.

Nitipan, S., Mamimin, C., Intrasungkha, N., Birkeland, N.K., and Sompong, O., 2014. Microbial Community Analysis of Thermophilic Mixed Culture Sludge for Biohydrogen Production from Palm Oil Mill Effluent. *International Journal of Hydrogen Energy*, 39(33), pp.19285−19293.

Noparat, P., Maneerat, S., and Saimmai, A., 2014. Utilization of Palm Oil Decanter Cake as a Novel Substrate for Biosurfactant Production from a New and Promising Strain of *Ochrobactrum anthropi* 2/3. *World Journal of Microbiology and Biotechnology*, 30(3), pp.865−877.

Nor, M.H.M, Mubarak, M.F.M., Elmi, H.S.A., Ibrahim, N., Wahab, M.F.A., and Ibrahim, Z., 2015. Bioelectricity Generation in Microbial Fuel Cell using

Natural Microflora and Isolated Pure Culture Bacteria from Anaerobic Palm Oil Mill Effluent Sludge. *Bioresource Technology*, 190, pp.458−465.

Noratiqah, K., Madihah, M.S., Aisyah, B.S., Eva, M.S., Suraini, A.A., and Kamarulzaman, K., 2013. Statistical Optimization of Enzymatic Degradation Process for Oil Palm Empty Fruit Bunch (OPEFB) in Rotary Drum Bioreactor using Crude Cellulase Produced from *Aspergillus niger* EFB1. *Biochemical Engineering Journal*, 75, pp.8−20.

Norfadilah, N., Raheem, A., and Harun, R., 2016. Bio-Hydrogen Production from Palm Oil Mill Effluent (POME): A Preliminary Study. *International Journal of Hydrogen Energy*, 41(28), pp.11960−11964.

Norhasmillah, A.H., Wei, P., Nor, A.I., Azhari, S.B., and May, C., 2015. Composting of Oil Palm Biomass: Fourier Transform-Infrared and Thermogravimetry Analyses. *Journal of Oil Palm Research*, 27(3), pp.241−249.

Ntaikou, I., Antonopoulou, G., and Lyberatos, G., 2010. Biohydrogen Production from Biomass and Wastes Via Dark Fermentation: A Review. *Waste and Biomass Valorization*, 1(1), pp.21−39.

Ntaikou, I., Kourmentza, C., Koutrouli, E.C., Stamatelatou, K., Zampraka, A., Kornaros, M., and Lyberatos, G., 2009. Exploitation of Olive Oil Mill Wastewater for Combined Biohydrogen and Biopolymers Production. *Bioresource Technology*, 100(15), pp.3724−3730.

Oey, M., Sawyer, A.L., Ross, I.L., and Hankamer, B., 2016. Challenges and Opportunities for Hydrogen Production from Microalgae. *Plant Biotechnology Journal*, 14(7), pp.1487−1499.

Oh, S.E. and Logan, B.E., 2006. Proton Exchange Membrane and Electrode Surface Areas as Factors That Affect Power Generation in Microbial Fuel Cells. *Applied Microbiology and Biotechnology*, 70(2), pp.162−169.

Oh, S.E., Ginkel, S.V., and Logan, B.E., 2003. The Relative Effectiveness of pH Control and Heat Treatment for Enhancing Biohydrogen Gas Production. *Environmental Science & Technology*, 37(22), pp.5186−5190.

Oh, S.E., Iyer, P., Bruns, M.A., and Logan, B.E., 2004b. Biological Hydrogen Production using a Membrane Bioreactor. *Biotechnology and Bioengineering*, 87(1), pp.119−127.

Oh, T.H., Hasanuzzaman, M., Selvaraj, J., Teo, S.C., and Chua, S.C., 2018. Energy Policy and Alternative Energy in Malaysia: Issues and Challenges for Sustainable Growth—An Update. *Renewable and Sustainable Energy Reviews*, 81(Part 2), pp.3021−3031.

Oh, T.H., Pang, S.Y., and Chua, S.C., 2010. Energy Policy and Alternative Energy in Malaysia: Issues and Challenges for Sustainable Growth. *Renewable and Sustainable Energy Reviews*, 14, pp.1241−1252.

Oh, Y.K., Kim, S.H., Kim, M.S., and Park, S., 2004a. Thermophilic Biohydrogen Production from Glucose with Trickling Biofilter. *Biotechnology and Bioengineering*, 88(6), pp.690−698.

Oh, Y.K., Raj, S.M., Jung, G.Y., and Park, S. 2013. Metabolic Engineering of Microorganisms for Biohydrogen Production. In: Pandey, A., Chang, J.S., Hallenbeck, P.C., and Larroche, C. (eds) *Biohydrogen*. Burlington, MA, USA: Elsevier.

Oh, Y.K., Seol, E.H., Lee, E.Y., and Park, S., 2002. Fermentative Hydrogen Production by a New Chemoheterotrophic Bacterium *Rhodopseudomonas palustris* P4. *International Journal of Hydrogen Energy*, 27(11−12), pp.1373−1379.

Okwute, L.O. and Isu, N.R., 2007. The Environmental Impact of Palm Oil Mill Effluent (POME) on Some Physico-Chemical Parameters and Total Aerobic Bioload of Soil at a Dump Site in Anyigba, Kogi State, Nigeria. *African Journal of Agricultural Research,* 2(12), pp.656−662.

Olson, E.R., 1993. Influence of pH on Bacterial Gene Expression. *Molecular Microbiology,* 8(1), pp.5−14.

Ölz, S. and Beerepoot, M., 2010. *Deploying Renewables in South East Asia—Trends and Potentials*. Paris, France: OECD/IEA.

Ong, H.C., Mahlia, T.M.I., and Masjuki, H.H., 2011. A Review on Energy Scenario and Sustainable Energy in Malaysia. *Renewable and Sustainable Energy Reviews*, 15(1), pp.639−647.

Ooi, H.S. and Kumar, S.S., 2008. Co-composting for Sustainable Crude Palm Oil Production in Malaysia. *Jurutera*, pp.22−26.

Oosterveer, P., 2015. Promoting Sustainable Palm Oil: Viewed from a Global Networks and Flows Perspective. *Journal of Cleaner Production*, 107, pp.146−153.

Ortiz-Estrada, Á.M., Gollas-Galván, T., Martínez-Córdova, L.R., and Martínez-Porchas, M., 2019. Predictive Functional Profiles using Metagenomic 16S rRNA Data: A Novel Approach to Understanding the Microbial Ecology of Aquaculture Systems. *Reviews in Aquaculture*, 11(1), pp.234−245.

O-Thong, S. Hniman, A., Prasertsan, P., and Imai, T., 2011. Biohydrogen Production from Cassava Starch Processing Wastewater by Thermophilic Mixed Cultures. *International Journal of Hydrogen Energy*, 36(5), pp.3409−3416.

O-Thong, S., Hniman, A., Prasertsan, P., and Imai, T., 2011. Biohydrogen Production from Cassava Starch Processing Wastewater by Thermophilic Mixed Cultures. *International Journal of Hydrogen Energy*, 36(5), pp.3409−3416.

O-Thong, S., Prasertsan, P., Karakashev, D., and Angelidaki, I., 2007. Specific Detection of *Thermoanaerobacterium* spp., *Thermoanaerobacterium thermosaccharolyticum* and *Caldicellulosiruptor* spp. in Thermophilic Biohydrogen Reactor using Fluorescent In Situ Hybridization (FISH). *International Journal of Hydrogen Energy*, 33, pp.6082−6091.

O-Thong, S., Prasertsan, P., Karakashev, D., and Angelidaki, I., 2008. Thermophilic Fermentative Hydrogen Production by the Newly Isolated *Thermoanaerobacterium thermosaccharolyticum* PSU-2. *International Journal of Hydrogen Energy*, 33(4), pp.1204−1214.

Oviasogie, P.O., and Aghimien, A.E., 2003. Macronutrient Status and Speciation of Cu, Fe, Zn and Pb in Soil Containing Palm Oil Mill Effluent. *Global Journal of Pure and Applied Sciences*, 9(1), pp.71−80.

Özgür, E., Afsar, N., de Vrije, T., Yücel, M., Gündüz, U., Claassen, P.A., and Eroglu, I., 2010. Potential Use of Thermophilic Dark Fermentation Effluents in Photofermentative Hydrogen Production by *Rhodobacter capsulatus*. *Journal of Cleaner Production*, 18, pp.S23−S28.

Palmqvist, E. and Hahn-Hägerdal, B., 2000. Fermentation of Lignocellulosic Hydrolysates. II: Inhibitors and Mechanisms of Inhibition. *Bioresource Technology*, 74(1), pp.25−33.

Panapanaan, V., Helin, T., Kujanpää, M., Soukka, R., Heinimö, J., and Linnanen, L., 2009. *Sustainability of Palm oil Production and Opportunities for Finnish Technology and Know-how Transfer*. Lappeenranta, Finland: Lappeenranta University of Technology.

Pandey, P., Shinde, V.N., Deopurkar, R.L., Kale, S.P., Patil, S.A., and Pant, D., 2016. Recent Advances in the Use of Different Substrates in Microbial Fuel Cells Toward Wastewater Treatment and Simultaneous Energy Recovery. *Applied Energy*, 168, pp.706−723.

Pandiyan, K., Tiwari, R., Singh, S., Nain, P.K., Rana, S., Arora, A., Singh, S.B., and Nain, L., 2014. Optimization of Enzymatic Saccharification of Alkali Pretreated *Parthenium* sp. using Response Surface Methodology. *Enzyme Research*.

Pant, D., Van Bogaert, G., Diels, L., and Vanbroekhoven, K., 2010. A Review of the Substrates Used in Microbial Fuel Cells (MFCs) for Sustainable Energy Production. *Bioresource Technology*, 101(6), pp.1533−1543.

Parameswaran, P., Torres, C.I., Lee, H.S., Krajmalnik-Brown, R., and Rittmann, B.E., 2009. Syntrophic Interactions Among Anode Respiring Bacteria (ARB) and Non-ARB in a Biofilm Anode: Electron Balances. *Biotechnology and Bioengineering*, 103(3), pp.513−523.

Park, J., Lee, B., Tian, D., and Jun, H., 2018. Bioelectrochemical Enhancement of Methane Production from Highly Concentrated Food Waste in a Combined Anaerobic Digester and Microbial Electrolysis Cell. *Bioresource Technology*, 247, pp.226−233.

Parkhey, P. and Gupta, P., 2017. Improvisations in Structural Features of Microbial Electrolytic Cell and Process Parameters of Electrohydrogenesis for Efficient Biohydrogen Production: A Review. *Renewable and Sustainable Energy Reviews*, 69, pp.1085−1099.

Parks, D.H., Tyson, G.W., Hugenholtz, P., and Beiko, R.G., 2014. STAMP: Statistical Analysis of Taxonomic and Functional Profiles. *Bioinformatics*, 30(21), pp.3123−3124.

Pasha, T.N., 2007. Boosting Animal Feed. *Global Oil & Fats Business Magazine*, 4, pp.43−44.

Pasupuleti, S.B., Srikanth, S., Mohan, S.V., and Pant, D., 2015. Development of Exoelectrogenic Bioanode and Study on Feasibility of Hydrogen Production using Abiotic VITO-CoRE™ and VITO-CASE™ Electrodes in a Single Chamber Microbial Electrolysis Cell (MEC) at Low Current Densities. *Bioresource Technology*, 195, pp.131−138.

Patil, S.A., Surakasi, V.P., Koul, S., Ijmulwar, S., Vivek, A., Shouche, Y.S., and Kapadnis, B.P., 2009. Electricity Generation using Chocolate Industry Wastewater and Its Treatment in Activated Sludge Based Microbial Fuel Cell and Analysis of Developed Microbial Community in the Anode Chamber. *Bioresource Technology*, 100(21), pp.5132−5139.

Pattanamanee, W., Choorit, W., Deesan, C., Sirisansaneeyakul, S., and Chisti, Y., 2012. Photofermentive Production of Biohydrogen from Oil Palm Waste Hydrolysate. *International Journal of Hydrogen Energy*, 37(5), pp.4077−4087.

Pearl, I.A. and Benson, H.K., 1990. The Determination of Lignin in Sulphide Pulping Liquor. *Paper Trade Journal*, 111(18), pp.35−36.

Peixoto, G., Pantoja-Filho, J.L.R., Agnelli, J.A.B., Barboza, M., and Zaiat, M., 2012. Hydrogen and Methane Production, Energy Recovery, and Organic Matter Removal from Effluents in a Two-Stage Fermentative Process. *Applied Biochemistry and Biotechnology*, 168(3), pp.651−671.

Peltier, G., Tolleter, D., Billon, E., and Cournac, L., 2010. Auxiliary Electron Transport Pathways in Chloroplasts of Microalgae. *Photosynthesis Research*, 106(1-2), pp.19−31.

Pendyala, B., Chaganti, S.R., Lalman, J.A., Shanmugam, S.R., Heath, D.D., and Lau, P.C.K., 2012. Pretreating Mixed Anaerobic Communities from Different Sources: Correlating the Hydrogen Yield with Hydrogenase Activity and Microbial Diversity. *International Journal of Hydrogen Energy*, 37(17), pp.12175−12186.

Peng, X., Zhang, Z., Luo, W., and Jia, X., 2013. Biodegradation of Tetrabromobisphenol A by a Novel *Comamonas* sp. Strain, JXS-2-02, Isolated from Anaerobic Sludge. *Bioresource Technology*, 128, pp.173−179.

Perna, V., Castelló, E., Wenzel, J., Zampol, C., Lima, D.F., Borzacconi, L., Varesche, M.B., Zaiat, M., and Etchebehere, C., 2013. Hydrogen Production in an Upflow Anaerobic Packed Bed Reactor Used to Treat Cheese Whey. *International Journal of Hydrogen Energy*, 38(1), pp.54−62.

Petinrin, J.O. and Shaaban, M., 2015. Renewable Energy for Continuous Energy Sustainability in Malaysia. *Renewable and Sustainable Energy Reviews*, 50, pp.967−981.

Petit, E., Coppi, M.V., Hayes, J.C., Tolonen, A.C., Warnick, T., Latouf, W.G., Amisano, D., Biddle, A., Mukherjee, S., Ivanova, N., and Lykidis, A., 2015. Genome and Transcriptome of *Clostridium phytofermentans*, Catalyst for the Direct Conversion of Plant Feedstocks to Fuels. *PLoS One*, 10(6), p.e0118285.

Piemonte, V., Di Paola, L., Chakraborty, S., and Basile, A., 2014. Sequencing Batch Reactors (SBRs) for BioH_2 Production: Reactor Operation Criteria. *International Journal of Hydrogen Energy*, 39(10), pp.4863−4869.

Pham, T.H., Rabaey, K., Aelterman, P., Clauwaert, P., De Schamphelaire, L., Boon, N., and Verstraete, W., 2006. Microbial Fuel Cells in Relation to Conventional Anaerobic Digestion Technology. *Engineering in Life Sciences*, 6(3), pp.285−292.

Picioreanu, C., Head, I.M., Katuri, K.P., van Loosdrecht, M.C., and Scott, K., 2007. A Computational Model for Biofilm-Based Microbial Fuel Cells. *Water Research*, 41(13), pp.2921−2940.

Poh, P.E., Ong, W.Y.J., Lau, E.V., and Chong, M.N., 2014. Investigation on Micro-Bubble Flotation and Coagulation for the Treatment of Anaerobically Treated Palm Oil Mill Effluent (POME). *Journal of Environmental Chemical Engineering*, 2(2), pp.1174−1181.

Poku, K., 2002. Small-Scale Palm Oil Processing in Africa. *FAO Agricultural Services Bulletin*, 148, pp.56.

Pourmorad, F., Hosseinimehr, S.J., and Shahabimajd, N., 2006. Antioxidant Activity, Phenol and Flavonoid Contents of Some Selected Iranian Medicinal Plants. *African Journal of Biotechnology*, 5(11), pp.1142−1145.

Prakasham, R.S. and Kumar, B.S. 2019. Bacterial Metabolism−Coupled Energetics. In: Mohan, S.V., Varjani, S., and Pandey, A. (eds) *Microbial Electrochemical Technology*. Amsterdam, Netherlands: Elsevier.

Prasertsan, P., Sompong, O., and Birkeland, N.K., 2009. Optimization and Microbial Community Analysis for Production of Biohydrogen from Palm Oil Mill Effluent by Thermophilic Fermentative Process. *International Journal of Hydrogen Energy*, 34(17), pp.7448−7459.

Prowe, S.G. and Antranikian, G., 2001. *Anaerobranca gottschalkii* sp. nov., a Novel Thermoalkaliphilic Bacterium that Grows Anaerobically at High pH and Temperature. *International Journal of Systematic and Evolutionary Microbiology*, 51(2), pp.457−465.

Puah, C. and Choo, Y., 2008. Palm Biodiesel Development and Its Social and Environment Impacts in Malaysia. Paper presented at the *Policy Dialogue on Biofuels in Asia: Benefits and Challenges*, Beijing, China.

Purushothaman, M., Anderson, R., Narayana, S., and Jayaraman, V., 2001. Industrial Byproducts as Cheaper Medium Components Influencing the Production of Polyhydroxyalkanoates (PHA)−Biodegradable Plastics. *Bioprocess and Biosystems Engineering*, 24(3), pp.131−136.

Qiu, C., Shi, P., Xiao, S., and Sun, L., 2017. Effects of pH and Substrate Concentrations on Dark Fermentative Biohydrogen Production from Xylose by Extreme Thermophilic Mixed Culture. *World Journal of Microbiology and Biotechnology*, 33(1), p.7.

Qiu, C., Wen, J., and Jia, X., 2011. Extreme-Thermophilic Biohydrogen Production from Lignocellulosic Bioethanol Distillery Wastewater with Community Analysis of Hydrogen-Producing Microflora. *International Journal of Hydrogen Energy*, 36(14), pp.8243−8251.

Qiu, Y.L., Hanada, S., Ohashi, A., Harada, H., Kamagata, Y., and Sekiguchi, Y., 2008. *Syntrophorhabdus aromaticivorans* gen. nov., sp. nov., the First Cultured Anaerobe Capable of Degrading Phenol to Acetate in Obligate Syntrophic Associations with a Hydrogenotrophic Methanogen. *Applied and Environmental Microbiology*, 74(7), pp.2051−2058.

Quast, C., Pruesse, E., Yilmaz, P., Gerken, J., Schweer, T., Yarza, P., Peplies, J., and Glöckner, F.O., 2012. The SILVA Ribosomal RNA Gene Database Project: Improved Data Processing and Web-Based Tools. *Nucleic Acids Research*, 41(D1), pp.D590−D596.

Rabaey, K. and Rozendal, R.A., 2010. Microbial Electrosynthesis—Revisiting the Electrical Route for Microbial Production. *Nature Reviews Microbiology*, 8(10), pp.706−716.

Rabaey, K., Boon, N., Siciliano, S.D., Verhaege, M., and Verstraete, W., 2004. Biofuel Cells Select for Microbial Consortia That Self-Mediate Electron Transfer. *Applied and Environmental Microbiology*, 70(9), pp.5373−5382.

Raghavulu, S.V., Mohan, S.V., Goud, R.K., and Sarma, P.N., 2009. Effect of Anodic pH Microenvironment on Microbial Fuel Cell (MFC) Performance in Concurrence with Aerated and Ferricyanide Catholytes. *Electrochemistry Communications*, 11(2), pp.371−375.

Rahimnejad, M., Adhami, A., Darvari, S., Zirepour, A., and Oh, S.E., 2015. Microbial Fuel Cell as New Technology for Bioelectricity Generation: A Review. *Alexandria Engineering Journal*, 54(3), pp.745−756.

Rahman, S.N.A., Masdar, M.S., Rosli, M.I., Majlan, E.H., Husaini, T., Kamarudin, S.K., and Daud, W.R.W., 2016. Overview Biohydrogen Technologies and Application in Fuel Cell Technology. *Renewable and Sustainable Energy Reviews*, 66, pp.137−162.

Rai, P.K., Singh, S.P., and Asthana, R.K., 2012. Biohydrogen Production from Cheese Whey Wastewater in a Two-Step Anaerobic Process. *Applied Biochemistry and Biotechnology*, 167(6), pp.1540−1549.

Rajendhran, J. and Gunasekaran, P., 2011. Microbial Phylogeny and Diversity: Small Subunit Ribosomal RNA Sequence Analysis and Beyond. *Microbiological Research*, 166(2), pp.99−110.

Ramírez, M., Gómez, J.M., Aroca, G., and Cantero, D., 2009. Removal of Hydrogen Sulfide by Immobilized *Thiobacillus thioparus* in a Biotrickling Filter Packed with Polyurethane Foam. *Bioresource Technology*, 100(21), pp.4989−4995.

Ramírez-Morales, J.E., Tapia-Venegas, E., Campos, J.L., and Ruiz-Filippi, G., 2019. Operational Behavior of a Hydrogen Extractive Membrane Bioreactor (HEMB) during Mixed Culture Acidogenic Fermentation. *International Journal of Hydrogen Energy*, 44(47), pp.25565−25574.

Ramos, C., Buitrón, G., Moreno-Andrade, I., and Chamy, R., 2012. Effect of the Initial Total Solids Concentration and Initial pH on the Bio-Hydrogen Production from Cafeteria Food Waste. *International Journal of Hydrogen Energy*, 37(18), pp.13288−13295.

Ramos-Zúñiga, J., Gallardo, S., Martínez-Bussenius, C., Norambuena, R., Navarro, C.A., Paradela, A., and Jerez, C.A., 2019. Response of the Biomining *Acidithiobacillus ferrooxidans* to High Cadmium Concentrations. *Journal of Proteomics*, 198, pp.132−144.

Randhir, R., Lin, Y.T., and Shetty, K., 2004. Stimulation of Phenolics, Antioxidant and Antimicrobial Activities in Dark Germinated Mung Bean Sprouts in Response to Peptide and Phytochemical Elicitors. *Process Biochemistry*, 39(5), pp.637−646.

Randolph, K. and Studer, S., 2013. Biological Hydrogen Production Workshop Summary Report. *Proceedings from the Biological Hydrogen Production Workshop*. 24−25 Sept. National Renewable Energy Laboratory, Golden, CO, USA.

Rasdi, Z., Mumtaz, T., and Hassan, M.A., 2012. Kinetic Analysis of Biohydrogen Production from Anaerobically Treated POME in Bioreactor Under Optimized Condition. *International Journal of Hydrogen Energy*, 37(23), pp.17724−17730.

Rasdi, Z., Rahman, N.A.A., Abd-Aziz, S., Lai-Yee, P., Zulkhairi, M., Yusoff, M., Mei-Ling, C., and Ali Hassan, M., 2009. Statistical Optimization of Biohydrogen Production from Palm Oil Mill Effluent by Natural Microflora. *The Open Biotechnology Journal*, 3(1), pp.79−86.

Rass-Hansen, J., Falsig, H., Jørgensen, B., and Christensen, C.H., 2007. Bioethanol: Fuel or Feedstock?. *Journal of Chemical Technology and Biotechnology*, 82(4), pp.329−333.

Razak, C.N.A., Salleh, A.B., Musani, R., Samad, M.Y., and Basri, M., 1997. Some Characteristics of Lipases from Thermophilic Fungi Isolated from Palm Oil Mill Effluent. *Journal of Molecular Catalysis B: Enzymatic*, 3(1-4), pp.153−159.

Razak, M.N.A., Ibrahim, M.F., Yee, P.L., Hassan, M.A., and Abd-Aziz, S., 2012. Utilization of Oil Palm Decanter Cake for Cellulase and Polyoses Production. *Biotechnology and Bioprocess Engineering*, 17(3), pp.547−555.

Reginatto, V. and Antônio, R.V., 2015. Fermentative Hydrogen Production from Agroindustrial Lignocellulosic Substrates. *Brazilian Journal of Microbiology*, 46(2), pp.323−335.

Ren, L., Wu, Y., Ren, N., Zhang, K., and Xing, D., 2010. Microbial Community Structure in an Integrated A/O Reactor Treating Diluted Livestock Wastewater During Start-Up Period. *Journal of Environmental Sciences*, 22(5), pp.656−662.

Ren, N., Li, J., Li, B., Wang, Y., and Liu, S., 2006. Biohydrogen Production from Molasses by Anaerobic Fermentation with a Pilot-Scale Bioreactor System. *International Journal of Hydrogen Energy*, 31(15), pp.2147−2157.

Ren, N., Wang, A., Cao, G., Xu, J., and Gao, L., 2009. Bioconversion of Lignocellulosic Biomass to Hydrogen: Potential and Challenges. *Biotechnology Advances*, 27(6), pp.1051−1060.

Ren, N.Q. and Gong, M.L., 2006. Acclimation Strategy of a Biohydrogen Producing Population in a Continuous-Flow Reactor with Carbohydrate Fermentation. *Engineering in Life Sciences*, 6(4), pp.403−409.

Ren, N.Q., Chua, H., Chan, S.Y., Tsang, Y.F., Wang, Y.J., and Sin, N., 2007. Assessing Optimal Fermentation Type for Bio-Hydrogen Production in Continuous-Flow Acidogenic Reactors. *Bioresource Technology*, 98(9), pp.1774−1780.

Ren, N.Q., Guo, W.Q., Wang, X.J., Xiang, W.S., Liu, B.F., and Wang, X.Z., 2008. Effects of Different Pretreatment Methods on Fermentation Types and Dominant Bacteria for Hydrogen Production. *International Journal of Hydrogen Energy*, 33, pp.4318−4324.

Ren, Z., Ramasamy, R.P., Cloud-Owen, S.R., Yan, H., Mench, M.M., and Regan, J.M., 2011. Time-Course Correlation of Biofilm Properties and Electrochemical Performance in Single-Chamber Microbial Fuel Cells. *Bioresource Technology*, 102(1), pp.416−421.

Rezania, S., Md Din, M.F., Mat Taib, S., Sohaii, J., Chelliapan, S., Kamyab, H., and Saha, B.B., 2017. Review on Fermentative Biohydrogen Production from Water Hyacinth, Wheat Straw and Rice Straw with Focus on Recent Perspectives. *International Journal of Hydrogen Energy*, 42, pp.20955−20969.

Ringeisen, B.R., Ray, R., and Little, B., 2007. A Miniature Microbial Fuel Cell Operating with an Aerobic Anode Chamber. *Journal of Power Sources*, 165(2), pp.591−597.

Rivera, I., Buitrón, G., Bakonyi, P., Nemestóthy, N., and Bélafi-Bakó, K., 2015. Hydrogen Production in a Microbial Electrolysis Cell Fed with a Dark Fermentation Effluent. *Journal of Applied Electrochemistry*, 45(11), pp.1223−1229.

Rozendal, R.A., Hamelers, H.V., Molenkamp, R.J., and Buisman, C.J., 2007. Performance of Single Chamber Biocatalyzed Electrolysis with Different Types of Ion Exchange Membranes. *Water Research*, 41(9), pp.1984−1994.

Rozendal, R.A., Hamelers, H.V., Rabaey, K., Keller, J., and Buisman, C.J., 2008. Towards Practical Implementation of Bioelectrochemical Wastewater Treatment. *Trends in Biotechnology*, 26(8), pp.450−459.

Rozendal, R.A., Hamelers, H.V.M., and Buisman, C.J.N., 2006. Effects of Membrane Cation Transport on pH and Microbial Fuel Cell Performance. *Environmental Science and Technology*, 40(17), pp.5206−5211.

Ruggeri, B., Tommasi, T., and Sanfilippo, S., 2015. *BioH2 & BioCH4 Through Anaerobic Digestion: From Research to Full-Scale Applications*. London, UK: Springer-Verlag.

Rupani, P.F., Singh, R.P., Ibrahim, M.H., and Esa, N., 2010. Review of Current Palm Oil Mill Effluent (POME) Treatment Methods: Vermicomposting as a Sustainable Practice. *World Applied Sciences Journal*, 11(1), pp.70−81.

Rushdy, R., Reza, M., and Mckay, G., 2014. Combined Magnetic Field and Adsorption Process for Treatment of Biologically Treated Palm Oil Mill Effluent (POME). *Chemical Engineering Journal*, 243, pp.31−42.

Ryu, J.H., Lee, H.L., Lee, Y.P., Kim, T.S., Kim, M.K., Anh, D.T.N., Tran, H.T., and Ahn, D.H., 2013. Simultaneous Carbon and Nitrogen Removal from Piggery

Wastewater using Loop Configuration Microbial Fuel Cell. *Process Biochemistry*, 48(7), pp.1080−1085.

Sabiha-Hanim, S., Noor, M.A.M., and Rosma, A., 2011. Effect of Autohydrolysis and Enzymatic Treatment on Oil Palm (*Elaeis guineensis Jacq.*) Frond Fibres for Xylose and Xylooligosaccharides Production. *Bioresource Technology*, 102(2), pp.1234−1239.

Sagnak, R., Kargi, F., and Kapdan, I.K., 2011. Bio-hydrogen Production from Acid Hydrolyzed Waste Ground Wheat by Dark Fermentation. *International Journal of Hydrogen Energy*, 36(20), pp.12803−12809.

Saidur, R., Islam, M.R., Rahim, N.A., and Solangi, K.H., 2010. A Review on Global Wind Energy Policy. *Renewable and Sustainable Energy Reviews*, 14(7), pp.1744−1762.

Saitou, N. and Nei, M., 1987. The Neighbor-Joining Method: A New Method for Reconstructing Phylogenetic Trees. *Molecular Biology and Evolution*, 4(4), pp.406−425.

Santoro, C., Arbizzani, C., Erable, B., and Ieropoulos, I., 2017. Microbial Fuel Cells: From Fundamentals to Applications. A Review. *Journal of Power Sources*, 356, pp.225−244.

Saratale, G.D., Chen, S.D., Lo, Y.C., Saratale, R.G., and Chang, J.S., 2008. Outlook of Biohydrogen Production from Lignocellulosic Feedstock using Dark Fermentation—A Review. *Journal of Scientific and Industrial Research*, 67, pp.962−979.

Sarma, S., Dubey, V.K., and Moholkar, V.S., 2016. Kinetic and Thermodynamic Analysis (with Statistical Optimization) of Hydrogen Production from Crude Glycerol using *Clostridium pasteurianum*. *International Journal of Hydrogen Energy*, 41(44), pp.19972−19989.

SAS, R.A., 2004. *Conductivity Theory and Practice*. France: Radiometer Analytics SAS.

Sathish-Kumar, K., Solorza-Feria, O., Vázquez-Huerta, G., Luna-Arias, J.P., and Poggi-Varaldo, H.M., 2012. Electrical Stress-Directed Evolution of Biocatalysts Community Sampled from a Sodic-Saline Soil for Microbial Fuel Cells. *Journal of New Materials for Electrochemical Systems*, 15(3), pp.181−186.

Schiel-Bengelsdorf, B. and Dürre, P., 2012. Pathway Engineering and Synthetic Biology using Acetogens. *FEBS Letters*, 586(15), pp.2191−2198.

Schloss, P.D., Gevers, D., and Westcott, S.L., 2011. Reducing the Effects of PCR Amplification and Sequencing Artifacts on 16S rRNA-Based Studies. *PloS One*, 6(12), p.e27310.

Schröder, U., Harnisch, F., and Angenent, L.T., 2015. Microbial Electrochemistry and Technology: Terminology and Classification. *Energy & Environmental Science*, 8(2), pp.513−519.

Sciarria, T.P., Merlino, G., Scaglia, B., D'Epifanio, A., Mecheri, B., Borin, S., Licoccia, S., and Adani, F., 2015. Electricity Generation using White and Red Wine Lees in Air Cathode Microbial Fuel Cells. *Journal of Power Sources*, 274, pp.393−399.

Searmsirimongkol, P., Rangsunvigit, P., Leethochawalit, M., and Chavadej, S., 2011. Hydrogen Production from Alcohol Distillery Wastewater Containing High Potassium and Sulfate using an Anaerobic Sequencing Batch Reactor. *International Journal of Hydrogen Energy*, 36(20), pp.12810−12821.

SEDA., 2013. *Annual Report 2013 Sustainable Energy Development Authority Malaysia*. Putrajaya, Malaysia: Sustainable Energy Development Authority Malaysia.

Sedaqatvand, R., Esfahany, M.N., Behzad, T., Mohseni, M., and Mardanpour, M.M., 2013. Parameter Estimation and Characterization of a Single-Chamber Microbial Fuel Cell for Dairy Wastewater Treatment. *Bioresource Technology*, 146, pp.247−253.

Seifert, K., Waligorska, M., and Laniecki, M., 2010a. Hydrogen Generation in Photobiological Process from Dairy Wastewater. *International Journal of Hydrogen Energy*, 35(18), pp.9624−9629.

Seifert, K., Waligorska, M., and Laniecki, M., 2010b. Brewery Wastewaters in Photobiological Hydrogen Generation in Presence of *Rhodobacter sphaeroides* OU 001. *International Journal of Hydrogen Energy*, 35(9), pp.4085−4091.

Sekar, N. and Ramasamy, R.P., 2013. Electrochemical Impedance Spectroscopy for Microbial Fuel Cell Characterization. *Journal of Microbial and Biochemical Technology*, 5(S6), pp.001−004.

Sekoai, P.T., Ayeni, A.O., and Daramola, M.O., 2017. Parametric Optimization of Biohydrogen Production from Potato Waste and Scale-Up Study using Immobilized Anaerobic Mixed Sludge. *Waste and Biomass Valorization*, pp.1−13.

Sekoai, P.T., Yoro, K.O., Bodunrin, M.O., Ayeni, A.O., and Daramola, M.O., 2018. Integrated System Approach to Dark Fermentative Biohydrogen Production for Enhanced Yield, Energy Efficiency and Substrate Recovery. *Reviews in Environmental Science and Bio/Technology*, 17(3), pp.501−529.

Selembo, P.A., Merrill, M.D., and Logan, B.E., 2009. The Use of Stainless Steel and Nickel Alloys as Low-Cost Cathodes in Microbial Electrolysis Cells. *Journal of Power Sources*, 190(2), pp.271−278.

Sen, B. and Suttar, R.R., 2012. Mesophilic Fermentative Hydrogen Production from Sago Starch-Processing Wastewater using Enriched Mixed Cultures. *International Journal of Hydrogen Energy*, 37(20), pp.15588−15597.

Sen, U., Shakdwipee, M., and Banerjee, R., 2008. Status of Biological Hydrogen Production. *Journal of Scientific and Industrial Research*, 67, pp.980−993.

Seol, E., Jang, Y., Kim, S., Oh, Y.K., and Park, S., 2012. Engineering of Formate-Hydrogen Lyase Gene Cluster for Improved Hydrogen Production in *Escherichia coli*. *International Journal of Hydrogen Energy*, 37(20), pp.15045−15051.

Seppälä, J.J., Puhakka, J.A., Yli-Harja, O., Karp, M.T., and Santala, V., 2011. Fermentative Hydrogen Production by *Clostridium butyricum* and *Escherichia coli* in Pure and Cocultures. *International Journal of Hydrogen Energy*, 36(17), pp.10701−10708.

Sevda, S. and Sreekrishnan, T.R., 2012. Effect of Salt Concentration and Mediators in Salt Bridge Microbial Fuel Cell for Electricity Generation from Synthetic Wastewater. *Journal of Environmental Science and Health, Part A*, 47(6), pp.878−886.

Shafie, S.M., Mahlia, T.M.I., Masjuki, H.H., and Ahmad-Yazid, A., 2012. A Review on Electricity Generation Based on Biomass Residue in Malaysia. *Renewable and Sustainable Energy Reviews*, 16(8), pp.5879−5889.

Shafie, S.M., Mahlia, T.M.I., Masjuki, H.H., and Andriyana, A., 2011. Current Energy Usage and Sustainable Energy in Malaysia: A Review. *Renewable and Sustainable Energy Reviews*, 15(9), pp.4370−4377.

Shafiee, S. and Topal, E., 2009. When Will Fossil Fuel Reserves be Diminished?. *Energy Policy*, 37(1), pp.181−189.

Shahrifun, N.S.A., Ab'lah, N.N., Hussain, H., Aris, A., Omar, Q., and Ahmad, N., 2015. Characterization of Palm Oil Mill Secondary Effluent (POMSE). *Malaysian Journal of Civil Engineering*, 27(1), pp.144−151.

Shaikh, P.H., Nor, N.B.M., Sahito, A.A., Nallagownden, P., Elamvazuthi, I., and Shaikh, M.S., 2017. Building Energy for Sustainable Development in Malaysia: A Review. *Renewable and Sustainable Energy Reviews*, 75, pp.1392−1403.

Shak, K.P.Y. and Wu, T.Y., 2015. Optimized Use of Alum Together with Unmodified *Cassia obtusifolia* Seed Gum as a Coagulant Aid in Treatment of Palm Oil Mill Effluent Under Natural pH of Wastewater. *Industrial Crops and Products*, 76, pp.1169−1178.

Shanks, O.C., Newton, R.J., Kelty, C.A., Huse, S.M., Sogin, M.L., and McLellan, S.L., 2013. Comparison of the Microbial Community Structures of Untreated Wastewaters from Different Geographic Locales. *Applied and Environmental Microbiology*, 79(9), pp.2906−2913.

Shanmugam, S.R., Chaganti, S.R., Lalman, J.A., and Heath, D., 2014. Using a Statistical Approach to Model Hydrogen Production from a Steam Exploded Corn Stalk Hydrolysate Fed to Mixed Anaerobic Cultures in an ASBR. *International Journal of Hydrogen Energy*, 39(19), pp.10003−10015.

Shao, X., Peng, D., Teng, Z., and Ju, X., 2008. Treatment of Brewery Wastewater using Anaerobic Sequencing Batch Reactor (ASBR). *Bioresource Technology*, 99(8), pp.3182−3186.

Sharma, S., Basu, S., Shetti, N.P., and Aminabhavi, T.M., 2020. Waste-to-Energy Nexus for Circular Economy and Environmental Protection: Recent Trends in Hydrogen Energy. *Science of The Total Environment*, 713, p.136633.

Sharma, V. and Kundu, P.P., 2010. Biocatalysts in Microbial Fuel Cells. *Enzyme and Microbial Technology*, 47(5), pp.179−188.

Sharon, I., and Banfield, J.F., 2013. Genomes from Metagenomics. *Science*, 342(6162), pp.1057−1058.

Shaw, A.J., Covalla, S.F., Hogsett, D.A., and Herring, C.D., 2011. Marker Removal System for *Thermoanaerobacterium saccharolyticum* and Development of a Markerless Ethanologen. *Applied Microbiology and Biotechnology*, 77(7), pp.2534−2536.

Shekarchian, M., Moghavvemi, M., Mahlia, T.M.I., and Mazandarani, A., 2011. A Review on The Pattern of Electricity Generation and Emission in Malaysia from 1976 to 2008. *Renewable and Sustainable Energy Reviews*, 15(6), pp.2629−2642.

Shen, H.B., Yong, X.Y., Chen, Y.L., Liao, Z.H., Si, R.W., Zhou, J., Wang, S.Y., Yong, Y.C., OuYang, P.K., and Zheng, T., 2014. Enhanced Bioelectricity Generation by Improving Pyocyanin Production and Membrane Permeability Through Sophorolipid Addition in *Pseudomonas aeruginosa*-Inoculated Microbial Fuel Cells. *Bioresource Technology*, 167, pp.490−494.

Shen, L., Bagley, D.M., and Liss, S.N., 2009. Effect of Organic Loading Rate on Fermentative Hydrogen Production from Continuous Stirred Tank and Membrane Bioreactors. *International Journal of Hydrogen Energy*, 34(9), pp.3689−3696.

Sheth, P.N. and Babu, B.V., 2010. Production of Hydrogen Energy through Biomass (Waste Wood) Gasification. *International Journal of Hydrogen Energy,* 35(19), pp.10803−10810.

Shevade, V.S. and Loboda, T.V., 2019. Oil Palm Plantations in Peninsular Malaysia: Determinants and Constraints on Expansion. *PLoS One*, 14(2), p.e0210628.

Shi, X.Y., Jin, D.W., Sun, Q.Y., and Li, W.W., 2010. Optimization of Conditions for Hydrogen Production from Brewery Wastewater by Anaerobic Sludge using Desirability Function Approach. *Renewable Energy*, 35(7), pp.1493−1498.

Shi, Y., Ge, Y., Chang, J., Shao, H., and Tang, Y., 2013. Garden Waste Biomass for Renewable and Sustainable Energy Production in China: Potential, Challenges and Development. *Renewable and Sustainable Energy Reviews*, 22, pp.432−437.

Shima, S., Pilak, O., Vogt, S., Schick, M., Stagni, M.S., Meyer-Klaucke, W., Warkentin, E., Thauer, R.K., and Ermler, U., 2008. The Crystal Structure of [Fe]-Hydrogenase Reveals the Geometry of the Active Site. *Science,* 321(5888), pp.572−575.

Shobana, S., Kumar, G., Bakonyi, P., Saratale, G.D., Nemestóthy, N., Bélafi-Bakó, K., Xia, A., and Chang, J.S., 2017. A Review on the Biomass Pretreatment and Inhibitor Removal Methods as Key-Steps towards Efficient Macroalgae-Based Biohydrogen Production. *Bioresource Technology*, 244, pp.1341−1348.

Show, K.Y., Lee, D.J., and Chang, J.S., 2011. Bioreactor and Process Design for Biohydrogen Production. *Bioresource Technology*, 102(18), pp.8524−8533.

Show, K.Y., Lee, D.J., Tay, J.H., Lin, C.Y., and Chang, J.S., 2012. Biohydrogen Production: Current Perspectives and the Way Forward. *International Journal of Hydrogen Energy*, 37(20), pp.15616−15631.

Show, K.Y., Zhang, Z.P., Tay, J.H., Liang, D.T., Lee, D.J., and Jiang, W.J., 2007. Production of Hydrogen in a Granular Sludge-Based Anaerobic Continuous Stirred Tank Reactor. *International Journal of Hydrogen Energy,* 32(18), pp.4744−4753.

Si, B., Liu, Z., Zhang, Y., Li, J., Xing, X.H., Li, B., Duan, N., and Lu, H., 2015. Effect of Reaction Mode on Biohydrogen Production and Its Microbial Diversity. *International Journal of Hydrogen Energy*, 40(8), pp.3191−3200.

Siddique, B.M., Ahmad, A., Ibrahim, M.H., Hena, S., and Rafatullah, M., 2010. Physico-Chemical Properties of Blends of Palm Olein with Other Vegetable Oils. *Grasas y Aceites*, 61(4), pp.423−429.

Sindhuja, M., Harinipriya, S., Bala, A.C., and Ray, A.K., 2018. Environmentally Available Biowastes as Substrate in Microbial Fuel Cell for Efficient Chromium Reduction. *Journal of Hazardous Materials,* 355, pp.197−205.

Singh, A., Yadav, A., and Bishnoi, N. R., 2013. Statistical Screening and Optimization of Process Variables for Xylanase Production Utilizing Alkali-Pretreated Rice Husk. *Annals of Microbiology*, 63, pp.353−361.

Singh, B.K., Bardgett, R.D., Smith, P., and Reay, D.S., 2010. Microorganisms and Climate Change: Terrestrial Feedbacks and Mitigation Options. *Nature Reviews Microbiology*, 8(11), pp.779−790.

Singh, B.R. and Singh, O., 2012. *Global Trends of Fossil Fuel Reserves and Climate Change in the 21st Century*. In S. Khan (ed.) *Fossil Fuel and the Environment*. London, UK: InTechOpen.

Singhania, R.R., Patel, A.K., Christophe, G., Fontanille, P., and Larroche, C., 2013. Biological Upgrading of Volatile Fatty Acids, Key Intermediates for The

Valorization of Biowaste Through Dark Anaerobic Fermentation. *Bioresource Technology*, 145, pp.166−174.

Sinha, P. and Pandey, A., 2011. An Evaluative Report and Challenges for Fermentative Biohydrogen Production. *International Journal of Hydrogen Energy*, 36(13), pp.7460−7478.

Sinnaraprasat, S. and Fongsatitkul, P., 2011. Optimal Condition of Fenton's Reagent to Enhance the Alcohol Production from Palm Oil Mill Effluent (POME). *Environment Asia*, 4(2), pp.9−16.

Sivagurunathan, P., Sen, B., and Lin, C.Y., 2014. Batch Fermentative Hydrogen Production by Enriched Mixed Culture: Combination Strategy and Their Microbial Composition. *Journal of Bioscience and Bioengineering*, 117(2), pp.222−228.

Sivagurunathan, P., Anburajan, P., Kumar, G., and Kim, S.H., 2016b. Effect of Hydraulic Retention Time (HRT) on Biohydrogen Production from Galactose in an Up-Flow Anaerobic Sludge Blanket Reactor. *International Journal of Hydrogen Energy*, 41(46), pp.21670−21677.

Sivagurunathan, P., Kumar, G., Bakonyi, P., Kim, S.H., Kobayashi, T., Xu, K.Q., Lakner, G., Tóth, G., Nemestóthy, N., and Bélafi-Bakó, K., 2016a. A Critical Review on Issues and Overcoming Strategies for the Enhancement of Dark Fermentative Hydrogen Production in Continuous Systems. *International Journal of Hydrogen Energy*, 41(6), pp.3820−3836.

Sivagurunathan, P. and Lin, C.Y., 2019. Biohydrogen Production From Beverage Wastewater using Selectively Enriched Mixed Culture. *Waste and Biomass Valorization*, pp.1−10.

Sivaramakrishna, D., Sreekanth, D., Himabindu, V., and Anjaneyulu, Y., 2009. Biological Hydrogen Production from Probiotic Wastewater as Substrate by Selectively Enriched Anaerobic Mixed Microflora. *Renewable Energy*, 34(3), pp.937−940.

Sleutels, T.H.J.A., Darus, L., Hamelers, H.V., and Buisman, C.J., 2011. Effect of Operational Parameters on Coulombic Efficiency in Bioelectrochemical Systems. *Bioresource Technology*, 102(24), pp.11172−11176.

Soetaert, W. and Vandamme, E.J., 2009. Biofuels in Perspective. *Biofuels*, pp.1−8.

Sompong, O., Prasertsan, P., and Birkeland, N.K., 2009. Evaluation of Methods for Preparing Hydrogen-Producing Seed Inocula Under Thermophilic Condition by Process Performance and Microbial Community Analysis. Bioresource Technology, 100, pp.909−918.

Sopian, K., Othman, M.H., and Wirsat, A., 1995. The Wind Energy Potential of Malaysia. *Renewable Energy*, 6(8), pp.1005−1016.

Sovacool, B.K. and Drupady, I.M., 2011. Examining the Small Renewable Energy Power (SREP) Program in Malaysia. *Energy Policy*, 39(11), pp.7244−7256.

Sreela-Or, C., Imai, T., Plangklang, P., and Reungsang, A., 2011a. Optimization of Key Factors Affecting Hydrogen Production from Food Waste by Anaerobic Mixed Cultures. *International Journal of Hydrogen Energy*, 36(21), pp.14120−14133.

Sreela-Or, C., Plangklang, P., Imai, T., and Reungsang, A., 2011b. Co-Digestion of Food Waste and Sludge for Hydrogen Production by Anaerobic Mixed Cultures: Statistical Key Factors Optimization. *International Journal of Hydrogen Energy*, 36(21), pp.14227−14237.

Srikanth, S., Mohan, S.V., Devi, M.P., Peri, D., and Sarma, P.N., 2009. Acetate and Butyrate as Substrates for Hydrogen Production Through Photo-Fermentation:

Process Optimization and Combined Performance Evaluation. *International Journal of Hydrogen Energy*, 34(17), pp.7513−7522.

Srirugsa, T., Prasertsan, S., Theppaya, T., Leevijit, T., and Prasertsan, P., 2019. Appropriate Mixing Speeds of Rushton Turbine for Biohydrogen Production from Palm Oil Mill Effluent in a Continuous Stirred Tank Reactor. *Energy*, 179, pp.823−830.

Stamatelatou, K., Dravillas, K., and Lyberatos, G., 2003. Methane Production from Sweet Sorghum Residues via a Two-Stage Process. *Water Science and Technology*, 48(4), pp.235−238.

Steffan, R.J., Goksøyr, J., Bej, A.K., and Atlas, R.M., 1988. Recovery of DNA from Soils and Sediments. *Applied and Environmental Microbiology*, 54(12), pp.2908−2915.

Strous, M., Heijnen, J.J., Kuenen, J.G., and Jetten, M.S.M., 1998. The Sequencing Batch Reactor as a Powerful Tool for the Study of Slowly Growing Anaerobic Ammonium-Oxidizing Microorganisms. *Applied Microbiology and Biotechnology*, 50(5), pp.589−596.

Su, H., Cheng, J., Zhou, J., Song, W., and Cen, K., 2009. Combination of Dark-and Photo-Fermentation to Enhance Hydrogen Production and Energy Conversion Efficiency. *International Journal of Hydrogen Energy*, 34(21), pp.8846−8853.

Su, W., Zhang, L., Li, D., Zhan, G., Qian, J., and Tao, Y., 2012. Dissimilatory Nitrate Reduction by *Pseudomonas alcaliphila* with an Electrode as the Sole Electron Donor. *Biotechnology and Bioengineering*, 109(11), pp.2904−2910.

Subha, C., Kavitha, S., Abisheka, S., Tamilarasan, K., Arulazhagan, P., and Banu, J.R., 2019. Bioelectricity Generation and Effect Studies from Organic Rich Chocolaterie Wastewater using Continuous Upflow Anaerobic Microbial Fuel Cell. *Fuel*, 251, pp.224−232.

Sulaiman, F., Abdullah, N., Gerhauser, H., and Shariff, A., 2011. An Outlook of Malaysian Energy, Oil Palm Industry and Its Utilization of Wastes as Useful Resources. *Biomass and Bioenergy*, 35(9), pp.3775−3786.

Sun, M., Sheng, G.P., Zhang, L., Xia, C.R., Mu, Z.X., Liu, X.W., Wang, H.L., Yu, H.Q., Qi, R., Yu, T., and Yang, M., 2008. An MEC−MFC−Coupled System for Biohydrogen Production from Acetate. *Environmental Science & Technology*, 42(21), pp.8095−8100.

Sun, Y., Liao, Q., Huang, Y., Xia, A., Fu, Q., Zhu, X., and Zheng, Y., 2016. Integrating Planar Waveguides Doped with Light Scattering Nanoparticles into a Flat-Plate Photobioreactor to Improve Light Distribution and Microalgae Growth. *Bioresource Technology*, 220, pp.215−224.

Suriyamongkol, P., Weselake, R., Narine, S., Moloney, M., and Shah, S., 2007. Biotechnological Approaches for the Production of Polyhydroxyalkanoates in Microorganisms and Plants—A Review. *Biotechnology Advances*, 25(2), pp.148−175.

Taha, M.R., and Ibrahim, A.H., 2014. COD Removal from Anaerobically Treated Palm Oil Mill Effluent (AT-POME) via Aerated Heterogeneous Fenton Process: Optimization Study. *Journal of Water Process Engineering*, 1, pp.8−16.

Tai, J., Adav, S.S., Su, A., and Lee, D.J., 2010. Biological Hydrogen Production from Phenol-Containing Wastewater using *Clostridium butyricum*. *International Journal of Hydrogen Energy*, 35(24), pp.13345−13349.

Takabatake, H., Suzuki, K., Ko, I.B., and Noike, T., 2004. Characteristics of Anaerobic Ammonia Removal by a Mixed Culture of Hydrogen Producing Photosynthetic Bacteria. *Bioresource Technology*, 95(2), pp.151−158.

Takahashi, S., Tomita, J., Nishioka, K., Hisada, T., and Nishijima, M., 2014. Development of a Prokaryotic Universal Primer for Simultaneous Analysis of Bacteria and Archaea using Next-Generation Sequencing. *PloS One*, 9(8), p.e105592.

Takai, K., Moser, D.P., Onstott, T.C., Spoelstra, N., Pfiffner, S.M., Dohnalkova, A., and Fredrickson, J.K., 2001. *Alkaliphilus transvaalensis* gen. nov., sp. nov., an Extremely Alkaliphilic Bacterium Isolated from a Deep South African Gold Mine. *International Journal of Systematic and Evolutionary Microbiology*, 51(4), pp.1245−1256.

Tamura, K., Peterson, D., Peterson, N., Stecher, G., Nei, M., and Kumar, S., 2011. MEGA5: Molecular Evolutionary Genetics Analysis using Maximum Likelihood, Evolutionary Distance, and Maximum Parsimony Methods. *Molecular Biology and Evolution*, 28(10), pp.2731−2739.

Tan, A.T.H., 2008. The Security of the ASEAN Energy Supply Chain. *Seminar on Sustainable Development and Energy Security*. 22−23 April. Singapore, pp.18−22.

Tan, Y.D. and Lim, J.S., 2019. Feasibility of Palm Oil Mill Effluent Elimination towards Sustainable Malaysian Palm Oil Industry. *Renewable and Sustainable Energy Reviews*, 111, pp.507−522.

Tang, C.F., 2008. A Re-Examination of The Relationship Between Electricity Consumption and Economic Growth in Malaysia. *Energy Policy*, 36(8), pp.3077−3085.

Tang, K., Jiao, N., Liu, K., Zhang, Y., and Li, S., 2012. Distribution and Functions of TonB-Dependent Transporters in Marine Bacteria and Environments: Implications for Dissolved Organic Matter Utilization. *PloS One*, 7(7), p.e41204.

Tapia-Venegas, E., Ramirez-Morales, J.E., Silva-Illanes, F., Toledo-Alarcón, J., Paillet, F., Escudie, R., Lay, C.H., Chu, C.Y., Leu, H.J., Marone, A., and Lin, C.Y., 2015. Biohydrogen Production by Dark Fermentation: Scaling-Up and Technologies Integration for a Sustainable System. *Reviews in Environmental Science and Bio/Technology*, 14(4), pp.761−785.

Tarley, C.R.T., Silveira, G., dos Santos, W.N.L., Matos, G.D., da Silva, E.G.P., Bezerra, M.A., Miró, M., and Ferreira, S.L.C., 2009. Chemometric Tools in Electroanalytical Chemistry: Methods for Optimization Based on Factorial Design and Response Surface Methodology. *Microchemical Journal*, 92(1), pp.58−67.

Tartakovsky, B., Manuel, M.F., Wang, H., and Guiot, S.R., 2009. High Rate Membrane-less Microbial Electrolysis Cell for Continuous Hydrogen Production. *International Journal of Hydrogen Energy*, 34(2), pp.672−677.

Tomazetto, G., Hahnke, S., Wibberg, D., Pühler, A., Klocke, M., and Schlüter, A., 2018. *Proteiniphilum saccharofermentans* str. M3/6T Isolated from a Laboratory Biogas Reactor is Versatile in Polysaccharide and Oligopeptide Utilization as Deduced from Genome-Based Metabolic Reconstructions. *Biotechnology Reports*, 18, p.e00254.

Tomei, M.C., Annesini, M.C., Rita, S., and Daugulis, A.J., 2008. Biodegradation of 4-Nitrophenol in a Two-Phase Sequencing Batch Reactor: Concept

Demonstration, Kinetics and Modelling. *Applied Microbiology and Biotechnology*, 80(6), pp.1105−1112.

Tsai, Y.L. and Olson, B.H., 1992. Detection of Low Numbers of Bacterial Cells in Soils and Sediments by Polymerase Chain Reaction. *Applied and Environmental Microbiology*, 58(2), pp.754−757.

Tukey, J.W., 1970. *Exploratory Data Analysis* (Limited Preliminary ed.) Reading, MA, USA: Addison-Wesley Publishing Company.

Tyagi, V.K., Campoy, R.A., Álvarez-Gallego, C.J., and García, L.R., 2014. Enhancement in Hydrogen Production by Thermophilic Anaerobic Co-Digestion of Organic Fraction of Municipal Solid Waste and Sewage Sludge—Optimization of Treatment Conditions. *Bioresource Technology*, 164, pp.408−415.

Umar, M.S., Jennings, P., and Urmee, T., 2013. Strengthening the Palm Oil Biomass Renewable Energy Industry in Malaysia. *Renewable Energy*, 60, pp.107−115.

Valdez-Vazquez, I., Ríos-Leal, E., Esparza-García, F., Cecchi, F., and Poggi-Varaldo, H.M., 2005. Semi-Continuous Solid Substrate Anaerobic Reactors for H_2 Production from Organic Waste: Mesophilic Versus Thermophilic Regime. *International Journal of Hydrogen Energy*, 30(13−14), pp.1383−1391.

Valdez-Vazquez, I., Sparling, R., Risbey, D., Rinderknecht-Seijas, N., and Poggi-Varaldo, H.M., 2005. Hydrogen Generation Via Anaerobic Fermentation of Paper Mill Wastes. *Bioresource Technology*, 96(17), pp.1907−1913.

van Ginkel, S.W., and Logan, B.E., 2005. Inhibition of Biohydrogen Production by Undissociated Acetic and Butyric Acids. *Environmental Science & Technology*, 39(23), pp.9351−9356.

van Ginkel, S.W., Oh, S.E., and Logan, B.E., 2005. Biohydrogen Gas Production from Food Processing and Domestic Wastewaters. *International Journal of Hydrogen Energy*, 30(15), pp.1535−1542.

van Ginkel, S.W., Sung, S., and Lay, J.J., 2001. Biohydrogen Production as a Function of pH and Substrate Concentration. *Environmental Science & Technology*, 35(24), pp.4726−4730.

van Niel, E.W., Claassen, P.A., and Stams, A.J., 2003. Substrate and Product Inhibition of Hydrogen Production by the Extreme Thermophile, *Caldicellulosiruptor saccharolyticus*. *Biotechnology and Bioengineering*, 81(3), pp.255−262.

Vatsala, T.M., Raj, S.M., and Manimaran, A., 2008. A Pilot-Scale Study of Biohydrogen Production from Distillery Effluent using Defined Bacterial Co-Culture. *International Journal of Hydrogen Energy*, 33(20), pp.5404−5415.

Veit, A., Akhtar, M.K., Mizutani, T., and Jones, P.R., 2008. Constructing and Testing the Thermodynamic Limits of Synthetic NAD(P)H:H_2 Pathways. *Microbial Biotechnology*, 1(5), pp.382−394.

Verea, L., Savadogo, O., Verde, A., Campos, J., Ginez, F., and Sebastian, P.J., 2014. Performance of a Microbial Electrolysis Cell (MEC) for Hydrogen Production with a New Process for the Biofilm Formation. *International Journal of Hydrogen Energy*, 39(17), pp.8938−8946.

Verhelst, S. and Wallner, T., 2009. Hydrogen-Fueled Internal Combustion Engines. *Progress in Energy and Combustion Science*, 35(6), pp.490−527.

Vierheilig, J., Savio, D., Ley, R.E., Mach, R.L., Farnleitner, A.H., and Reischer, G.H., 2015. Potential Applications of Next Generation DNA Sequencing of 16S rRNA Gene Amplicons in Microbial Water Quality Monitoring. *Water Science and Technology*, 72(11), pp.1962−1972.

Vijayaraghavan, K. and Ahmad, D., 2006. Biohydrogen Generation from Palm Oil Mill Effluent using Anaerobic Contact Filter. *International Journal of Hydrogen Energy*, 31(10), pp.1284−1291.

Villano, M., Aulenta, F., Beccari, M., and Majone, M., 2012. Start-Up and Performance of an Activated Sludge Bioanode in Microbial Electrolysis Cells. *Chemical Engineering Transactions*, 27, pp.109−114.

Virdis, B., Rabaey, K., Rozendal, R.A., Yuan, Z., and Keller, J., 2010. Simultaneous Nitrification, Denitrification and Carbon Removal in Microbial Fuel Cells. *Water Research*, 44(9), pp.2970−2980.

Wahid, Z. and Nadir, N., 2013. Improvement of One Factor at a Time Through Design of Experiments. *World Applied Sciences Journal*, 21, pp.56−61.

Wang, B., Wan, W., and Wang, J., 2009. Effect of Ammonia Concentration on Fermentative Hydrogen Production by Mixed Cultures. *Bioresource Technology*, 100(3), pp.1211−1213.

Wang, H., Jiang, S.C., Wang, Y., and Xiao, B., 2013. Substrate Removal and Electricity Generation in a Membrane-Less Microbial Fuel Cell for Biological Treatment of Wastewater. *Bioresource Technology*, 138, pp.109−116.

Wang, J. and Wan, W., 2008a. Comparison of Different Pretreatment Methods for Enriching Hydrogen-Producing Bacteria from Digested Sludge. *International Journal of Hydrogen Energy*, 33, pp.2934−2941.

Wang, J. and Wan, W., 2008b. Effect of Temperature on Fermentative Hydrogen Production by Mixed Cultures. *International Journal of Hydrogen Energy,* 33(20), pp.5392−5397.

Wang, J. and Wan, W., 2008c. Optimization of Fermentative Hydrogen Production Process by Response Surface Methodology. *International Journal of Hydrogen Energy*, 33(23), pp.6976−6984.

Wang, J. and Wan, W., 2008d. The Effect of Substrate Concentration on Biohydrogen Production by using Kinetic Models. *Science in China Series B: Chemistry,* 51(11), pp.1110−1117.

Wang, J. and Wan, W., 2009a. Experimental Design Methods for Fermentative Hydrogen Production: A Review. *International Journal of Hydrogen Energy,* 34(1), pp.235−244.

Wang, J. and Wan, W., 2009b. Factors Influencing Fermentative Hydrogen Production: A Review. *International Journal of Hydrogen Energy*, 34, pp.799−811.

Wang, J. and Wan, W., 2011. Combined Effects of Temperature and pH on Biohydrogen Production by Anaerobic Digested Sludge. *Biomass and Bioenergy*, 35(9), pp.3896−3901.

Wang, J. and Yin, Y., 2017. Principle and Application of Different Pretreatment Methods for Enriching Hydrogen-Producing Bacteria from Mixed Cultures. *International Journal of Hydrogen Energy*, 42(8), pp.4804−4823.

Wang, A., Ren, N., Shi, Y., and Lee, D.J., 2008. Bioaugmented Hydrogen Production from Microcrystalline Cellulose using Co-Culture—*Clostridium acetobutylicum* X9 and *Ethanoigenens harbinense* B49. *International Journal of Hydrogen Energy*, 33(2), pp.912−917.

Wang, A., Sun, D., Cao, G., Wang, H., Ren, N., Wu, W.M., and Logan, B.E., 2011. Integrated Hydrogen Production Process from Cellulose by Combining Dark Fermentation, Microbial Fuel Cells, and a Microbial Electrolysis Cell. *Bioresource Technology*, 102(5), pp.4137−4143.

Wang, L., Zhou, Q., and Li, F.T., 2006. Avoiding Propionic Acid Accumulation in the Anaerobic Process for Biohydrogen Production. *Biomass and Bioenergy,* 30(2), pp.177−182.

Wang, L., Wu, Y., Zheng, Y., Liu, L., and Zhao, F., 2015. Efficient Degradation of Sulfamethoxazole and the Response of Microbial Communities in Microbial Fuel Cells. *RSC Advances*, 5(69), pp.56430−56437.

Wang, Q., Garrity, G.M., Tiedje, J.M., and Cole, J.R., 2007. Naive Bayesian Classifier for Rapid Assignment of rRNA Sequences into the New Bacterial Taxonomy. *Applied and Environmental Microbiology*, 73(16), pp.5261−5267.

Wang, X., Feng, Y.J., and Lee, H., 2008. Electricity Production from Beer Brewery Wastewater using Single Chamber Microbial Fuel Cell. *Water Science and Technology*, 57(7), pp.1117−1121.

Ward, B., 2015. Bacterial Energy Metabolism. In: Tang, Y.W., Sussman, M., Liu, D., Poxton, I., and Schwartzman, J. (eds) *Molecular Medical Microbiology* (2nd ed). London: Academic Press.

Weiland, P., 2010. Biogas Production: Current State and Perspectives. *Applied Microbiology and Biotechnology*, 85(4), pp.849−860.

Wen, Q., Wu, Y., Zhao, L.X., Sun, Q., and Kong, F.Y., 2010. Electricity Generation and Brewery Wastewater Treatment from Sequential Anode-Cathode Microbial Fuel Cell. *Journal of Zhejiang University SCIENCE B*, 11(2), pp.87−93.

WHO., 2003. Ammonia in Drinking Water. *World Health Organization*. Retrieved 15 December 2017, from http://www.who.int/water_sanitation_health/dwq/ammonia.pdf

Wimonsong, P. and Nitisoravut, S., 2009. Pretreatment Evaluation and Its Application on Palm Oil Mill Effluent for Bio-Hydrogen Enhancement and Methanogenic Activity Repression. *Pakistan Journal of Biological Sciences*, 12(16), pp.1127−1133.

Wingren, A., Galbe, M., and Zacchi, G., 2003. Techno-Economic Evaluation of Producing Ethanol from Softwood: Comparison of SSF and SHF and Identification of Bottlenecks. *Biotechnology Progress*, 19(4), pp.1109−1117.

Wong, S.L., Ngadi, N., Abdullah, T.A.T., and Inuwa, I.M., 2015. Recent Advances of Feed-In Tariff in Malaysia. *Renewable and Sustainable Energy Reviews*, 41, pp.42−52.

Wong, Y.M., Wu, T.Y., and Juan, J.C., 2014. A Review of Sustainable Hydrogen Production using Seed Sludge via Dark Fermentation. *Renewable and Sustainable Energy Review*, 34, pp.471−482.

Wooley, J.C., Godzik, A., and Friedberg, I., 2010. A Primer on Metagenomics. *PLoS Computational Biology*, 6(2), p.e1000667.

Wrana, N., Sparling, R., Cicek, N., and Levin, D.B., 2010. Hydrogen Gas Production in a Microbial Electrolysis Cell by Electrohydrogenesis. *Journal of Cleaner Production*, 18, pp.S105−S111.

Wright, E.S., Yilmaz, L.S., and Noguera, D.R., 2012. DECIPHER, A Search-Based Approach to Chimera Identification for 16S rRNA Sequences. *Applied and Environmental Microbiology*, 78(3), pp.717−725.

Wu, J.H. and Lin, C.Y., 2004. Biohydrogen Production by Mesophilic Fermentation of Food Wastewater. *Water Science and Technology*, 49(5−6), pp.223−228.

Wu, S.Y., Hung, C.H., Lin, C.N., Chen, H.W., Lee, A.S., and Chang, J.S., 2006a. Fermentative Hydrogen Production and Bacterial Community Structure in

High-Rate Anaerobic Bioreactors Containing Silicone-Immobilized and Self-Flocculated Sludge. *Biotechnology and Bioengineering*, 93(5), pp.934−946.

Wu, S.Y., Hung, C.H., Lin, C.Y., Lin, P.J., Lee, K.S., Lin, C.N., Chang, F.Y., and Chang, J.S., 2008. HRT-Dependent Hydrogen Production and Bacterial Community Structure of Mixed Anaerobic Microflora in Suspended, Granular and Immobilized Sludge Systems using Glucose as the Carbon Substrate. *International Journal of Hydrogen Energy*, 33(5), pp.1542−1549.

Wu, T., Zhu, G., Jha, A.K., Zou, R., Liu, L., Huang, X., and Liu, C., 2013. Hydrogen Production with Effluent from an Anaerobic Baffled Reactor (ABR) using a Single-Chamber Microbial Electrolysis Cell (MEC). *International Journal of Hydrogen Energy*, 38(25), pp.11117−11123.

Wu, T.Y., Mohammad, A.W., Jahim, J.M., and Anuar, N., 2005. Penghasilan Asid Itakonik oleh *Aspergillus terreus* IMI 282743 Dalam Pelbagai Jenis Medium Penghasilan. *Pascasidang Kolokium Jabatan Kejuruteraan Kimia dan Proses*. Selangor, Malaysia, pp.147−151.

Wu, T.Y., Mohammad, A.W., Jahim, J.M., and Anuar, N., 2006b. Investigations on Protease Production by a Wild-Type *Aspergillus terreus* Strain using Diluted Retentate of Pre-Filtered Palm Oil Mill Effluent (POME) as Substrate. *Enzyme and Microbial Technology*, 39(6), pp.1223−1229.

Wu, T.Y., Mohammad, A.W., Jahim, J.M., and Anuar, N., 2007. Palm Oil Mill Effluent (POME) Treatment and Bioresources Recovery using Ultrafiltration Membrane: Effect of Pressure on Membrane Fouling. *Biochemical Engineering Journal*, 35(3), pp.309−317.

Wu, T.Y., Mohammad, A.W., Jahim, J.M., and Anuar, N., 2009. A Holistic Approach to Managing Palm Oil Mill Effluent (POME): Biotechnological Advances in the Sustainable Reuse of POME. *Biotechnology Advances*, 27(1), pp.40−52.

Wu, T.Y., Mohammad, A.W., Jahim, J.M., and Anuar, N., 2010. Pollution Control Technologies for the Treatment of Palm Oil Mill Effluent (POME) Through End-Of-Pipe Processes. *Journal of Environmental Management*, 91(7), pp.1467−1490.

Xia, C., Zhang, D., Pedrycz, W., Zhu, Y., and Guo, Y., 2018. Models for Microbial Fuel Cells: A Critical Review. *Journal of Power Sources*, 373, pp.119−131.

Xiao, L., Deng, Z., Fung, K.Y., and Ng, K.M. 2013. Biohydrogen Generation from Anaerobic Digestion of Food Waste. *International Journal of Hydrogen Energy*, 38(32), pp.13907−13913.

Xiao, Q., Lim, L.T., and Tong, Q., 2012. Properties of Pullulan-Based Blend Films as Affected by Alginate Content and Relative Humidity. *Carbohydrate Polymers*, 87(1), pp.227−234.

Xie, L., Liu, H., Chen, Y.G., and Zhou, Q., 2014. pH-Adjustment Strategy for Volatile Fatty Acid Production from High-Strength Wastewater for Biological Nutrient Removal. *Water Science and Technology*, 69(10), pp.2043−2051.

Xing, D., Ren, N., Wang, A., Li, Q., Feng, Y., and Ma, F., 2008. Continuous Hydrogen Production of Auto-Aggregative *Ethanoligenens harbinense* YUAN-3 under Non-Sterile Condition. *International Journal of Hydrogen Energy*, 33(5), pp.1489−1495.

Yacob, S., Hassan, M.A., Shirai, Y., Wakisaka, M., and Subash, S., 2005. Baseline Study of Methane Emission from Open Digesting Tanks of Palm Oil Mill Effluent Treatment. *Chemosphere*, 59(11), pp.1575−1581.

Yacob, S., Hassan, M.A., Shirai, Y., Wakisaka, M., and Subash, S., 2006. Baseline Study of Methane Emission from Anaerobic Ponds of Palm Oil Mill Effluent Treatment. *Science of the Total Environment*, 366(1), pp.187−196.

Yamada, H., Tanaka, R., Sulaiman, O., Hashim, R., Hamid, Z.A.A., Yahya, M.K.A., Kosugi, A., Arai, T., Murata, Y., Nirasawa, S., Yamamoto, K., Ohara, S., Nor, M.Y.M., Ibrahim, W.A., and Mori, Y., 2010. Old Oil Palm Trunk: A Promising Source of Sugars for Bioethanol Production. *Biomass and Bioenergy*, 34(11), pp.1608−1613.

Yang, H., Shao, P., Lu, T., Shen, J., Wang, D., Xu, Z., and Yuan, X., 2006. Continuous Biohydrogen Production from Citric Acid Wastewater Via Facultative Anaerobic Bacteria. *International Journal of Hydrogen Energy*, 31(10), pp.1306−1313.

Yang, P., Zhang, R., McGarvey, J.A., and Benemann, J.R., 2007. Biohydrogen Production from Cheese Processing Wastewater by Anaerobic Fermentation using Mixed Microbial Communities. *International Journal of Hydrogen Energy*, 32(18), pp.4761−4771.

Yang, T., Li, K., Pu, L., Liu, Z., Ge, B., Pan, Y., and Liu, Y., 2016. Hollow-Spherical Co/NC Nanoparticle as an Efficient Electrocatalyst Used in Air Cathode Microbial Fuel Cell. *Biosensors and Bioelectronics*, 86, pp.129−134.

Yang, X., Choi, H.S., Park, C., and Kim, S.W., 2015. Current States and Prospects of Organic Waste Utilization for Biorefineries. *Renewable and Sustainable Energy Reviews*, 49, pp.335−349.

Yasin, M.H., Mamat, R., Najafi, G., Ali, O.M., Yusop, A.F., and Ali, M.H., 2017. Potentials of Palm Oil as New Feedstock Oil for a Global Alternative Fuel: A Review. *Renewable and Sustainable Energy Review*, 79, pp.1034−1049.

Yasin, N.H., Man, H.C., Yusoff, M.Z.M., and Hassan, M.A., 2011. Microbial Characterization of Hydrogen-Producing Bacteria in Fermented Food Waste at Different pH Values. *International Journal of Hydrogen Energy*, 36(16), pp.9571−9580.

Yatim, P., Mamat, M.N., Mohamad-Zailani, S.H., and Ramlee, S., 2016. Energy Policy Shifts Towards Sustainable Energy Future for Malaysia. *Clean Technologies and Environmental Policy*, 18(6), pp.1685−1695.

Ye, L., Shao, M.F., Zhang, T., Tong, A.H.Y., and Lok, S., 2011. Analysis of the Bacterial Community in a Laboratory-Scale Nitrification Reactor and a Wastewater Treatment Plant by 454-Pyrosequencing. *Water Research*, 45(15), pp.4390−4398.

Yeates, C., Gillings, M.R., Davison, A.D., Altavilla, N., and Veal, D.A., 1998. Methods for Microbial DNA Extraction from Soil for PCR Amplification. *Biological Procedures Online*, 1(1), p.40−47.

Yin, Q., Yang, S., Wang, Z., Xing, L., and Wu, G., 2018. Clarifying Electron Transfer and Metagenomic Analysis of Microbial Community in the Methane Production Process with the Addition of Ferroferric Oxide. *Chemical Engineering Journal*, 333, pp.216−225.

Yin, Y., Hu, J., and Wang, J., 2014. Enriching Hydrogen-Producing Bacteria from Digested Sludge by Different Pretreatment Methods. *International Journal of Hydrogen Energy*, 39(25), pp.13550−13556.

Yin, Y. and Wang, J., 2016a. Changes in Microbial Community During Biohydrogen Production using Gamma Irradiated Sludge as Inoculum. *Bioresource Technology*, 200, pp.217−222.

Yin, Y. and Wang, J., 2016b. Characterization and Hydrogen Production Performance of a Novel Strain *Enterococcus faecium* INET2 Isolated from Gamma Irradiated Sludge. *International Journal of Hydrogen Energy*, 41(48), pp.22793−22801.

Yokoi, H., Maki, R., Hirose, J., and Hayashi, S., 2002. Microbial Production of Hydrogen from Starch-Manufacturing Wastes. *Biomass and Bioenergy*, 22(5), pp.389−395.

Yokoi, H., Saitsu, A., Uchida, H., Hirose, J., Hayashi, S., and Takasaki, Y., 2001. Microbial Hydrogen Production from Sweet Potato Starch Residue. *Journal of Bioscience and Bioengineering*, 91(1), pp.58−63.

Yokoyama, H., Moriya, N., Ohmori, H., Waki, M., Ogino, A., and Tanaka, Y., 2007b. Community Analysis of Hydrogen-Producing Extreme Thermophilic Anaerobic Microflora Enriched from Cow Manure with Five Substrates. *Applied Microbiology and Biotechnology*, 77(1), pp.213−222.

Yokoyama, H., Ohmori, H., Waki, M., Ogino, A., and Tanaka, Y., 2009. Continuous Hydrogen Production from Glucose by using Extreme Thermophilic Anaerobic Microflora. *Journal of Bioscience and Bioengineering*, 107(1), pp.64−66.

Yokoyama, H., Waki, M., Moriya, N., Yasuda, T., Tanaka, Y., and Haga, K., 2007a. Effect of Fermentation Temperature on Hydrogen Production from Cow Waste Slurry by using Anaerobic Microflora within the Slurry. *Applied Microbiology and Biotechnology*, 74(2), pp.474−483.

Yossan, S., Sompong, O., and Prasertsan, P., 2012. Effect of Initial pH, Nutrients and Temperature on Hydrogen Production from Palm Oil Mill Effluent using Thermotolerant Consortia and Corresponding Microbial Communities. *International Journal of Hydrogen Energy*, 37(18), pp.13806−13814.

Yu, H., Zhu, Z., Hu, W., and Zhang, H., 2002. Hydrogen Production from Rice Winery Wastewater in an Upflow Anaerobic Reactor by using Mixed Anaerobic Cultures. *International Journal of Hydrogen Energy*, 27(11−12), pp.1359−1365.

Yu, H.Q. and Mu, Y., 2006. Biological Hydrogen Production in a UASB Reactor with Granules. II: Reactor Performance in 3-Year Operation. *Biotechnology and Bioengineering*, 94(5), pp.988−995.

Yu, H.Q., Zheng, X.J., Hu, Z.H., and Gu, G.W., 2003. High-Rate Anaerobic Hydrolysis and Acidogenesis of Sewage Sludge in a Modified Upflow Reactor. *Water Science and Technology*, 48(4), pp.69−75.

Yu, J., Seon, J., Park, Y., Cho, S., and Lee, T., 2012. Electricity Generation and Microbial Community in a Submerged-Exchangeable Microbial Fuel Cell System for Low-Strength Domestic Wastewater Treatment. *Bioresource Technology*, 117, pp.172−179.

Yuan, Y., Zhao, B., Zhou, S., Zhong, S., and Zhuang, L., 2011. Electrocatalytic Activity of Anodic Biofilm Responses to pH Changes in Microbial Fuel Cells. *Bioresource Technology*, 102(13), pp.6887−6891.

Yusof, M.Y.M. 2010. Terengganu at the Forefront of Pioneering Hybrid Electricity Supply. *Tenaga Link*, 1, pp.18−19.

Yusof, Z.A. and Bhattasali, D., 2008. *Economic Growth and Development in Malaysia: Policy Making and Leadership*. Washington, DC, USA: The International Bank for Reconstruction and Development/The World Bank.

Yusoff, M.Z.M., Hassan, M.A., Abd-Aziz, S., and Rahman, N.A.A., 2009. Start-Up of Biohydrogen Production from Palm Oil Mill Effluent Under Non-Sterile

Condition in 50 L Continuous Stirred Tank Reactor. *International Journal of Agricultural Research*, 4(4), pp.163−168.

Yusoff, S. 2006. Renewable Energy from Palm Oil—Innovation on Effective Utilization of Waste. *Journal of Cleaner Production*, 14(1), pp.87−93.

Yusoff, S. and Hansen, S.B., 2007. Feasibility Study of Performing an Life Cycle Assessment on Crude Palm Oil Production in Malaysia. *International Journal of Life Cycle Assessment*, 12(1), pp.50−58.

Zahrim, A.Y., Nasimah, A., and Hilal, N., 2014. Pollutants Analysis during Conventional Palm Oil Mill Effluent (POME) Ponding System and Decolourisation of Anaerobically Treated POME via Calcium Lactate-Polyacrylamide. *Journal of Water Process Engineering*, 4, pp.159−165.

Zainal, B.S., Zinatizadeh, A.A., Chyuan, O.H., Mohd, N.S., and Ibrahim, S., 2018. Effects of Process, Operational and Environmental Variables on Biohydrogen Production using Palm Oil Mill Effluent (POME). *International Journal of Hydrogen Energy*, 43(23), pp.10637−10644.

Zanirun, Z., Bahrin, E.K., Lai-Yee, P., Hassan, M.A., and Abd-Aziz, S., 2014. Effect of Physical and Chemical Properties of Oil Palm Empty Fruit Bunch, Decanter Cake and Sago Pith Residue on Cellulases Production by *Trichoderma asperellum* UPM1 and *Aspergillus fumigatus* UPM2. *Applied Biochemistry and Biotechnology*, 172(1), pp.423−435.

Zavarzina, D.G., Tourova, T.P., Kolganova, T.V., Boulygina, E.S., and Zhilina, T.N., 2009. Description of *Anaerobacillus alkalilacustre* gen. nov., sp. nov−Strictly Anaerobic Diazotrophic Bacillus Isolated from Soda Lake and Transfer of *Bacillus arseniciselenatis*, *Bacillus macyae*, and *Bacillus alkalidiazotrophicus* to *Anaerobacillus* as the New Combinations *A. arseniciselenatis* comb. nov., *A. macyae* comb. nov., and *A. alkalidiazotrophicus* comb. nov. *Microbiology*, 78(6), pp.723−731.

Zhang, B., Zhang, L.L., Zhang, S.C., Shi, H.Z., and Cai, W.M., 2005. The Influence of pH on Hydrolysis and Acidogenesis of Kitchen Wastes in Two-Phase Anaerobic Digestion. *Environmental Technology*, 26(3), pp.329−340.

Zhang, B., Zhao, H., Zhou, S., Shi, C., Wang, C., and Ni, J., 2009. A Novel UASB–MFC–BAF Integrated System for High Strength Molasses Wastewater Treatment and Bioelectricity Generation. *Bioresource Technology*, 100(23), pp.5687−5693.

Zhang, G., Zhang, H., Zhang, C., Zhang, G., Yang, F., Yuan, G., and Gao, F., 2013. Simultaneous Nitrogen and Carbon Removal in a Single Chamber Microbial Fuel Cell with a Rotating Biocathode. *Process Biochemistry*, 48(5−6), pp.893−900.

Zhang, H., Bruns, M.A., and Logan, B.E., 2006b. Biological Hydrogen Production by *Clostridium acetobutylicum* in an Unsaturated Flow Reactor. *Water Research*, 40(4), pp.728−734.

Zhang, J.J., Li, X.Y., Oh, S.E., and Logan, B.E., 2004. Physical and Hydrodynamic Properties of Flocs Produced During Biological Hydrogen Production. *Biotechnology and Bioengineering*, 88(7), pp.854−860.

Zhang, J.N., Li, Y.H., Zheng, H.Q., Fan, Y.T., and Hou, H.W., 2015. Direct Degradation of Cellulosic Biomass to Bio-Hydrogen from a Newly Isolated Strain *Clostridium sartagoforme* FZ11. *Bioresource Technology,* 192, pp.60−67.

Zhang, M.L., Fan, Y.T., Xing, Y., Pan, C.M., Zhang, G.S., and Lay, J.J., 2007b. Enhanced Biohydrogen Production from Cornstalk Wastes with Acidification

Pretreatment by Mixed Anaerobic Cultures. *Biomass and Bioenergy*, 31(4), pp.250−254.

Zhang, T., Cui, C., Chen, S., Yang, H., and Shen, P. 2008b. The Direct Electrocatalysis of *Escherichia coli* Through Electroactivated Excretion in Microbial Fuel Cell. *Electrochemistry Communications*, 10(2), pp.293−297.

Zhang, T., Gannon, S.M., Nevin, K.P., Franks, A.E., and Lovley, D.R., 2010. Stimulating the Anaerobic Degradation of Aromatic Hydrocarbons in Contaminated Sediments by Providing an Electrode as the Electron Acceptor. *Environmental Microbiology*, 12(4), pp.1011−1020.

Zhang, T., Liu, H., and Fang, H.H., 2003. Biohydrogen Production from Starch in Wastewater Under Thermophilic Condition. *Journal of Environmental Management*, 69(2), pp.149−156.

Zhang, Y., Noori, J.S., and Angelidaki, I., 2011. Simultaneous Organic Carbon, Nutrients Removal and Energy Production in a Photomicrobial Fuel Cell (PFC). *Energy & Environmental Science*, 4(10), pp.4340−4346.

Zhang, Z.P., Show, K.Y., Tay, J.H., Liang, D.T., and Lee, D.J., 2007a. Biohydrogen Production with Anaerobic Fluidized Bed Reactors—A Comparison of Biofilm-Based and Granule-Based Systems. *International Journal of Hydrogen Energy*, 33(5), pp.1559−1564.

Zhang, Z.P., Show, K.Y., Tay, J.H., Liang, D.T., Lee, D.J., and Jiang, W.J., 2006a. Effect of Hydraulic Retention Time on Biohydrogen Production and Anaerobic Microbial Community. *Process Biochemistry*, 41(10), pp.2118−2123.

Zhang, Z.P., Show, K.Y., Tay, J.H., Liang, D.T., Lee, D.J., and Jiang, W.J., 2007c. Rapid Formation of Hydrogen-Producing Granules in an Anaerobic Continuous Stirred Tank Reactor Induced by Acid Incubation. *Biotechnology and Bioengineering*, 96(6), pp.1040−1050.

Zhang, L., Zhou, S., Zhuang, L., Li, W., Zhang, J., Lu, N., and Deng, L., 2008a. Microbial Fuel Cell Based on *Klebsiella pneumoniae* Biofilm. *Electrochemistry Communications*, 10(10), pp.1641−1643.

Zhao, B.H., Yue, Z.B., Zhao, Q.B., Mu, Y., Yu, H.Q., Harada, H., and Li, Y.Y., 2008a. Optimization of Hydrogen Production in a Granule-Based UASB Reactor. *International Journal of Hydrogen Energy*, 33(10), pp.2454−2461.

Zhao, C., Sompong, O., Karakashev, D., Angelidaki, I., Lu, W., and Wang, H., 2009. High Yield Simultaneous Hydrogen and Ethanol Production Under Extreme-Thermophilic (70°C) Mixed Culture Environment. *International Journal of Hydrogen Energy*, 34(14), pp.5657−5665.

Zhao, S., Deng, L., Hu, N., Zhao, B., and Liang, Y., 2008b. Cost-Effective Production of *Bacillus licheniformis* using Simple Netting Bag Solid Bioreactor. *World Journal of Microbiology and Biotechnology*, 24(12), pp.2859−2863.

Zhao, X., Xing, D., Fu, N., Liu, B., and Ren, N., 2011. Hydrogen Production by the Newly Isolated *Clostridium* beijerinckii RZF-1108. *Bioresource Technology*, 102(18), pp.8432−8436.

Zhen, G., Lu, X., Kumar, G., Bakonyi, P., Xu, K., and Zhao, Y., 2017. Microbial Electrolysis Cell Platform for Simultaneous Waste Biorefinery and Clean Electrofuels Generation: Current Situation, Challenges and Future Perspectives. *Progress in Energy and Combustion Science*, 63, pp.119−145.

Zheng, G.H., Wang, L., and Kang, Z.H., 2010. Feasibility of Biohydrogen Production from Tofu Wastewater with Glutamine Auxotrophic Mutant of *Rhodobacter sphaeroides*. *Renewable Energy*, 35(12), pp.2910−2913.

Zheng, S., Yang, F., Chen, S., Liu, L., Xiong, Q., Yu, T., Zhao, F., Schröder, U., and Hou, H., 2015. Binder-Free Carbon Black/Stainless Steel Mesh Composite Electrode for High-Performance Anode in Microbial Fuel Cells. Journal of Power Sources, 284, pp.252−257.

Zheng, X.J. and Yu, H.Q., 2005. Inhibitory Effects of Butyrate on Biological Hydrogen Production with Mixed Anaerobic Cultures. *Journal of Environmental Management*, 74(1), pp.65−70.

Zhou, M., Chi, M., Luo, J., He, H., and Jin, T., 2011. An Overview of Electrode Materials in Microbial Fuel Cells. *Journal of Power Sources*, 196(10), pp.4427−4435.

Zhu, H., Parker, W., Basnar, R., Proracki, A., Falletta, P., Béland, M., and Seto, P., 2009. Buffer Requirements for Enhanced Hydrogen Production in Acidogenic Digestion of Food Wastes. *Bioresource Technology*, 100(21), pp.5097−5102.

Zhu, H., Ueda, S., Asada, Y., and Miyake, J., 2002. Hydrogen Production as a Novel Process of Wastewater Treatment—Studies on Tofu Wastewater with Entrapped *R. sphaeroides* and Mutagenesis. *International Journal of Hydrogen Energy*, 27(11-12), pp.1349−1357.

Zhu, H., Wakayama, T., Asada, Y., and Miyake, J., 2001. Hydrogen Production by Four Cultures with Participation by Anoxygenic Phototrophic Bacterium and Anaerobic Bacterium in the Presence of NH_4^+. *International Journal of Hydrogen Energy*, 26(11), pp.1149−1154.

Zhu, H.G. and Beland, M., 2006. Evaluation of Alternative Methods of Preparing Hydrogen Producing Seeds from Digested Wastewater Sludge. *International Journal of Hydrogen Energy*, 31, pp.1980−1988.

Zhu, Z., Shi, J., Zhou, Z., Hu, F., and Bao, J., 2010. Photo-Fermentation of *Rhodobacter sphaeroides* for Hydrogen Production using Lignocellulose-Derived Organic Acids. *Process Biochemistry*, 45(12), pp.1894−1898.

Zinatizadeh, A.A., Mirghorayshi, M., Birgani, P.M., Mohammadi, P., and Ibrahim, S., 2017. Influence of Thermal and Chemical Pretreatment on Structural Stability of Granular Sludge for High-Rate Hydrogen Production in an UASB Bioreactor. *International Journal of Hydrogen Energy*, 42(32), pp.20512−20519.

Zuo, Y., Xing, D., Regan, J.M., and Logan, B.E., 2008. Isolation of the Exoelectrogenic Bacterium *Ochrobactrum anthropi* YZ-1 by using a U-Tube Microbial Fuel Cell. *Applied and Environmental Microbiology*, 74(10), pp.3130−3137.

Züttel, A., Borgschulte, A., and Schlapbach, L., 2008. Hydrogen as a Future Energy Carrier. *Environmental Engineering and Management Journal*, 7(3), pp.343−344.