STUDIO LEGALE CATELLI

Avv. Vittorio G. Catelli

Avv. Laura Mossenta
Dott. Tommaso Mancini

Segreteria:
Cinzia Campagnoni

A mani

Bologna, 28 marzo 2008

Pregg.mi Signori
Marco Astorri
Guy Cicognani
BIO-ON s.r.l.
via Dante n. 7/b
San Giorgio di Piano
40016 - Bologna -

Oggetto: ***BIO-ON s.r.l.: originale Research Agreement University of Hawaii.***

Carissimi Marco e Guy,

unitamente alla presente sono a consegnarVi l'originale del *Research Agreement* debitamente sottoscritto dall'Università delle Hawaii.

Buon lavoro e un caro saluto.

Vittorio

VGC/cc

All.: come nel testo.

Bologna, viale Ercolani n. 3, 40138 Tel. 051.237973 Fax 051.6568357 *e-mail*: studio@studiocatelli.it
C.F.: CTL VTR 65 C 21 L 219 P P.I. 04199230378

RESEARCH AGREEMENT

with object

Research Project
titled
"Bioplastics Production from Sugar Manufacturing Waste"

by and between

BIO-ON s.r.l.

and

UNIVERSITY OF HAWAII

signed

on February, 8th 2008 (Bio-ON s.r.l.)

and 19 FEB 2008 (University of Hawaii)

Index

Disclaimer for accessing sensitive documents

This document contains, in whole or in part, sensitive information, personal data, confidential information, and/or material protected by intellectual property rights.

For this reason, the document is not publicly available in its entirety. Some pages have been made available solely to provide an initial overview of the document and its contents, while the remaining sections are not available for public consultation because they contain information subject to confidentiality, privacy, or other legal restrictions.

The restriction on public access does not prevent the provision, where possible and in compliance with the rights of the individuals and entities concerned and with any applicable confidentiality obligations, of information that may be relevant to journalistic work, research, or further investigation.

Journalists, researchers, and other professionals interested in reviewing the document may contact the “Exploring the BIO-ON Case” team at capirebioon@gmail.com, stating the purpose of their request and, where possible, the specific information they are seeking.

Each request will be considered individually, taking into account the nature of the information contained in the document, intellectual property rights, and any confidentiality obligations or other restrictions that may apply to its disclosure.

15. <u>Description of this Agreement.</u>

15.1. The present Agreement, drawn up and signed in two originals, one for each of the Party, is composed of n. 15 articles and n. 16 pages, excluding the Attachments.

15.2. There are two Attachments that are identified with the numbers "1" and "2".

In Witness Whereof, the parties have caused this Agreement to be executed by their duly authorized representatives.

BIO-ON s.r.l.

C.E.O
Marco Astorri

08/02/2008
Date

bio-on s.r.l.
via dante 7/b
40016 San Giorgio di Piano
BOLOGNA-ITA
p.iva c.f.: 02740251208
www.bio-on.it

UNIVERSITY OF HAWAII

Director
Richard Cox

19 FEB 2008
Date

READ AND ACKNOWLEDGED

Jian Yu, Ph.D.

20 Feb 2008
Date

The present Agreement, its content, the terms and conditions established and the Attachment are confidential and secret to the extent allowed under applicable law.

ATTACHMENT 1

RESEARCH PROJECT

A PROPOSAL

SUBMITTED BY

UNIVERSITY OF HAWAII

TO:	Bio-On, Bologna, Italy
PROJECT TITLE:	*Bioplastics Production from Sugar Manufacturing Waste*
PRINCIPAL INVESTIGATOR:	Dr. Jian Yu
DEPARTMENT:	Hawaii Natural Energy Institute
PROJECT PERIOD:	March 1, 2008 – February 28, 2010
AMOUNT REQUESTED:	US$389,161
AUTHORIZING UNIVERSITY OFFICIAL:	Richard H Cox DATE: 19 FEB 2008

Richard Cox
Director of OTTED

ADDRESS:

University of Hawaii
Office of Technology Transfer and
Economic Development
Manoa Innovation Center
2800 Woodlawn Drive, Suite 280
Honolulu, HI 96822

Contents

Synopsis

Polyhydroxyalkanoates (PHAs) are eco-friendly bioplastics that can be produced from renewable feedstocks including organic residues and wastes from industries. New technologies developed by PI at the University of Hawaii could significantly reduce the production cost of PHA bioplastics in comparison with conventional technologies that use glucose or starch. Sugar beet pulp and molasses are the residues from sugar manufacturing and could be used for PHA production with a high yield based on preliminary tests. We propose further research and development at UH to commercialize this technology by Bio-on in Italy and Europe. The goal of this project is to build up a pre-industrial pilot plant with a PHA fermentation capacity of 1,000 liters in two years including one year for construction. We will conduct experiments in the laboratory to find the optimal PHA production conditions on sugar beet pulp. We will then design the pilot plant and provide consulting service during the period of plant construction. In addition, we will also investigate cost effective PHA production on molasses and make the necessary process modification. The proposal is prepared for a fixed price research contract. The proposed R&D shall make the technology transfer and commercialization a great success.

1. Project background

Petrochemical plastics derived from fossil fuels are widely used in daily lives. With increased concerns on global warming, peak oil, environmental pollution and municipal solid waste management, bioplastics derived from renewable resources have attracted great interest in academic research and industrial commercialization. Polyhydroxyalkanoates (PHA) are a family of polyesters synthesized and accumulated by some microbial species as intracellular carbon and energy reserves. Fig. 1 shows PHA granules accumulated in the cells of a soil bacterium, *Ralstonia eutropha*, under an electronic microscope. PHA biopolymers are synthesized and decomposed completely via microbial activities, but can be melted and molded like conventional thermoplastics. They are eco-friendly bioplastics.

Fig. 1. White PHA granules accumulated in *R. eutropha* cells under a transmission electron microscope (University of Hawaii)

Industrial production of PHA bioplastics via microbial fermentation, however, is dragged by their high production cost, including the costs of raw materials (e.g. pure sugar and organic acids), high density microbial fermentation, polymer recovery and purification, and waste treatment and disposal. It has been recognized for long time that the high price of PHA is a major barrier for the bioplastics to be widely accepted in markets. For example, in a recent conference[1], Tianan Biologic Material Co. China, a major PHA supplier in the current global market with a capacity of 1,000 metric tons PHA per year, released the lowest PHA price of US$4.4/kg. A joint venture of two US companies (ADM and Metabolix Inc.), a potential leading supplier in global PHA market, is building a first full scale commercial plant of 50,000 tons PHA per year (http://www.metabolix.com). Their target PHA price is US$2.5/lb as released in the same meeting[1].

Dr. Jian Yu, the principal investigator at the University of Hawaii, has been engaged in PHA research for more than 12 years and published more than 28 articles in peer-reviewed scientific journals, books, conference proceedings, and patents plus numerous conference presentations and seminars (see Appendix). In brief, his group has developed innovative technologies to produce PHA bioplastics in a more cost effective way. The innovation and breakthroughs include (a) using cheap raw materials such as organic wastes from food processing, (b) effective bioreactor for microbial growth and PHA synthesis, (c) solvent-free recovery and purification of PHA biopolymers, and (d) recycle and reuse of cell debris, a major waste stream from PHA production. Fig. 2 gives a schematic process flow sheet and the four breakthroughs of PHA production from a cheap and complicated feedstock.

[1] International Symposium on Polymers and the Environment: Emerging Technology and Science, Oct. 17-20, 2007, Vancouver, Washington, USA

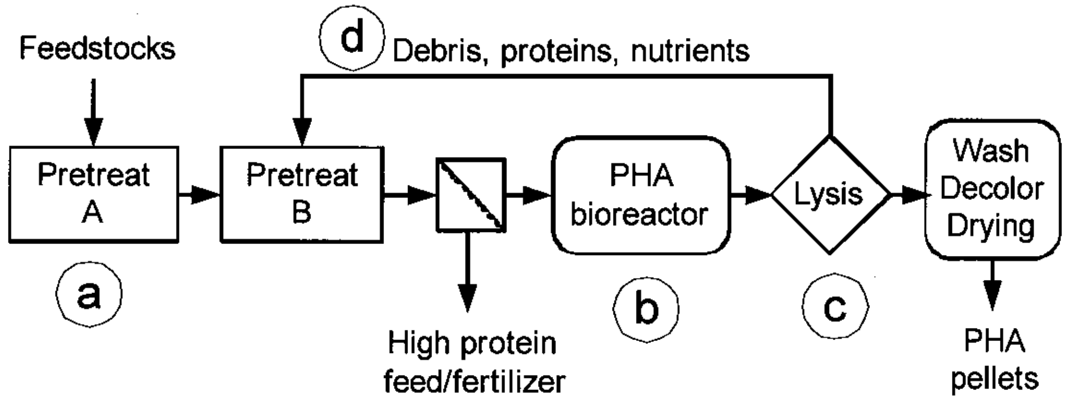

Fig. 2. Schematic process flow sheet and four major breakthroughs of PHA production via microbial fermentation on renewable feedstocks. The co-product could be a high protein animal feed or soil conditioner depending on the feedstocks.

Sugar manufacturing from sugar beet or sugar cane generates a large amount of organic residues such as pulp and molasses. They have a high solid content with a substantial amount of sucrose. Traditionally, they are sold at low price as animal feed or feedstocks for ethanol and yeast fermentation. At the request from Bio-on, the PI has tested two samples of sugar beet pulp and molasses for production of PHA bioplastics in the laboratory. The results are very promising. PHA biopolymers of high molecular weight (MW 1,000-2,000 kDa) were produced from both sugar pulp and molasses. With appropriate cost effective pretreatment, the pulp can give a quite high PHA yield and polymer content in cell mass (0.35 g PHA/g sugar and 60% w/w), in comparison with glucose. In addition, we were able to produce ductile PHA plastics by co-fermentation of pulp and an organic acid with high yield and polymer content. Further investigation is needed for optimization of the process conditions that are essential to designing a pre-industrial pilot plant. On the other hand, molasses contains a relatively high non-sugar solids (>40% wt) and possible inhibitive substances. Its pretreatment technology needs to be further developed for commercial production of PHA. Based on the promising results from the preliminary tests, we propose to optimize the production conditions of PHA from pulp, design a pre-industrial plant with a PHA fermentation capacity of 1,000 liters, and continue the research on sugar beet molasses as a potential feedstock.

2. Project objectives

The proposed project has four objectives. They are:

- o **Objective 1**. Optimizing PHA production conditions on sugar beet pulp as the feedstock.
- o **Objective 2.** Designing a pre-industrial pilot plant with a PHA fermentation capacity of 1,000 liters based on the optimized conditions
- o **Objective 3.** Providing consulting and training service during the engineering design and construction of the pilot plant in Italy.
- o **Objective 4.** Investigating cost effective production of PHA on sugar beet molasses and find the optimal process conditions.

3. Tasks and approaches

According to the project objectives, we have identified corresponding tasks and approaches. They are described as follows.

3.1. Task 1. Optimizing PHA production conditions on sugar beet pulp

In the preliminary tests on the sugar beet pulp samples delivered by Bio-on, we found that the pulp was a good feedstock for PHA production. A relatively high yield and PHA content were obtained, but further work is needed to optimize the process conditions for designing a pre-industrial pilot plant. To meet Objective 1, Task 1 is further divided into three subtasks (1a, 1b and 1c) as detailed as follows.

Task 1a. Optimization of pretreatment of sugar beet pulp to make the pulp suitable for microbial growth and PHA biosynthesis

A large portion of organic matter, including sucrose, in the raw pulp cannot be directly utilized by the PHA-producing cells. Some inhibitive compounds also exit in the raw pulp that can inhibit and/or deteriorate cell's metabolism and PHA biosynthesis. A relatively low PHA yield was obtained if the pulp was not appropriately treated. Hydrolysis has been found a simple and cost effective way to pre-treat the pulp. We also found that the pretreatment under inappropriate conditions can generate some byproducts that may inhibit PHA biosynthesis. In this task, we will find the optimal conditions to convert the organic solids into fermentable sugars such as glucose and fructose for PHA biosynthesis and at the same time minimize the formation of potential inhibitors. We will test the effects of three major operation parameters (temperature, pH and time) as well as their combination on pretreatment results.

Task 1b. Optimization of the PHA formation on the pretreated sugar pulp

It has been observed in the preliminary tests that PHA can be produced on the pretreated pulp with a high yield. Further work must be performed to understand how effectively the sugars as well as other organic compounds in the pulp are utilized and converted to PHA biopolymers. Ideally, as much sugars and organic compounds as possible should be consumed for high yield of the biopolymers. This will not only generate the maximum amount of PHA polymers, but also minimize the organic wastes left from the fermentation. One important parameter of PHA production via microbial fermentation in bioreactor is the productivity of PHA, or the amount of PHA produced per reactor volume per time (g PHA/L/hr). A high productivity is usually desired for low PHA production cost. The productivity itself is determined by two factors, the PHA content in the cells (g PHA/g cells) and the cell density increase with time in the bioreactor (g cells/L/hr).

The bioreactor's productivity (g PHA/L/hr) = (g PHA/g cells)(g cells/L/hr).

The overall productivity is therefore affected by many factors including the type and concentration of organic substrates (e.g. sugars and organic acids) and nutrient profile (nitrogen, phosphorous, minerals, micronutrients). Other important factors including temperature, pH, dissolved oxygen and energy consumption also play important roles in PHA fermentation. One strategy to reach a high productivity is to obtain a high cell density first in the bioreactor in a so-called cell growth stage and then control the fermentation condition to direct microbial activities towards PHA formation and accumulation. In this task, we will optimize the two stages by using a bench-top bioreactor (2 liters) and the pretreated pulp to reach a high PHA productivity. The optimized conditions will be run in a bioreactor of 20 liters for confirmation and demonstration, *depending on the request by Bio-on and availability of feedstocks in the laboratory.*

Task 1c. PHA recovery and reuse of cell debris in PHA fermentation

After the PHA fermentation, the cells will contain 60-70% wt of PHA polymers and the rest is the biological cellular components consisting of cell walls, membranes, DNA, RNAs and proteins. The cellular proteins account for about 50% dry matter of the residual cell mass and are actually excellent nutrients for cell growth and PHA biosynthesis. A cost effective technology has been developed at the University of Hawaii to dissolve the cell mass, separate and purify the PHA polymers solids in a solvent-free aqueous solution. Importantly, the cell proteins are released and decomposed into amino acids or oligopeptides, which are available to cells for utilization as essential nutrients. Based on this new technology, we will develop and tune the process conditions that are optimized for cells and PHA polymers formed in the sugar beet pulp medium.

Furthermore, this task will also investigate how to effectively recycle and reuse the cell debris and proteins with the beet pulp for cell growth and PHA production. Because the decomposed cellular debris is actually good nutrients for cell growth and PHA biosynthesis, the reuse will not only dramatically reduce the wastes discharged from the process, but also save the costs of fermentation nutrients and promote PHA production. This technical innovation is very unique in comparison with other PHA manufacturing processes based on glucose. *We will file a new patent for this technology in Europe during the project.*

3.2 Task 2. Designing a pre-industrial pilot plant

Based on the experimental results, we will design a pilot plant for PHA production on sugar beet pulp. The PHA fermentation capacity is 1,000 liters. This task will use computer simulation and design software (SuperPro Designer ®, Intelligen Inc. NJ, USA) to produce a process flow sheet with materials flows and stream compositions. In addition, the size of major auxiliary equipment such as seed fermentation tanks, pulp pretreatment tank, centrifuges, washing and storage tanks, filtration and drying of PHA pellets will also be identified. Other information from the design includes consumption of raw materials, utilities (water, electricity, steam and cooling water), and labor hours. This design provides the necessary information for engineering design and purchase of individual equipment for the pilot plant.

3.3 Task 3. Consulting and training

After completing Task 2, *an **Engineering company in Italy*** will be hired by Bio-on for further engineering design and installation of the pilot plant at a site in Italy determined by Bio-on. We will provide consulting service and feed-back responses to the company during this period of time. We will make corresponding changes in process design according to their suggestions and the local conditions of the site in Italy. It is expected that the engineering company needs 12 months to build up the pilot plant at the site. During this period of time, we can train one or two engineers/scientists in the laboratory at UH ***at the request of Bio-on***. The training cost is ***not*** included in this project budget because we do not know if the training service is required at the moment. Furthermore, the overhead charge for education project is much lower than for research project like this one.

3.4 Task 4. Investigation of PHA production on sugar beet molasses

In our preliminary tests, we found substantial composition difference between the pulp and the molasses, which made PHA production on molasses more difficult than pulp. Considering the time frame of Bio-on, this project first focuses on the pulp as the feedstock. After Tasks 1 and 2, our laboratory at UH will have the time to further investigate how to effectively pre-treat the molasses for PHA production. In addition to the pretreatment, we may also do the similar work of Task 1 to optimize PHA production on molasses. Task 4 will be started after Task 2 and run in parallel with Task 3 (see the following time schedule).

4. Time schedule, milestones and deliverables

We will complete this project in 24 months, including 6 months for Task 1 (a, b & c) for optimization of PHA production on sugar beet pulp, 6 months for Task 2 for pilot plant design, and 12 months for Task 3 to provide consulting with engineering design and pilot plant construction. In conclusion, we will use the first 12 months for the experiments in the laboratory and pilot plant design at the University of Hawaii and use the second 12 months to consult the construction of the pilot plant in Italy. During the second 12 months, we also carry on Task 4. Similar to the optimization of PHA production on pulp, investigation on molasses also consists of three subtasks, pretreatment (4a), fermentation (4b), and PHA recovery/cell debris reuse (4c).

Because of the more complicated structure of molasses, a cost effective pretreatment time may take more time to find than pulp. The project will be started on January 1 of 2008 and completed on December 31 of 2009. Table 1 shows the details in time schedules of the tasks and milestones. In addition, Table 1 also indicates the funding installments marked with $ symbol and the project report submission marked with R symbol. Overall, the project will generate four project reports, including three progress reports and one final report. We will deliver the reports at the end of arrows as shown in Table 1. Some of the results are used in the project and some of them will be in the form of process design report and patent filing.

Table 1. Time schedule, milestones, funding installments ($) and reports (R)

Task	Month 1-3	Month 4-6	Month 7-9	Month 10-12	Month 13-15	Month 16-18	Month 19-21	Month 22-24
1a	$ →							
1b	→	→						
1c		R →						
2			$ →	R →				
3					$ →	→	→	→
4a					→	R →		
4b						→	$ →	
4c							→	R →

The project deliverables include:

1. Optimal conditions of pulp pretreatment from **Task 1a**.
2. Optimal conditions of PHA production on pretreated pulp from **Task 1b**.
3. Optimal conditions of PHA recovery and cell debris reuse in PHA production in pulp medium from **Task 1c**.
4. Chemical and thermal properties of PHA bioplastics from **Task 1.** Specially, they are chemical composition analysis and the spectra of Fourier transform infrared spectroscopy

(FTIR), differential scanning calorimetry (DSC), and thermal mechanical analysis (TMA).

5. A process flow sheet of a pre-industrial pilot plant for PHA production on sugar beet pulp, including major auxiliary equipment and size for a PHA fermenter of 1,000 liters from **Task 2**.
6. The material flows and composition of individual streams of the pilot plant including potential emissions and wastewater streams from **Task 2**.
7. Batch operation conditions of the pilot plant, including the consumption of sugar beet pulp and other chemicals and materials used in PHA fermentation and recovery, utility consumptions (electricity, water, steam, cooling water), and labor hours from **Task 2**.
8. Discovery disclosure and patent filing on technology innovation for integrated PHA recovery and reuse of cell debris for waste minimization and fermentation cost reduction from **Tasks 1 & 2**.
9. Consulting and training service for the pilot plant construction from **Task 3**.
10. Optimal production of PHA on sugar beet molasses from **Task 4**.
11. Modification of the process flow sheet and processing conditions from **Task4**.

ATTACHMENT 2 (*RESEARCH BUDGET*)

5. Budget, justification and funding Installments

The fixed price of the contract research is US$389,161 and the budget is allocated in Table 2.

Table 2. Project budget over 24 months in US dollars

	Person Mo.	Salary	Fringe	Subtotal
A. Senior Personnel				
	4.00	41,182	15,756	56,938
Subtotal		41,182	15,756	56,938
B. Other Personnel*				
Technician (one)	24.00	70,512	26,978	97,490
Graduate Assistant (one)	24.00	36,400	30,358	66,758
Subtotal		106,912	57,336	164,248
Total Salary and Fringe		148,094	73,092	221,186
C. Stipend (Postdoc)*				0
D. Permanent Equipment*				0
E. Materials and Supplies				30,000
F. Repair/Maintenance				20,000
G. Travel*				10,000
H. Subcontracts*				0
I. Other Direct Costs				0
J. Total Direct Costs (A-I)				281,186
K. Indirect Costs (38.4% excluding C, D & H>$25,000)				107,975
L. Total Direct and Indirect Costs				**389,161**

The budget is justified as follows.

A. Senior personnel ($56,938)

Dr. Jian Yu is the principal investigator (PI) of the project and responsible for science and technology of the project. His duties include supervision and training of technician and junior researchers, project management, coordination, progress and report. He will spend three months per year in the project with two months compensation from the project. The faculty fringe benefit rate of the university is 38.26%.

B. Other personnel ($164,248)

The project will hire a full time technician to conduct the experiments and routine work in the laboratory. This technical staff should have a bachelor degree in chemistry or chemical engineering and a few years laboratory work experience. At University of Hawaii, a laboratory research technician has a minimum pay of $35,256/year (PBA) with fringe benefit of 38.26%. The project will also need a postgraduate assistant to conduct process simulation and design. This part-time helper will be paid at $18,200/year (<50% FTE) with fringe benefit of 8.34%.

E. Materials and supplies ($30,000)

According to the spending rate and our experience on experimental supplies, we allocated $30,000 for the materials and supplies to run the experiments. It covers the consumables such as chemicals, solvents, gas, nutrients, HPLC columns and lab safety supplies. The fees for PHA characterization in a third party laboratory such as DSC and TMA are included. The budget will also cover other fees such as internet charge, document preparation, printing and sample delivery.

F. Repair and Maintenance ($20,000)

The experiments will use many permanent facilities in the laboratory such as bioreactors, centrifuges, freeze-dryer, HPLC, UV/Vis spectrometer etc. According our experience, we need $10,000/year to maintain their work conditions and replace the broken parts such as pH and temperature sensors. The budget will also cover the cost in modification and maintenance of bioreactors (2L, 20L, 50L) as well as the cost of computer software updates.

G. Travel ($10,000)

Two travels from Hawaii to Italy are planned for the project. We expect one trip during the construction of pilot plant for technical consulting and another one for the first operation of the pilot plant to provide technical training. The budget covers the return air tickets and per diem in Italy.

K. Indirect cost ($107,795)

This research project will be conducted in the PI's laboratory on campus and the indirect cost rate of the university is 38.4% of the total direct cost ($281,196).

Funding installments

The **fixed price** of US$389,161 will be paid in four installments (see Table 1):

1. The first installment of US$97,290 upon execution of this contract.
2. The second installment of US$ 97,290 on or before August 1, 2008
3. The third installment of US$97,290 on or before February 1, 2009
4. The fourth installment for the rest (US$97,291) on or before August 1, 2009.

6. Appendix: Patents and publications of PI on bioplastics

Patents:

1. **Jian Yu (2007)** "Recovery and purification of polyhydroxyalkanoates from PHA-containing cell mass" US Patent Application No. 11/684,110

2. **Jian Yu (2001)** "A green technology to produce biodegradable thermoplastics and elastomers from organic wastes" (US Patent 7,141,400 11/28/2006; Singapore Patent No. 105875 [WO03/062439A1]; Chinese Patent No. ZL03802258.3; Taiwanese Patent No. I268288).

Publications:

1. **Jian Yu** (2006). Microbial production of bioplastics from renewable resources. In: S.T. Yang (editor), Bioprocessing of Value Added Products from Renewable Resources. Pp 585-610, Amsterdam, Elsevier.

2. **Jian Yu** and Lilian Chen (2006). Cost effective recovery and purification of polyhydroxyalkanoates by selective dissolution of cell mass. Biotechnology Progress 22, 547-553.

3. Sun-En Lee, Qing X. Li and **Jian Yu** (2006). Proteomic examination of *Ralstonia eutropha* in cellular response to formic acid inhibition. Proteomics 6(15):4259-4268.

4. **Jian Yu**, David Plackett, Lilian X L Chen (2005). Kinetics and mechanism of the monomeric products from abiotic hydrolysis of poly[(R)-3-hydroxybutyrate] under acidic and alkaline conditions. Polymer Degradation and Stability 89:289-299.

5. Lilian X. L. Chen and **Jian Yu (2005)**. Abiotic hydrolysis of poly[(R)-3-hydroxybutyrate] in acidic and alkaline media. Macromolecular Symposium 224:35-46.

6. **Jian Yu** and Yingtao Si (2004). Metabolic carbon fluxes and biosynthesis of polyhydroxyalkanoates in *Ralstonia eutropha* on short chain fatty acids. Biotechnology Progress 20(4):1015-1024.

7. Guochen Du, Lilian X. L. Chen and **Jian Yu** (2004). High-efficiency production of bioplastics from biodegradable organic solids. Journal of Polymers and the Environment, 12:89-94

8. **Jian Yu** (2003). Biodegradation-based polymer surface erosion and surface renewal for foul-release at low ship speeds. Biofouling, 19(suppl.): 83-90.

9. Lo Wing Hong and **Jian Yu** (2003). Environmental factors and kinetics of microbial degradation of poly(3-hydroxybutyrate-co-3-hydroxyvalerate) in aqueous medium. Journal of Applied Polymer Science, 87(2):205-213.

10. Guocheng Du and **Jian Yu** (2002). Metabolic analysis on fatty acids utilization by *Pseudomonas oleovorans*: mcl-poly(3-hydroxyalkanoates) synthesis versus β-oxidation. Process Biochemistry, 38:325-332.

11. Guocheng Du and **Jian Yu** (2002). Green technology for conversion of food scraps to biodegradable thermoplastic polyhydroxyalkanoates. Environmental Science & Technology, 36(24):5511-5516.

12. **Jian Yu,** Yingtao Si and Wan Keung R.Wang (2002). Kinetics modeling of inhibition and utilization of mixed volatile fatty acids in the formation of polyhydroxyalkanoates by *Ralstonia eutropha*, Process Biochemistry, 37:731-738.

13. Wing Hung Lo and **Jian Yu** (2002). Effects of energy dissipation rate and surface erosion on the biodegradation of poly(hydroxybutyrate-co-hydroxyvalerate) and its blends with synthetic polymers in an aquatic medium. Journal of Applied Polymer Science, 83, 1036-1045.

14. Du, Y. Si and **J. Yu** (2001). Inhibitory effect of medium-chain-length fatty acids on synthesis of polyhydroxyalkanoates from volatile fatty acids by *Ralstonia eutropha.* Biotechnology Letters, 23:1613-1617.

15. Guocheng Du, Jian Chen, **Jian Yu** and Shiyi Lun (2001). Kinetic studies on poly-3-hydroxybutyrate formation by *Ralstonia eutropha* in a two-stage continuous culture system. Process Biochemistry 37(3):219-227.

16. **Jian Yu** and Yingtao Si (2001). A dynamic study and modeling of the formation of polyhydroxyalkanoates combined with treatment of high strength wastewater, Environmental Science & Technology, 35:3584-3588.

17. Guocheng Du, Jian Chen, **Jian Yu** and Shiyi Lun (2001). Feeding strategy of propionic acid for production of poly(3-hydroxybutyrate-co-3-hydroxyvalerate) with *Ralstonia eutropha.* Biochemical Engineering Journal, 8:103-110.

18. Guocheng Du, Jian Chen, **Jian Yu** and Shiyi Lun (2001). Continuous production of poly-3-hydroxybutyrate by *Ralstonia eutropha* in a two-stage culture system. Journal of Biotechnology, 88:59-65.

19. **Jian Yu** and Jianping Wang (2001). Metabolic flux modeling of detoxification of acetic acid by *Ralstonia eutropha* at slightly alkaline pH levels. Biotechnology and Bioengineering, 73(6):458-464.

20. Wang J. and **Yu J** (2001). Kinetic analysis on formation of poly(3-hydroxybutyrate) from acetic acid by *Ralstonia eutropha* under chemically defined conditions. Journal of Industrial Microbiology and Biotechnology, 26:121-126.

21. **Jian Yu** (2001). Production of PHA from starchy wastewater via organic acids. Journal of Biotechnology. 86:105-112.

22. Jianping Wang and **Jian Yu** (2000). Kinetic analysis on inhibited growth and poly(3-hydroxybutyrate) formation of *Alcaligenes eutrophus* on acetate under nutrient-rich conditions. Process Biochemistry 36:201-207.

23. **Jian Yu**, Fuming Zhang, Tommy Low and Po Lock Yue (2000). Biodegradable thermoplastic blends for management of municipal solid waste. 3rd Asia Pacific Conference on Sustainable Energy and Environmental Technologies. 3-6 December 2000, Hong Kong.

24. **Jian Yu**, Chumwai Tam, Yingtao Si (2000). Production of polyhydroxyalkanoates from starchy waste in membrane-coupled bioreactors. Proceedings of the 5th international symposium on Environmental Biotechnology, 9-13 July 2000, Kyoto, Japan.

25. **Jian Yu** and Ruan Wenquan (1999). Utilization of volatile acids by *Alcaligenes eutrophus* for production of biodegradable thermoplastics. Proceedings of Asia-Pacific Chemical Reaction Engineering Symposium'99, Pp. 139-144. 13-16 June, Hong Kong.

26. Samuel Lee and **Jian Yu** (1997). Production of biodegradable thermoplastics from municipal sludge by a two-stage bioprocess. Resources, Conservation and Recycling, 19:151-164.

Conference presentations and seminars:

J. Yu (**2007**). Formation of polyhydroxyalkanoates with microbial utilization of biomass hydrolysates. International Symposium on Polymers and the Environment: Emerging Technology and Science. October 17-20, Vancouver, Washington, USA.

Jian Yu (**2007**). Engineering Aspects of Biomass Refining into Biofuels, Biochemicals and BioplasticsEnergy: Efficient Biomass Refining into Biofuels and Bioplastics. Pacific Rim Summit on Industrial Biotechnology and Bioenergy, November 14-16, Honolulu, Hawaii, USA.

J. Yu (2007). Energy efficient biorefining of biomass into fuel ethanol and bioplastics. Symposium 2007 of the Consortium of Plant Biotechnology Research, Feb. 11-15, Washington DC, USA.

J. Yu (2006). Production of PHA bioplastics with biorefinery of biomass. The 2nd International Conference on Technology & Application of Biodegradable/Biobased Plastics (ICTABP2), Oct. 13-15. Hangzhou, China

J. Yu (2006). Eco-friendly bioplastics from renewable feedstocks: microbial conversion and downstream recovery. The 10th Annual Green Chemistry & Engineering Conference, June 26-30, 2006, Washington DC, USA.

J. Yu (2006). Mini-pilot plant bioreactor for production of bioplastics from food scraps. Final project report to I-PHA Biopolymers Ltd. June 1, University of Hawaii, Honolulu, USA.

J. Yu (2006). Biorefinery of biomass into fuel and thermoplastics. May 9, Hawaii Natural Energy Institute, University of Hawaii, Honolulu, USA.

J. Yu (2005). Microbial production of novel PHA bioplastics from lignocellulosic biomass. The 2nd World Congress on Industrial Biotechnology and Bioprocessing, April 20-23, Orlando, USA.

J. Yu (2004). Formation mechanism and kinetics of monomeric compounds from abiotic degradation of biopolyester poly[R-3-hydroxybutyrate]. The 8th World Conference on Biodegradable Polymers and Plastics. June 1-4, Seoul, Korea.

J. Yu (2004). Pilot Plant and Bioreactor Design for Bioplastics Production from Food Scraps. A final report to I-PHA Biopolymers. August 31, University of Hawaii, Honolulu, USA.

J. Yu (2003). Metabolic carbon flow in biosynthesis of PHA on mixed organic acids. 11th Annual Meeting of the BioEnvironmental Polymer Society, August 10-13, Denver, USA.

J. Yu (2003). Green technology: Renewable Biomass to Bioplastics. 2nd Technology Showcase of University of Hawaii. June 12, Manoa, Honolulu.

J. Yu (2002). High efficiency production of bioplastics from food scraps. 10th Annual Meeting of the BioEnvironmental Polymer Society, 10-14 Sept. Albuquerque, NM, USA.

J. Yu (2002). Bio-surface erosion and surface renewal for foul release under low hydrodynamic shear stress. 11th International Congress on Marine Corrosion and Fouling, 21-26 July, San Diego, USA.

J. Yu. (2001). A novel technology: food scraps to biodegradable thermoplastics (PHAs). Gordon Research Conferences: Biodegradable Polymers. July 8-13, 2001. Queen's College, Oxford, UK.

J. Yu. (2001). A novel green technology: organic wastes to biodegradable thermoplastics. The First Forum of Chinese Young Scholars in Environmental Science & Engineering, June 19-22, Shenzhen, China.

J. Yu (2000). Converting food wastes to biodegradable thermoplastics. Department of Chemical Engineering, University of Saskatchewan, Saskatoon, Canada.

J. Yu (1999). Production of PHA from starchy wastewater via organic acids, Biopolymers'99, International Society of Environmental Biotechnology. 2-5 March 1999, Leipzig, Germany.

J. Yu, F.Zhang, T. Low and PL Yue (1999). The performance, degradability and material property of disposable plastic food containers (project FP98-009). Final project report to the Environmental Protection Department, Hong Kong.

S. Lee and **J. Yu** (1996). A two-step bioprocess converting industrial organic wastes to biodegradable plastics. The 10th International Biotechnology Symposium, 25-30 August, Sydney, Australia.