



**CENTRAL LUZON STATE UNIVERSITY**



**OPTIMIZATION OF CULTURE CONDITIONS FOR MYCELIAL GROWTH OF  
*Oudemansiella* sp. COLLECTED FROM MAYOYAO, IFUGAO PROVINCE**

**MYLENE L. BRIONES**

An Undergraduate Thesis Submitted to the Faculty of the Department of  
Biological Sciences, College of Arts and Sciences, Central Luzon  
State University, Science City of Muñoz, Nueva Ecija,  
Philippines, In Partial Fulfillment of the  
Requirements for the Degree

**BACHELOR OF SCIENCE IN BIOLOGY**

**JULY 2017**



Republic of the Philippines  
**CENTRAL LUZON STATE UNIVERSITY**  
Science City of Muñoz, Nueva Ecija

COLLEGE OF ARTS AND SCIENCES  
Department of Biological Sciences

**APPROVAL SHEET**

The Undergraduate Thesis entitled: **OPTIMIZATION OF CULTURE CONDITIONS FOR MYCELIAL GROWTH OF *Oudemansiella* sp. FROM MAYOYAO, IFUGAO PROVINCE** prepared and submitted by **MYLENE L. BRIONES** in partial fulfilment of the requirements for the degree of **BACHELOR OF SCIENCE IN BIOLOGY** is hereby approved and accepted.

  
**ANGELES M. DE LEON, PhD**

Adviser

09-15-17

Date Signed

  
**SOFRONIO P. KALAW, PhD**

Critic

09-15-17

Date Signed

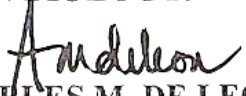
  
**RICH MILTON R. DULAY, MSc**

Department Research Coordinator

09-15-17

Date Signed

Accepted in partial fulfillment of the requirements for the degree of **BACHELOR OF SCIENCE IN BIOLOGY**.

  
**ANGELES M. DE LEON, PhD**

Department Chair

09-15-17

Date Signed

  
**RICH MILTON R. DULAY, MSc**

College Research Coordinator

09-15-17

Date Signed

  
**EVARISTO A. ABELLA, PhD**

Dean

09-15-17

Date Signed



## BIOGRAPHICAL SKETCH

### PERSONAL INFORMATION

Name: MYLENE LUSTRE BRIONES  
Date of Birth: April 25, 1997  
Place of Birth: Science City of Muñoz, Nueva Ecija  
Address: 325, Poblacion West, Science City of Muñoz,  
Nueva Ecija  
Religion: Roman Catholic  
Civil Status: Single  
Parents: Mr. Manuel Nacario Briones  
Mrs. Elizabeth Enriquez Lustre



### EDUCATIONAL BACKGROUND

*TERTIARY* : Central Luzon State University  
(A. Y. 2013-2017) Science City of Muñoz, Nueva Ecija  
Bachelor of Science in Biology

*SECONDARY* : Muñoz National High School  
(A. Y. 2009-2013) Bantug, Science City of Muñoz, Nueva Ecija

*ELEMENTARY* : Muñoz Central School  
(A. Y. 2003-2009) Science City of Muñoz, Nueva Ecija

### SEMINAR AND TRAININGS ATTENDED

**HIV: AIDS "Survival of the Fittest. The Human Culture Media"**  
Central Luzon State University  
Science City of Munoz, Nueva Ecija

**Current Trends in Food and Safety**  
Central Luzon State University  
Science City of Muñoz, Nueva Ecija  
August 30, 2014



**Direct Seeding: A Response to Economical and Technological Challenges in Rice Farming**

Central Luzon State University  
Science City of Muñoz, Nueva Ecija  
September 7, 2013

ON THE JOB TRAINING

Bureau of Fisheries and Aquatic Resources (BFAR), Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines. June 21 – July 21, 2016.



## ACKNOWLEDGEMENT

This study would not have been possible if not for the people who helped the researcher achieve her goals. She would like to extend her sincerest gratitude to everyone that was part of this success.

First of all, the researcher would like to thank the God Almighty for giving her guidance to every steps and risks that she was about to take. If not for His guidance, this study would never be possible.

To her adviser, Dr. Angeles M. de Leon who was always more than willing to answer all the questions that needed answer. For her never failing reminders of the deadline, and for all the memories that they have shared before, after and during the duration of her thesis life. She was a one of a kind adviser. The kind that you will treasure forever.

To Dr. Sofronio P. Kalaw, her critic for all the justified criticisms and for the help in enhancing and betterment of her work. It was a pleasure working with him.

To Sir John Closter Olivo for the wonderful statistical analysis and his remarkable consultation.

To Dr. Evaristo Abella for letting her conduct her work in the interactive laboratory.

Ma'am Diane for patiently waiting for her to finish working in the Interactive Laboratory even though it is past the working hours.



Her thesis buddies, Jam, Raymark, Anna and Carlo with special participation of Jana Riederer for the laughs that they have shared during their stay in Hungduan and Mayoyao, Ifugao Province.

To the Ifugao people, her warmest appreciation for their unbelievable hospitality and kindheartedness while their stay in their land.

To her best friend, Jamila Maisha M. Asuncion, who was with her since the first day of her thesis life up to the last, who was always there whenever she needed her. The author would like to extend her sincerest and deepest gratitude to her for all the memories that they have shared together and through hardships and good times. This study will never be possible if not for her.

To her family, for the love and support that they have given her. For understanding her mood swings when she was stressed out about her work. And for teaching her not to give up.

To her friends, Raff Emil Primero for letting her borrow the digital vernier caliper for more accurate measurements of the mycelial diameter, Lexter and Janine for staying with her late at night in the laboratory and Jo-Eliz for giving her shelter when she was too tired to go home at late nights.

And to Ate Liezel, Manong Orly, Kuya Dennis and all the people that the researcher was not able to mention, her deepest gratefulness for all the help. She may have not been able to thank all of you in this paper but in her heart, she is always grateful.

**MYLENE LUSTRE BRIONES**



TABLE OF CONTENTS

	<b>PAGE</b>
<b>TITLE PAGE</b>	i
<b>APPROVAL SHEET</b>	ii
<b>BIOGRAPHICAL SKETCH</b>	iii
<b>ACKNOWLEDGEMENT</b>	v
<b>LIST OF TABLES</b>	ix
<b>LIST OF FIGURES</b>	x
<b>LIST OF APPENDICES</b>	xi
<b>LIST OF APPENDIX TABLES</b>	xii
<b>LIST OF APPENDIX FIGURES</b>	xiii
<b>ABSTRACT</b>	xiv
<b>INTRODUCTION</b>	1
Background of the Study	1
Objectives of the Study	2
Significance of the Study	2
Scope and Limitations of the Study	3
Time and Place of the Study	3
<b>REVIEW OF RELATED LITERATURE</b>	4
Mushroom	4
Cultivation of Macrofungi	6
Physical Growth Requirements	11
<b>MATERIALS AND METHODS</b>	13
Source of Mushroom	13
Surface-sterilization for mushroom tissues	13
Isolation of mushroom tissues	13



Sub-Study I. Nutritional Requirement of the Mycelia in Different Indigenous Culture Media	14
Preparation of Culture Media	14
Sub-Study II. Physical factors that affects the mycelial growth performance of <i>Oudemansiella</i> sp.	16
pH	16
Aeration	16
Illumination	16
Temperature	17
Sub-Study III. Evaluation of the Best Grain Spawning Material	17
Data gathered	18
Statistical analysis	18
<b>RESULTS AND DISCUSSION</b>	20
Sub-Study I. Nutritional Requirement of the Mycelia in Different Indigenous Culture Media	20
Sub-Study II. Physical factors that affects the mycelial growth performance of <i>Oudemansiella</i> sp.	22
pH	23
Aeration	25
Illumination	26
Temperature	27
Sub-Study III. Evaluation of the Best Grain Spawning Material	30
<b>SUMMARY, CONCLUSION AND RECOMMENDATION</b>	32
Summary	32
Conclusion	33
Recommendation	34
<b>LITERATURE CITED</b>	35
<b>APPENDICES</b>	41



LIST OF TABLES

TABLE		PAGE
1	Mean diameter of mycelial growth and mycelial density after 5 days of incubation of <i>Oudemansiella</i> sp. on different indigenous culture media	20
2	Mean diameter of mycelial growth and mycelial density after 5 days of incubation period of <i>Oudemansiella</i> sp. on CWG adjusted on different pH levels	24
3	Mean diameter of mycelial growth and mycelial density after 4 days of incubation period of <i>Oudemansiella</i> sp. on different aeration condition	25
4	Mean diameter of mycelial growth and mycelial density after 4 days of incubation period of <i>Oudemansiella</i> sp. on different illumination conditions	27
5	Mean diameter of mycelial growth and mycelial density after 4 days of incubation period of <i>Oudemansiella</i> sp. on different temperature conditions	28



LIST OF FIGURES

FIGURE		PAGE
1	Mycelial growth performance of <i>Oudemansiella</i> sp. on different indigenous culture media: (A) CWG, (B) CCDSG (C) PSG and (D) PDA after 5 days of incubation period	21
2	Mycelial growth performance of <i>Oudemansiella</i> sp on coconut water gelatin with different pH levels: (A) 4.0, (B) 5.0, (C) 6.0, (D) 7.0 and (E) 8.0 after 5 days of incubation period	24
3	Mycelial growth performance of <i>Oudemansiella</i> sp. on different aeration conditions: (A) Sealed and (B) Unsealed after 4 days of incubation period	26
4	Mycelial growth performance of <i>Oudemansiella</i> sp on different illumination conditions: (A) full dark, (B) lighted and (C) alternating light and dark condition after 4 days of incubation period	27
5	Mycelial growth performance of <i>Oudemansiella</i> sp. on different temperature conditions: (A) room temperature (28-30°C), (B) air-conditioned (23-25°C) and (C) refrigerated (7-10°C) after 4 days of incubation period	29
6	Mycelial colonization of <i>Oudemansiella</i> sp. on different spawning materials: (A) unmilled rice seeds, (B) cracked corn and (C) soybeans at 6 <sup>th</sup> day of incubation	31



LIST OF APPENDICES

APPENDIX		PAGE
A	Statistical Analysis	42
B	Documentation of Research Activity	45



LIST OF APPENDIX TABLES

APPENDIX TABLE		PAGE
1	Analysis of variance of mycelial growth diameter of <i>Oudemansiella</i> sp. in different indigenous media on the 5 <sup>th</sup> day of incubation	42
2	Analysis of variance of mycelial growth diameter of <i>Oudemansiella</i> sp. in different pH level on the 5 <sup>th</sup> day of incubation	42
3	T-test of mycelial growth diameter of <i>Oudemansiella</i> sp. influenced by different aeration condition on the 4 <sup>th</sup> day of incubation	43
4	Analysis of variance of mycelial growth diameter of <i>Oudemansiella</i> sp. influenced by different illumination condition on the 4 <sup>th</sup> day of incubation	43
5	Analysis of variance of mycelial growth diameter of <i>Oudemansiella</i> sp. influenced by different temperature conditions on the 3 <sup>rd</sup> day of incubation	44



LIST OF APPENDIX FIGURES

APPENDIX FIGURE		PAGE
1	Collection of fruiting bodies in Mayoyao, Ifugao Province	56
2	Surface sterilization of fruiting body of <i>Oudemansiella</i> sp.	56
3	Preparation of indigenous culture media. (A) CWG, (B) CCDSG, (C) PSG and (D) PDA	57
4	Pour plating	57
5	Inoculating of mycelial discs	57
6	Preparation of grain spawning media	58
7	Inoculating of mycelia of <i>Oudemansiella</i> sp. on prepared grain spawn	58



ABSTRACT

**BRIONES, MYLENE L.** Bachelor of Science in Biology, Department of Biological Sciences, College of Arts and Sciences, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines, July 2017. **OPTIMIZATION OF CULTURE CONDITIONS FOR MYCELIAL GROWTH OF *Oudemansiella* sp. FROM MAYOYAO, IFUGAO PROVINCE**

**Manuscript No. BIO-M-Sum17-002**

**Adviser: Angeles M. De Leon, Ph. D**

*Oudemansiella* sp. is a genus of the fungi belonging to Physalacriaceae family. The genus contains about 15 species that are widely distributed in tropical and temperate regions. To cultivate this wild edible species, the optimum culture conditions for its secondary mycelial growth with special reference to the influence of nutritional (different indigenous culture media), physical (pH, aeration, illumination, and temperature) and grain spawn factors were determined. Results of the study revealed that its secondary mycelia grew best on coconut water gulaman at a pH of 7.0, incubated unsealed, under lighted condition and at air-conditioned (23-25°C). Among all the grain spawning materials, yellow cracked corn yielded a very thick mycelial density with the shortest incubation period of 6 days. This study showed the optimum mycelial growth of *Oudemansiella* sp. on different indigenous culture media and its physical conditions determined in order to develop production technology. Therefore, the optimization of culture condition for mycelial growth of *Oudemansiella* sp. will contribute to the development of improved culture condition for its practical application and to provide additional information for other researchers in the future.



LITERATURE CITED

- ADEJUMO, T.O. AND O.B. AWOSANYA. 2005.** Proximate and mineral composition of four edible mushroom species from South Western Nigeria. *African Journal of Biotechnology*, 4 (10); 1084-1088.
- AKINYELE, B.J. AND F.A. AKINYOSOYE. 2005.** Effect of *Volvariella volvacea* cultivation on the chemical composition of agro wastes. *African Journal of Biotechnology*, 4(9); 979-83.
- ALEMAWOR, F., DZOGBEFIA, V.P, ODDOYE, E.O.K AND J.H. OLDHAM. 2009.** "Effect of *Pleurotus ostreatus* Fermentation on Cocoa Pod Husk Composition: Influence of Fermentation Period and Mn<sup>2+</sup> Supplementation on the Fermentation Process," *African Journal of Biotechnology*, 8(9); 1950-1958.
- ALEMU, F. 2014.** Cultivation of *Pleurotus ostreatus* on *Grevillea robusta* leaves at Dilla University, Ethiopia. *Journal of Yeast and Fungal Research*, 5;74-83.
- ATRI, N.S. 2013.** Studies for culturing and cultivation of *Lentinus cladopus* Lév., *Mycosphere*, 4 (4); 675-682.
- BONGINKHOSI, E., DIANA, M. AND T.M. MICHAEL. 2012.** Growth and Yield Response of Oyster Mushroom (*Pleurotus ostreatus*) Grown on Different Locally Available Substrates. *Journal of Biological Sciences*, 4(5); 623-629.
- BUIGUT, S.K. 2002.** Mushroom production in sustainable small-scale farming system-opportunities and constraints: a survey of Uasin Gishu district. In: Proceedings of the Horticulture seminar on Sustainable Horticultural Production in the Tropics at Jomo Kenyatta University of Agriculture & Technology, Juja, Kenya 3rd - 6th October, 2001. Eds. Wesonga JM, Losenge T, Ndung'u CK, Fricke A, Hau B, Stützel. H, 1-5.
- CHANG, S.T. AND P. MILES. 2004.** Mushrooms: cultivation, nutritional value, medicinal effect, and Environmental Impact, 4-6.
- CHANG, S.T., AND P.G. MILES. 1989.** Edible mushrooms and their cultivation, Florida: CRC press.
- CHANG, S.T. AND P. G. MILES. 2008.** Mushrooms: Cultivation, Nutritional Value, Medicinal Effect, and Environmental Impact, CRC Press, Boca Raton, Fla, USA, 2.



- CHANG, S.T. AND J.A. BUSWELL.** 1996. Mushroom Nutraceuticals. *World Journal of Microbiology, Biotechnology*, 12; 473-476.
- CHAUBEY, A., DEHARIYA, P. AND D. VYAS.** 2010. Solid waste management through oyster mushroom cultivation. *International Journal of biozone*, 2(1&2); 369-372.
- CUEVAS, M.J., REYES R.G. AND S.P. KALAW.** (2009). Biophysiology of *Lentinus sajor-caju*. 7; 48.
- DE LEON, A.M., REYES, R.G. AND T.E.E. DELA CRUZ.** (2013). *Lentinus Squarrosulus* (Mont.) Singer and *Polyporus Grammocephalus* Berk.: Newly Domesticated, Wild Edible Macrofungi from the Philippines. *Philippine Agricultural Scientist*, 96 (4); 411-418.
- DULAY, R.M.R., KALAW, S.P., REYES, R.G., CABRERA, E.C. AND N.F. ALFONSO.** (2012). Optimization of Culture Conditions for Mycelial Growth and Basidiocarp Production of *Lentinus tigrinus* (Bull.) Fr., A New Record of Domesticated Wild Edible Mushroom in the Philippines. *Journal of The Philippine Agricultural Scientist*, 95 (3); 278-285.
- DULAY, R.M.R., GAGARIN, W.S., ABELLA, E.A., SOFRONIO, P.K., AND R.G. REYES.** 2014. Aseptic Cultivation and Nutrients Compositions of *Coprinus comatus* (O.F. Müll.) Pers. On *Pleurotus* Mushroom Spent. *Journal of Microbiology, Biotechnology*, 4 (3); 1-7.
- DULAY, R.M.R.** 2011. Optimization of Culture Conditions, Nutritional Characterization, Toxicity and Teratogenicity of *Lentinus tigrinus*- A newly recorded domesticated mushroom in the Philippines. Unpublished Masteral Thesis. De La Salle University, Taft Avenue, Manila.
- DUYFF, R.** 2006. *American Dietetic Association's Complete Food and Nutrition Guide*, Wiley & Sons. New Journal. 3.
- FIFE, B.** 2008. Nutritional benefits of coconut water. Retrieved May 12, 2011 from the World Wide Web.
- GAO, B.** 2000. The domestication and cultivation of *O. radicata*. *Edible Fungi China*, 19; 5-6.
- GUILLAMÓN, E., GARCÍA-LAFUENTE, A. AND M. LOZANO.** 2010. "Edible mushrooms: role in the prevention of cardiovascular diseases," *Fitoterapia*, 81(7); 715-723.



- HIBBETT, D.S. AND THORN, R.G. 2001.** Basidiomycota: homobasidiomycetes. In: McLaughlin DJ, McLaughlin EG, Lemke PA (eds) *The Mycota, Systematics and evolution*. Springer, Berlin, 7A; 121–168.
- HIGAKI, M., REYES, R.G., IJIMA, T., EGUCHI, F. AND C.C. DIVINA. 2000.** Mushroom Science and Technology in Central Luzon, Philippines for Food Security in the 21st Century. CLSU Press, Philippines.
- JATAV, R.S., GUPTA, A.K., DOSHI A. AND A.K. MEENA. 2012.** Studies of Different Physical Factors on Mycelial Growth of Blue Oyster Mushroom [*Hypsizygus ulmarius* (Bull.) Redhead]. *International Journal of Agricultural and Statistical Sciences*, 8 (1); 347-354.
- JAYASINGHE, C., IMTIAJ, A., HUR, H., LEE, G.W., LEE, T.S. AND U.Y. LEE. 2008.** Favorable Culture Conditions for Mycelial Growth of Korean Wild Strains in *Ganoderma lucidum*. *Korean Journal of Mycology*, 36; 28–33.
- JI, D., LI, D. AND M. SONG. 1982.** *Oudemansiella radicata* and its cultivation. *Edible Fungi*, 4; 11–12.
- JISKANI, M.M. 2001.** Energy potential of mushrooms. *The DAWN Economic and Business Review*, Oct. 15-21, 2001. P. IV.
- KHATUN, K., MAHTAB, H., KHANAM, P.A., SAYEED, M.A. AND K.A. KHAN. 2007.** Oyster mushroom reduced blood glucose and cholesterol in diabetic subjects. *Mymensingh Medical Journal*, 16(1); 94–99.
- KIBAR, B. AND A. PEKSEN. 2011.** Nutritional and environmental requirements for vegetative growth of edible ectomycorrhizal mushroom *Tricholoma terreum* *Journal of Zemdirbyste Agriculture*. 98 (4); 409-414.
- KIRK, P.M., CANNON, P.F., DAVID, J.C. AND J.A. STALPERS. 2001.** *Dictionary of the fungi*, CAB International, Wallingford, UK, 9.
- KIRK, P.M., CANNON, P.F., MINTER D.W. AND J.A. STALPERS. 2008.** *Dictionary of the fungi* Trowbride, UK: CAB international, Cromwell Press.
- LEVANON, D., ROTHSCHILD, N. AND O. DANAI. 1993.** Bulk treatment of substrate for the cultivation of shiitake mushrooms (*Lentinus edodes*) on straw. *Bioresource Technology*, 45; 63–64.
- LEE, G.W., JAYSINGHE, C., IMTIAJ, A., SHIM, M.J., HUR, H., LEE, M.W., LEE, K.R., KIM, S.H., KIM, H.Y., LEE, U.Y. AND T.S. LEE. 2007.** The artificial cultivation of *Oudemansiella mucida* on the oak sawdust medium. *Mycobiology*, 35; 226–229.



- LEE, J.M., KIM, J.Y., CHOI, K.D., HAN, K.D., HUR, H., KIM, S.W., SHIM, J.O., LEE, T.S. AND M.W. LEE. 2004. Sawdust media affecting the mycelial growth and fruiting body formation of *Sparassis crispa*. Mycobiology, 32; 190–193.
- LI, C.H., ZHANG, L.J., ZHANG, M.Y., XU, Z., SHANG, X.D., AND Q. TAN. 2012. Domestication and cultivation of *Oudemansiella submucida*. Acta Edulis Fungi 19; 45–48.
- LI, Y. 2012. Present development situation and tendency of edible mushroom industry in China. Mushroom Science, 18; 3–9.
- LIN, Z. 2004. Grass (Juncao). In: Mushroom Grower's Handbook 1: Oyster Mushroom Cultivation. Seoul, Korea: MushWorld-Heineart Inc., 107–113.
- MAGINGO, F.S. ORIO, N.M. AND A.K. KIVAISI. 2004. Cultivation of *Oudemansiella tanzanica* nom. prov. on agricultural solid wastes in Tanzania. Mycologia 96; 197-204.
- MANZI, P., AGUZZI, A. AND L. PIZZOFERRATO. 2001. Nutritional value of mushrooms widely consumed in Italy. Food Chemistry, 73 (3); 321-325.
- MATILA, P., KONKO, K., EUROLA, M., PIHLAVA, J.M., ASTOLA, J., VAHTERISTO, L., HIETANIEMI, V., KUMPULAINEN, J., VALTONEN, M. AND V. PIIRONEN. 2001. Contents of vitamins, mineral elements, and some phenolic compounds in cultivated mushrooms. Journal of Agricultural and Food Chemistry, 49; 2343–2348.
- MOLIN, J. 1996. Specially mushrooms: yesterday, today and tomorrow. Mushroom News, 2; 10-13.
- MURUGESAN, A.G., VIJAYALAKSHMI, G.S., SUKUMARAN, N. AND C. MARIAPPAN. 1995. Utilization of water hyacinth for oyster mushroom cultivation. Bioresource Technology, 51(1); 97-98.
- NICHOLAS, L.G. AND O. KERRY. 2006. Psilocybin Mushroom Handbook: easy indoor and outdoor cultivation. ISBN 13 publishing co Pvt Ltd; 649.
- OGUNDANA, S.K. AND O. FAGADE. 1981. The nutritive value of some Nigerian edible mushrooms. In: Mushroom Science XI, Proceedings of the Eleventh International Scientific Congress on the Cultivation of Edible Fungi, Australia, 123-131.
- ONUOHA, C.I., OYIBO, G. and E. JUDITH. 2009. Cultivation of straw mushroom (*Volvariella volvacea*) using some agro-waste material. J Am Sci., 5; 135–138.



- ORPILLA, J.O.V.** 2016. OPTIMIZATION OF CULTURE CONDITIONS FOR MYCELIAL GROWTH OF *Lentinus sajor-caju* COLLECTED FROM BANAUE, IFUGAO PROVINCE. Undegraduate thesis. Department of Biological Sciences, College of Arts and Sciences, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines.
- OSEMWEGIE, O.O., ISIKHUEMHEN, S.O., ONYOLU, O. J. AND J.A. OKHUOYA.** 2002. "Cultivation of Selected Sporophore-Only Producing Strain of the Edible and Medicinal Mushrooms; *Pleurotus tuber-regium* (Fr.) Singer (Agaricomycetidae) on Waste Papers and Plantain Peelings," International Journal of Medicinal Mushrooms, 4 (4); 343-348.
- OSEMWEGIE, O., OKHUOYA, A.J., AND T. DANIA.** 2014. Ethnomycological Conspectus of West African Mushrooms: An Awareness Document. Advances in Microbiology.
- PARK, W.H. AND H.D. LEE.** 1999. Illustrated book of Korean Medicinal mushrooms. Kyo-Hak Publishing C. Ltd., 759.
- QI, L.L., AN, Y. AND Y. LI.** 2011. Selected biological characteristics and artificial cultivation of *Oudemansiella brunneomarginata*. *Acta Edulis Fungi*. 18; 35-38.
- RIBAS, L.C.C., DE MENDONÇA, M.M., CAMELINI, C.M., AND C.H.L. SOARES.** 2009. Use of spent mushroom substrates from *Agaricus subrufescens* (syn. *A. blazei*, *A. brasiliensis*) and *Lentinula edodes* productions in the enrichment of a soil-based potting media for lettuce (*Lactuca sativa*) cultivation: growth promotion and soil bio-remediation. *Bioresearch Technology*, 100; 4750-4757.
- RUEGGER, M.J.S., TORNISIELO, S.M.T., BONONI, V.L.R., AND M. CAPELARI.** 2001. Cultivation of the edible mushroom *Oudemansiella canarii* (Jungh.) Hohn. in lignocellulosic substrates. *Brazilian Journal of Microbiology*, 32; 211-214.
- SEVILLA, N.R.L.** 2012. Optimization of Culture Conditions for Mycelia and Basidiocarp Production of *Pleurotus ostreatus* (Jacq. ex Fr.) Kumm. Undegraduate thesis. Department of Biological Sciences, College of Arts and Sciences, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines.
- SHIM, J.O., CHANG, K.C., KIM, T.H., LEE, Y.S., LEE, U.Y., LEE, T.S., AND M.W. LEE.** 2006. The fruiting body formation of *Oudemansiella radicata* in the Sawdust of Oak (*Quercus variabilis*) mixed with rice bran. *Mycobiology*, 34; 30-33.



- SMITH, D., RYAN, M.J., AND J.G. DAY. 2001.** The UK National Culture Collection (UKNCC) Biological Resource: Properties, Maintenance and Management at United Kingdom national culture collection.
- SNOWDON, W., OSBORN, T., AARBERLSBERG, B. AND J. SCHULTZ. 2003.** Coconut its role in health. Retrieved May 12, 2012 from the World Wide Web.
- STAMETS, P. 2000.** Growing Gourmet and Medicinal Mushrooms. Berkeley, CA: Ten Speed Press, 3.
- STAMETS, P. 2005.** Mycelium Running: How Mushroom Can Help Save the World. Berkeley and Toronto: Ten Speed Press, 574.
- STANLEY, O.H. AND G.D. AWI-WAADU. 2010.** Effect of Substrates of Spawn Production on Mycelial Growth of Oyster Mushroom Species. Research Journal of Applied Sciences, 5; 161-164.
- TSAI, S.Y., HUANG, S.J., LO, S.H., WU, T.P., LIAN, P.Y. AND J.L. MAU. 2009.** Flavour components and antioxidant properties of several cultivated mushrooms. Food Chemistry, 113(2); 578 – 584.
- VALDEZ, A.S. 2014.** Optimization of culture conditions for mycelial growth of *Pleurotus djamour* (rumph. Ex fr.) Boedjin. Undegraduate thesis. Department of Biological Sciences, College of Arts and Sciences, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines.
- WONG, J.Y. AND F.Y. CHYE. 2009.** Antioxidant properties of selected tropical wild edible mushrooms. Journal of Food Composition and Analysis, (22); 269-277.
- ZERVAKIS, G., PHILIPPOUSSIS, A., IOANNLDOU S. AND P. DLAMANTOPOULOU. 2001.** Mycelium growth kinetics and optimal temperature conditions for the cultivation of edible mushroom Chang S. T. and Miles P. G. 2004. Mushrooms-Cultivation, Nutritional value, Medicinal effect, and Environmental Impact. 2nd ed. CRC Press, London, 27-37.