Biocatalysis and Agricultural Biotechnology 9 (2017) 19–27

Contents lists available at ScienceDirect

Biocatalysis and Agricultural Biotechnology

journal homepage: www.elsevier.com/locate/bab

Identification of molecular species of acylglycerols of Philippine wild edible mushroom, *Ganoderma lucidum*☆

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ARTICLE INFO

Keywords:
Basidiomycetes
Ganoderma lucidum
Liquid cultivation
Bioactive lipids
Fatty acids
Triglycerides

ABSTRACT

We identified the lipid species of the solvent extract from liquid-cultured mycelium of *G. lucidum* NRRL66208. The molecular species of acylglycerols containing all normal fatty acids were identified. One hundred and three molecular species of acylglycerols containing all normal fatty acids were identified by the MS fragmentation involved their constituent fatty acids. The chain lengths of the constituent fatty acids were from 14 to 26 carbon atoms and the numbers of double bonds were from zero to three. The contents of the molecular species of triacylglycerols in the mushroom lipid extract in decreasing order were: OOP (2.45%), OOO (1.94%), LLP (1.92%), OLP (1.80%), LLO (1.57%), OPP (1.30%), OOL (1.09%), OOS (0.88%), and LLL (0.85%). Forty one molecular species of acylglycerols out of 103 contained fatty acids with odd numbered carbon atoms. The fatty acids with odd numbered carbon atoms were 15:0, 17:0, 17:1, 19:0, 19:1, 21:0, 23:0 and 25:0. The total content of fatty acids with odd numbered carbon atoms was about 6.6% of all of the fatty acids of the triacylglycerols containing three normal fatty acids, and contents of individual fatty acids with odd numbered carbon atoms were as: 15:0 (2.76%), 17:0 (2.13%), 17:1 (1.35%), 19:0 (0.20%), 19:1 (0.17%). The contents of fatty acids with odd numbered carbon atoms in mushroom were high compared to those in higher plants. This is the first report on the molecular species of acylglycerols in mushroom.

1. Introduction

Mushrooms are basidiomycetous fungi which are naturally found growing on lignin-cellulosic substrates in the temperate and tropical regions. More than 2000 species of mushrooms exist in nature. Among them, only 25 species are widely accepted as food and only a few have attained commercial status. Mushrooms are becoming more and more important in our diet for their nutritional, organoleptic, and pharmacological characteristics (Barros et al., 2007). Mushrooms are rich in carbohydrate, protein, ash, and low-fats which make them suitable as healthy food. Some Philippine wild edible mushrooms have been studied for their nutritional and functional activities. Fruiting bodies of mushrooms like *Schizophyllum commune, Lentinus tigrinus, Lentinus sajor-caju, Ganoderma lucidum, Collybia reinakeana* and *Paneaolus antillarium* exhibited anti-diabetic, antibacterial, anti-inflammatory, antioxidant, antihypertensive, and anti-coagulative properties (Reyes et al., 2004; Dulay et al., 2014, 2015a; Eguchi et al., 2014). These valuable bioactivities of Philippine mushrooms are now being recognized for their healthful benefits and economic importance.

We succeeded in growing the mycelia of four wild edible medicinal Philippine mushrooms, including *Ganoderma lucidum, Pleurotus cystidiosus, Volvariella volvacea,* and *Schizophyllum commune*, in liquid culture (Dulay et al., 2015b). *Ganoderma* species are one of the most widely studied medicinal mushrooms due to their potent bioactive properties. *G. lucidum* has been used as a medical remedy in China and Japan for centuries. Traditionally known as the God of fungi, it has been used routinely and said to work for every health related problem. *G. lucidum* has properties often associated with health and healing and is considered to promote longevity (Shiao and Lee, 1994). *Ganoderma* has a large amount of bioactive molecules and there is no single molecule in this mushroom that can be said to be the main bioactive component (Borchers et al., 1999). The components of this mushroom

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http://dx.doi.org/10.1016/j.bcab.2016.10.013
Received 7 September 2016; Received in revised form 27 October 2016; Accepted 28 October 2016
Available online 05 November 2016
1878-8181/ Published by Elsevier Ltd.

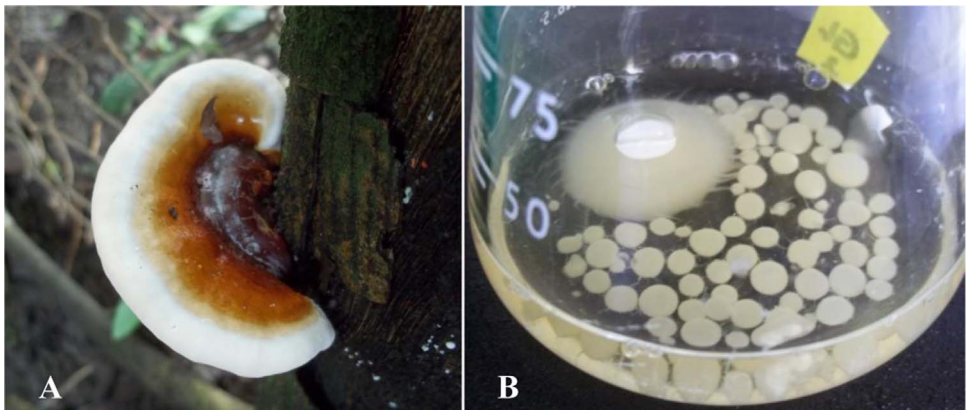

Fig. 1. Wild fruiting bodies (A) and liquid culture (B) of Philippine strain *Ganoderma lucidum*.

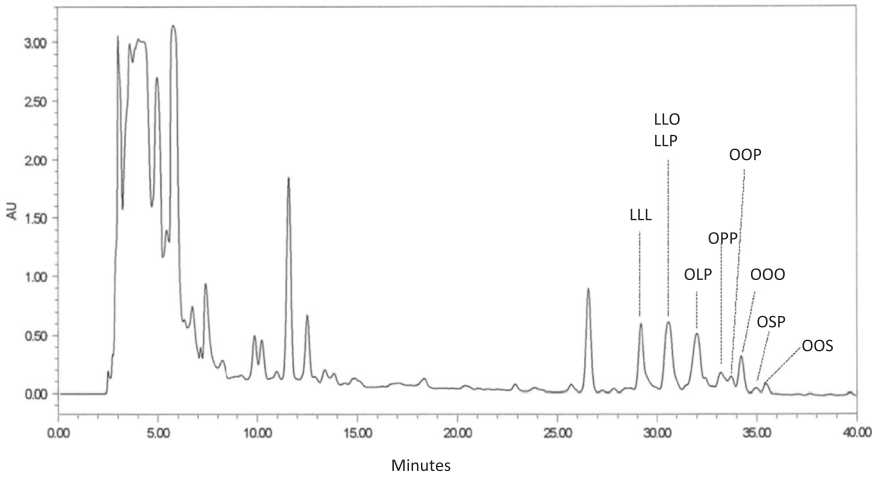

Fig. 2. HPLC chromatogram of mushroom lipid extract (1 mg) for fractionation (0.5 min/fraction). For HPLC conditions, see experimental procedure. The variation of the retention times of the eight HPLC fractionations (in the same day) pooled together was less than 0.1 min. For retention times of minor molecular species of acylglycerols, refer to HPLC fraction # of the molecular species of in Table 1 (fraction/0.5 min). For abbreviations of fatty acid constituents of triacylglycerols, see appendix of Table 1.

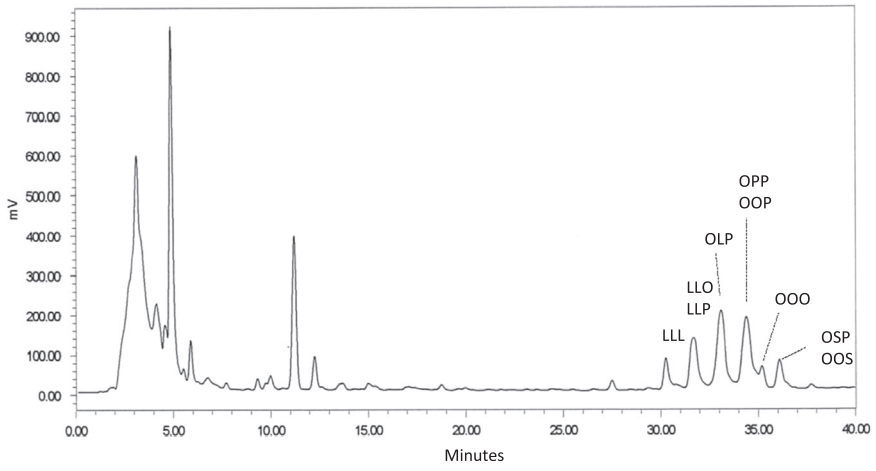

Fig. 3. HPLC chromatogram of mushroom lipid extract (0.06 mg) using evaporative light scattering detector. For HPLC conditions, see experimental procedure. For abbreviations of fatty acid constituents of triacylglycerols, see footnotes of Table 1.

reported to date are triterpenoids, polysaccharides, proteins, minerals, phenols, nucleotides and their derivatives, glycoproteins and sterols. It contains 1.8% ash, 26–28% carbohydrate, 3–5% crude fat, 59% crude fiber and 7–8% crude protein (Chang, 1996). Polysaccharides, Peptidoglycans and triterpenes are three major physiologically active constituents in *G. lucidum* (Boh et al., 2007).

Edible mushrooms have low lipid content, varying from 1.1% to 8.3% (dry weight), with an average of 4.0% (Chang and Miles, 2004) and a high proportion of polyunsaturated fatty acids (PUFAs), which gives them added value as a healthy food, recommended for including in the diet of people with high concentration of cholesterol in blood (Chang and Buswell, 1996; Helena et al., 2009; Kavishree et al., 2008). Several studies have elucidated the fatty acids composition of wide variety of wild edible mushrooms around the world (e.g. Ribeiro et al., 2009; Ergönül et al., 2013) in order to establish their functions not only in the human diet but most importantly for pharmacological purposes.