Proximate Composition and Functionality of the Culinary-Medicinal Tiger Sawgill Mushroom, *Lentinus tigrinus* (Higher Basidiomycetes), from the Philippines

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**ABSTRACT:** The proximate composition and functionality of *Lentinus tigrinus* were evaluated to establish and popularize this mushroom as functional food source. The evaluation of functionality focused on the antibacterial and hypoglycemic activities of the mushroom extracts. An acute single oral dose toxicity test in mice was used for its biosafety analysis. The pileus contained higher amounts of protein (25.9%), fat (2.1%), and ash (7.4%) and a higher energetic value (142.1 kcal/100 g) than the corresponding stipe, whereas the stipe contained higher amounts of total carbohydrates (67.7%), which consist of dietary fiber (63.0%) and reducing sugar (4.7%), than the pileus. Biosafety analysis confirmed that *L. tigrinus* is an edible mushroom species; it was found to be toxicologically safe in imprinting control region mice. The administration of lyophilized hot water extract of the fruiting body (both 100 and 250 mg/kg doses) to diabetic mice significantly lowered the glucose level by 26.9% in the third week, which was significantly comparable to the results of the antidiabetic agent glibenclamide, which was used as a positive control. In *in vitro* antibacterial assay showed that the ethanol extract of the fruiting body and the immobilized secondary mycelia had high antibacterial activities against *Staphylococcus aureus* but not on *Escherichia coli*. Combining its useful nutrients and significant biological properties, *L. tigrinus* can be considered a natural source of safe nutraceuticals.

**KEY WORDS:** medicinal mushrooms, *Lentinus tigrinus*, proximate composition, biological property, biosafety, mushroom nutraceuticals

**ABBREVIATIONS:** ANOVA, Analysis of Variance; AOAC, Association of Official Analytical Chemist; CTMR, Center for Tropical Mushroom Research and Development; DF, dietary fiber; EtLE, ethanol extract of *L. tigrinus*; ICR, imprinting control region; ISM, immobilized secondary mycelia; LLE, *L. tigrinus* lyophilized extract; LSD, least significant difference; MC, moisture content; NB, nutrient broth; PDA, potato dextrose agar; RS, reducing sugar; SP, soluble polysaccharide.

I. INTRODUCTION

Most of the causes of death in the Philippines are diet-related diseases, particularly heart diseases.1 Considering this fact, Filipinos are now searching for organic foods with important nutrients and multifunctional activities. Foods having these properties are known as nutraceuticals.2 Edible mushrooms are considered nutraceuticals because they contain bioactive proteins, polysaccharides, minerals, vitamins, very low fat,3–6 and metabolites such as alkaloids, terpenoids, lectins, lactones, sterols, and phenolic substances.7 These have emerged as natural sources of compounds that have antioxidant, antitumor, antibacterial, immunomodulating, cardiovascular protective, radical scavenging, antihypercholesterolemic, antidiabetic, antiviral, antiparasitic, and antifungal activities.8–11

In nature, the basidiomata of mushrooms develop from the successful mycelial colonization of the entire lignocellulosic microhabitat, indicating that these fungi produce bioactive compounds that effec-
tively inhibit the development of a large spectrum of other microorganisms.\textsuperscript{12,13} For instance, \textit{Marasmius scoronius}, \textit{Lentinus edodes}, \textit{Pycnoporus sanguineus}, \textit{Ganoderma applanatum}, \textit{Phellinus spp.}, \textit{Agaricus} cf. \textit{nigrecentulus}, \textit{Agrocybe perfecta}, \textit{Irpex lacteus}, \textit{Gloeoporus thelephoroides}, and \textit{Hexagonia hydnoide} exhibit antibacterial and antifungal activities against pathogenic and nonpathogenic microorganisms.\textsuperscript{14–18} In addition, mushrooms also are considered natural medicines with hypoglycemic activities.\textsuperscript{19} \textit{Agrocybe cylindracea}, \textit{Phellinus linteus}, \textit{Grifola frondosa}, \textit{Lentinus edodes}, and \textit{Ganoderma lucidum} are reported to be effective against diabetes.\textsuperscript{20–24} Indeed, higher Basidiomycetes can be promising multifunctional food sources.

Our team is continually searching for wild edible mushrooms with nutraceutical potential in the Philippines. One of the candidates is the Tiger sawgill mushroom, \textit{Lentinus tigrinus} (Bull.) Fr. (Polyporaceae, higher Basidiomycetes). This white wood-rotting basidiomycete was found growing on decaying logs in the forest area of Central Luzon State University, Science City of Muñoz, Nueva Ecija, and its cell lines were rescued. We recently established the optimum cultural conditions and production technology for this mushroom.\textsuperscript{25} Its secondary mycelia grow best on solid coconut water gulaman (local crude agar) medium with a pH range of 7.0–8.0, incubated either sealed or unsealed in the dark and at room temperature (32°C). The 2 parts sawdust + 8 parts rice straw (v/v) substrate formulation is the most efficient medium for fruiting body production. To establish and popularize this wild mushroom in the market, studies of its nutraceutical profile are deemed necessary.

With the aim of reporting another nutritious, multifunctional, and safe food source to fight diet-related diseases, we investigated the proximate composition and bioactive properties such as hypoglycemic and antibacterial activities of \textit{L. tigrinus}. The acute single oral dose toxicity of this species in mice also was evaluated.

II. MATERIALS AND METHODS

A. Culture and Basidiocarp Production

Pure culture of \textit{L. tigrinus} was obtained from the Center for Tropical Mushroom Research and Development. An approximately 10-mm\textsuperscript{2} × 3-mm agar block from the pure stock culture of \textit{L. tigrinus} was aseptically transferred into sterile potato dextrose agar plate and incubated at room temperature to allow mycelial growth.

Basidiocarp production was based on the production technology of \textit{L. tigrinus} established by Dulay et al.\textsuperscript{25} The 7-day-old culture was used for grain (unmilled rice) spawning. After full colonization, grains were aseptically inoculated into sterilized fruiting bags (polypropylene) containing a compacted rice straw–sawdust (8:2 v/v) substrate formulation. Bags were incubated at room temperature (30°C). The fully ramified bags were opened at both ends to allow fruiting bodies to develop. Fruiting bodies were harvested, and the stipes were separated from the pileus and shredded before they were dried in natural air for 1 week.

B. Proximate Composition

Fresh fruiting bodies and the air-dried pileus and stipe of the fruiting bodies of \textit{L. tigrinus} were brought to the Lipa Quality Control Center (Bocaue, Bulacan, Philippines) and FAST Laboratories (Cubao, Quezon City, Philippines) for proximate composition analysis. Crude protein, crude fat, ash, crude fiber, reducing sugar, and moisture content were analyzed according to the guidelines of the Association of Official Analytical Chemists.\textsuperscript{26} The crude protein was determined using the Kjeldahl method, using the conversion factor \( N \times 4.38 \). The Soxhlet apparatus was used to determine the crude fat content and the furnace was set at 550°C to collect the ash. Total carbohydrate content was calculated as follows: total carbohydrates = 100 – (protein + fat + ash + moisture content). Total carbohydrate consists of reducing sugars (RSs) and dietary fiber (DF), which consists of crude fiber and soluble polysaccharides.\textsuperscript{27} RS
content was determined using the Munson-walker method. Soluble polysaccharide content then was calculated by subtracting the crude fiber and RS contents from the total carbohydrate content; DF was determined by adding the crude fiber and soluble polysaccharide contents. Energy value was computed following the formula of Ulziijargal and Mau: \[\text{Energy (kcal/100 g)} = (\text{RS} \times 4) + (\text{fat} \times 9) + (\text{protein} \times 4)\]. Values of dried (stipe and pileus) and fresh fruiting bodies were expressed as means ± standard deviations.

C. Extraction of Mushroom

The functional components of the \textit{L. tigrinus} were obtained through hot-water extraction following the procedure described by Eguchi et al.\textsuperscript{28} The active components of the milled mushroom samples (20 g) were extracted in a 600-mL hot water bath (80–90°C) for 2 hours. The milled mushrooms were separated from the extract by filtration using Whatman filter paper no. 2 then filter sterilized through 0.45-μ filters. The filtrate was brought to the Chemistry Laboratory at De La Salle University (Manila, Philippines) for freeze-drying for 3 days to obtain the lyophilized extract (LLE). The yield of the extract was 8.0% on a dry weight basis. Ethanol extract of \textit{L. tigrinus} was prepared for antibacterial assay. The dried milled mushroom (100 g) was extracted with ethanol at room temperature for 24 hours and filtered. The filtrate was concentrated using a rotary evaporator, which yielded 10.0% extract.

D. Acute Single Oral Dose Toxicity

The protocols for a test to determine the single oral dose toxicity of mushrooms, as described by Eguchi et al.\textsuperscript{29} and Inatomi et al.,\textsuperscript{30} were adopted with minor modifications. Before oral administration of the extract, the 4-week-old female ICR mice (21–34 g body weight) were starved for 16 hours. Diabetes was induced by a single intraperitoneal injection of alloxan (Chemline Scientific Enterprises) freshly dissolved in 0.2 mL saline (154 mM sodium chloride) at a dose of 150 mg/kg body weight.\textsuperscript{31} Forty-eight hours after injection of alloxan, plasma glucose was determined, and mice with levels >117 mg/dL were considered diabetic and included in the study. Diabetic mice were randomly divided into 4 groups of 6 mice. The number of mice in each group was determined based on the experiments of Hwang et al.\textsuperscript{19} and Ahmed et al.\textsuperscript{31} Mice in groups I and II were treated with 100 and 250 mg/kg LLE, respectively; mice in group III (positive control) received glibenclamide 2 mg/kg; and nontreated mice in group IV served as the negative control. The animals were administered 200 μL of the specified treatment by oral gavage twice a day for 21 days. Blood samples were collected weekly: the tip of tails of the experimental animals, which had been starved for 8 hours, were injected with 0.02 mL of anaesthesia (Zoletil 50) then pricked; blood then was dropped directly onto the glucose strips. Blood glucose level was mea-
sured using a digital glucometer (Major II). Preweighed feeds and water were supplied ad libitum after the blood sampling. The body weight gain also was measured.

2. Antibacterial Activity

The antibacterial activities of fruiting body extracts and immobilized mycelia of L. tigrinus were determined following the paper disc diffusion method described by Bauer et al.32 Gram-positive Staphylococcus aureus and Gram-negative Escherichia coli were cultured in 9 mL of nutrient broth medium and incubated at 37 °C. After 24 hours, the turbidity of each bacterial culture was adjusted to equal that of 0.5 McFarland standard, which approximated $1.5 \times 10^4$ mL$^{-1}$. The bacterial suspension was spread on a nutrient agar plate using a sterile cotton swab. Paper discs (6-mm diameter) impregnated with ethanol extract (20 μL) and LLE (20 μL) at 1 g/mL were dissolved in sterile distilled water, and immobilized secondary mycelia (mycelial disc immobilized in an oven at 40°C for 2 days) and streptomycin (used as standard) were placed equidistant on the medium. Plates were incubated at 37°C, and the zones of inhibition were measured after 24 hours. Each test was done in triplicate.

F. Statistical Analysis

Data were analyzed using one-way analysis of variance and means of hypoglycemic activity were compared using the least significant difference test at a 5% level of significance. The statistical difference of the proximate compositions between the stipe and pileus of the dried mushroom was determined using the $t$ -test. All values are presented as means ± standard deviations. SAS statistical program version 9.1 was used for analysis.

III. RESULTS AND DISCUSSION

A. Proximate Composition

Mushrooms are popular foods mainly because of their exotic taste, culinary properties, and aroma. The proximate nutritional composition and estimated energetic value of the fresh fruiting body and air-dried pileus and stipe of fruiting bodies of L. tigrinus are depicted in Table 1. The fresh sample contained 88.6% moisture, 0.7% ash, 3.7% protein, 0.2 fat, 6.8% carbohydrates (0.1% RS and 6.7% DF) and 17.0 kcal/100 g energy. The dried pileus had higher amounts of crude protein (25.9%), crude fat (2.1%), ash (7.4%), and moisture (12.2%) and a higher energy value (142.1 kcal/100 g) than the corresponding dried stipe. On the other hand, the dried stipe was found to contain a significantly higher amount of total carbohydrates (67.7%) consisting of DF (63.0%) and RS (4.7%). These results indicate that L. tigrinus is richly endowed with nutrients. The findings agree with the previous report by Moore and Chi33 that edible mushrooms have promising nutritional composition and great potential applications in food industries.

Total carbohydrate content was higher in the stipe than in the pileus. This result is congruent with the carbohydrate content of Lentinus squarrosulus, which is higher in the stipe (65.07%) than in the pileus (56.23%).34 It can be noted of the nutrients in L. tigrinus, carbohydrate content was the highest. This high total carbohydrate composition is attributed to the valuable amounts of RSs and DF, which comprise soluble and insoluble polysaccharides (crude fiber). RS is the only carbohydrate content responsible for human energy uptake and blood glucose increases.27 Both the dried pileus and stipe of L. tigrinus contained comparable amounts of RS: 4.9% and 4.7%, respectively. Although these values are low compared to culinary-medicinal mushrooms studied by Ulzijargal and Mau,27 this information suggests importance of L. tigrinus in the diabetic diet.

DF is another component of the total carbohydrate content with essential physiological effects. The dried stipe had significantly higher DF (63.0%) than the pileus (47.5%). These values are within the range of DF in other culinary-medicinal mushrooms: 33.58% (in Cordyceps, the lowest) to 82.85% (in Inonotus obliquus, Chaga, the highest).27 This result indicates that L. tigrinus fruiting bodies are a very good source of DF with
### TABLE 1: Proximate Nutritional Composition and Energy Value of the Fresh and Air-Dried Pileus and Stipe of Fruiting Bodies of *Lentinus tigrinus*

<table>
<thead>
<tr>
<th>Sample</th>
<th>MC</th>
<th>Ash</th>
<th>Protein</th>
<th>Fat</th>
<th>RS</th>
<th>SP*</th>
<th>Fiber</th>
<th>DF†</th>
<th>Total</th>
<th>Energy‡ (kcal/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh</td>
<td>88.6 ± 0.4</td>
<td>0.7 ± 0.1</td>
<td>3.7 ± 0.2</td>
<td>0.2 ± 0.1</td>
<td>0.1 ± 0.0</td>
<td>4.7 ± 0.7</td>
<td>2.0 ± 0.1</td>
<td>6.7 ± 0.8</td>
<td>6.8 ± 0.8</td>
<td>17.0 ± 1.7</td>
</tr>
<tr>
<td>Pileus</td>
<td>12.2 ± 0.4</td>
<td>7.4 ± 0.3</td>
<td>25.9 ± 0.1</td>
<td>2.1 ± 0.4</td>
<td>4.9 ± 0.2</td>
<td>30.1 ± 0.3</td>
<td>17.4 ± 0.5</td>
<td>47.5 ± 0.4</td>
<td>52.4 ± 0.5</td>
<td>142.1 ± 4.4</td>
</tr>
<tr>
<td>Stipe</td>
<td>10.5 ± 0.2</td>
<td>4.0 ± 0.1</td>
<td>15.7 ± 0.1</td>
<td>1.9 ± 0.0</td>
<td>4.7 ± 0.1</td>
<td>38.3 ± 0.6</td>
<td>24.7 ± 0.4</td>
<td>63.0 ± 0.2</td>
<td>67.7 ± 0.3</td>
<td>98.7 ± 0.2</td>
</tr>
<tr>
<td>Pileus-to-stipe ratio (%)</td>
<td>86.1</td>
<td>54.1</td>
<td>60.6</td>
<td>90.5</td>
<td>95.9</td>
<td>78.6</td>
<td>70.4</td>
<td>75.4</td>
<td>77.4</td>
<td>69.5</td>
</tr>
</tbody>
</table>

Data are presented as mean percentages ± standard deviations (n = 3) unless otherwise indicated. *Significant difference between the pileus and stipe of *L. tigrinus*.

* Soluble polysaccharide (SP) calculated as: Total – (reducing sugar [RS] + fiber).
† Dietary fiber (DF) calculated as: SP + fiber.
‡ Energy (kcal/100 g) calculated as: (protein × 4) + (fat × 9) + (RS × 4).
MC, moisture content.
various polysaccharides. The polysaccharide fraction isolated from G. lucidum exhibited antitumor and anti-inflammatory activities, whereas crude exopolysaccharides from the medicinal mushroom Phellinus baumii showed a hypoglycemic effect. Soluble and insoluble polysaccharides (crude fiber) also were found in both the dried pileus and stipe of L. tigrinus. Interestingly, both polysaccharides were significantly superior in the stipe than its corresponding pileus. Fruiting bodies of L. tigrinus contained soluble polysaccharides ranging from 30.1% (in the pileus) to 38.3% (in the stipe), whereas crude fiber contents ranged from 17.4% (in the pileus) to 24.7% (in the stipe). With these biologically active components, L. tigrinus is a medicinal mushroom.

The protein content of the dried pileus alone is superior when compared to the dried fruiting bodies of L. edodes (13–17%) and Auricularia polytricha (4–8%) and within the range of the protein content of dried Volvariella volvacea (25–29%) and Amanita brunnescens (24–34%). Furthermore, the observation on higher protein content of the pileus than the stipe conforms with the finding of Nwanze et al. that the pileus of L. squarrosulus (27.25%) has higher protein composition than the stipe (18.32%). Indeed, mushrooms can play an important role in enriching human diets; with the protein content of mushrooms ranging from 3–7% when fresh and 25–40% when dry, they can be used as an alternative to meat, fish, and milk. Hence, L. tigrinus is a dietary source of protein.

The ash content is the total amount of minerals present within a food. The ash level obtained in the pileus was superior to the corresponding stipe. The 7.4% ash content in L. tigrinus conformed with the value obtained by Adejumo and Awosanya but was higher than the ash content of L. edodes, Lyophyllum shimeji, Pleurotus sajor-caju, and V. volvacea reported by Cheung. This amount of ash content could be equated to macrominerals such as magnesium (11 g/kg), sodium (0.2 g/kg), calcium, and potassium and microminerals such as iron (497 mg/kg), copper (6 mg/kg), and manganese (50 mg/kg) in L. tigrinus, as reported by Adejumo and Awosanya. The crude fat content of mushrooms in general can comprise <1% to as high as 15–20% of the dry weight, with an average of 2–8% fat. In the present study, L. tigrinus was found to have very low amounts of crude fat when compared to L. squarrosulus, although still within the average crude fat content of mushrooms in general.

The air-dried sample had a higher amount of moisture in the pileus than in stipe, which is contrary to previous observations in L. squarrosulus. The moisture content values obtained in both parts of the fruiting body conformed with the average moisture content (10–12%) of the air-dried mushrooms. The high moisture content in the fresh sample indicates that good post-harvest management must be undertaken in order to control microbial growth and enzymatic activity. Based on the chemical analysis of L. tigrinus, it was calculated that 100 g of dry mushroom could give 98.7–142.1 kcal of energy, which is within the energetic values (46.96–292.37 kcal/100 g) of culinary-medicinal mushrooms reported by Ulziijargal and Mau.

The proximate chemical composition of a Nigerian sample of L. tigrinus had been previously determined by Adejumo and Awosanya. Discrepancy of values could be attributed to different factors such as medium composition, mushroom strain, and management after harvest.

B. Food Safety Analysis

With the promising nutritional attributes of L. tigrinus, it is important to take its safety and edibility as a food into considerations using a single oral dose toxicity test. In this study, a total of 25 homogenous female ICR mice were used. Both treated and control mice showed discomfort within an hour after administration. Discomfort could be an effect of stress brought by the oral administration of the extract or distilled water (negative control). However, few bowel movements were observed after 6 hours in mice administered the highest dose (1000 mg/kg body weight), whereas no signs of discomfort or any abnormal external manifestations were observed among the treated and control mice 12 hours after treatment. There was no mortality or any evidence of adverse toxic effects.
noted in both treated and nontreated mice after the 48-hour observation period following administration of the acute single oral dose. These significant results suggest that the extract of *L. tigrinus* is toxicologically safe via oral administration; it is therefore recommended as an edible mushroom. Furthermore, Karunarathna et al.\(^\text{42}\) reported that almost all of the members of the *Lentinus* genus are edible, except those that have a tough texture. This finding also conforms with the nontoxic effect of *L. squarrosulus*, which was shown to have no effect on mortality when intraperitoneally injected into mice.\(^\text{43}\)

### C. Functional Activity

#### 1. Hypoglycemic Activity

Management of diabetes mellitus is focused on lowering high blood glucose levels to normal levels.\(^\text{44}\) In this study, the antidiabetic activity of *L. tigrinus* was assessed by determining the reduction of blood glucose level in alloxan-induced diabetic mice. Figure 1 shows the effect of LLE on the plasma glucose levels of diabetic mice. In mice treated with glibenclamide (positive control group), the plasma glucose level continuously decreased throughout the observation period, reaching a final level of 98 mg/dL. Similarly, the glucose level was significantly reduced in diabetic mice treated with 100 and 250 mg/kg of LLE, which was significantly comparable to glibenclamide. The administration of LLE at both doses lowered the glucose level by 26.9% during the third and final week of experimentation when compared with nontreated mice. Based on these results, administration of LLE to alloxan-induced diabetic mice displayed significant potential in diabetes management. As previously reported, oral administration of exopolysaccharides of *Ph. baumii*, *Tremella fuciformis*, and *Lentinus edodes\(^\text{23,45}\) and extracts derived from *Grifola frondosa* and *Ganoderma lucidum\(^\text{22,46}\) resulted in a reduction of the plasma glucose level in diabetic mice. The hypoglycemic activities of mushrooms are always chemically linked to the polysaccharides as \((1\rightarrow4)\)-linked and/or \((1\rightarrow6)\)-linked residues in a \((\beta\rightarrow1\rightarrow3)\)-\(\beta-D\)-glucan.\(^\text{20}\) This biological property could also be explained...
by the stimulation of pancreatic insulin secretion by the bioactive component of mushrooms, thus increasing consumption of glucose.\textsuperscript{19} Furthermore, Kiho et al.\textsuperscript{20} previously demonstrated that the high viscosity of mushroom polysaccharides prevented the rapid increase of glucose in the blood by delaying intestinal digestion and absorption.

The effect of LLE on body weight gain in diabetic mice also was determined (data not shown). No significant difference in body weight gain was observed between the groups of mice treated with 250 mg/kg LLE and glibenclamide, with 33.3\% and 42.9\% weight reductions, respectively, compared to the nontreated diabetic mice.

2. Antibacterial Activity

In addition to the study of hypoglycemic activity, \textit{L. tigrinus} was screened for the presence of antibacterial activities. Table 2 shows the results of the assays. It is noteworthy that both the fruiting body and secondary mycelia exhibited antibacterial activities. The ethanol extract of the fruiting body was found to have antibacterial activities against \textit{S. aureus}. In contrast, the extracts used in this study did not show activity against \textit{E. coli}. As previously reported in a number of studies, antimicrobial activity of an extract is solvent dependent. In the study by da Silva et al.,\textsuperscript{2} hexane and chloroform extracts of the 2 \textit{V. volvacea} strains were more active than the crude methanol extract, which showed low to moderate activity, whereas the ethyl acetate extract did not show activity against \textit{S. aureus}. The present study showed that the active antibacterial compound of the fruiting body was obtained using ethanol as the solvent extraction vehicle. This study further showed that the immobilized secondary mycelia also was active and able to demonstrate antibacterial activity with a mean zone inhibition diameter of 20.3 ± 2.0 mm. This result conforms with findings about the active effect of immobilized secondary mycelia of \textit{Schizophyllum commune} against \textit{E. coli} and \textit{S. aureus}.\textsuperscript{47}

It was established previously that \textit{L. tigrinus} under submerged cultivation was active against methicillin-resistant \textit{S. aureus} and a glycopeptide antibiotic-resistant strain of \textit{Leuconostoc mesenteroides}.\textsuperscript{48} Given these findings, however, the active constituents responsible for this biological property are still unknown and need to be identified and elucidated in the future.

IV. CONCLUSIONS

Our data demonstrate that \textit{L. tigrinus} contains very useful nutrients such as carbohydrates, proteins, and ash as well as low fat and high energetic value, all of which are on the list of healthy sources of the human diet. This mushroom is an edible species because it is toxicologically safe in ICR mice, as shown by the acute single oral dose toxicity test. Extracts of \textit{L. tigrinus} exhibited hypoglycemic ac-

\begin{table}[h]
\centering
\caption{Antibacterial Activity of \textit{Lentinus tigrinus} Against \textit{Staphylococcus aureus}}
\label{tab:antibacterial}
\begin{tabular}{|c|c|c|}
\hline
Mushroom Extract & Zone of Inhibition (mm)* & Antibacterial Activity \\
\hline
LLE & 8.0 ± 0.0 & Present \\
EtLE & 12.7 ± 1.2 & Present \\
ISM & 20.3 ± 2.0 & Present \\
Streptomycin & 25.0 ± 0.5 & Present \\
\hline
\end{tabular}
\footnote{The diameter of the disc used was 6.0 mm. Data are presented as means ± standard deviations (n = 3). LLE, lyophilized hot-water extract of the basidiome of \textit{L. tigrinus} (20 μL/disc at 1 g/mL in sterile distilled water); EtLE, ethanol extract of the basidiome (20 μL/disc) of \textit{L. tigrinus}; ISM, immobilized secondary mycelia of \textit{L. tigrinus}.}
\end{table}
tivity in alloxan-induced diabetic mice and antibacterial activity against \textit{S. aureus}. Considering these biological properties, this mushroom has great potential health benefits such as the management of diabetes mellitus and treatment of \textit{S. aureus} infection. In this regard, elucidation and identification of the bioactive components responsible for these biological properties are indeed necessary.

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