

EFFECT OF CULINARY MEDICINAL MUSHROOMS, *PLEUROTUS OSTREATUS* AND *P. CYSTIDIOSUS* ON FASTING AND POSTPRANDIAL GLYCAEMIA IN HEALTHY VOLUNTEERS

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ABSTRACT

Pleurotus ostreatus (Jacq.Fr.) P. Kumm. and *P. cystidiosus* OK Miller are culinary-medicinal mushrooms grown worldwide. Our previous studies have reported the promising oral hypoglycaemic potential of *P. ostreatus* and *P. cystidiosus* in both normal and alloxan-induced diabetic rats as well as the anti-inflammatory activity of *P. ostreatus*. This study evaluates the effect of suspensions of freeze dried and powdered *P. ostreatus* and *P. cystidiosus* on the fasting and postprandial serum glucose levels in healthy volunteers at a dose of 50 mg/kg body weight, followed by a glucose load. Safety of the both mushrooms after long term consumption by healthy volunteers was also investigated. There was a significant fasting and postprandial serum glucose reduction in *P. ostreatus* or *P. cystidiosus* groups when compared with respective control groups ($p < 0.05$). The percentage reduction in the fasting serum glucose levels for *P. ostreatus* and *P. cystidiosus* groups were 6.1% and 6.4% respectively and the postprandial serum glucose reductions were 16.4% and 12.1%. There were no significant differences in serum levels of liver enzymes, creatinine as well as estimated creatinine clearance before and after one month from the treatment. This indicated that the consumption of *P. ostreatus* and *P. cystidiosus* over a period of time did not cause any significant hepato cellular damage and detrimental effects in the renal system of the healthy volunteers. In conclusion, long-term consumption of *P. ostreatus* and *P. cystidiosus* appears to be effective as functional foods for glycaemic control.

Keywords: *Pleurotus ostreatus*, *Pleurotus cystidiosus*, hypoglycaemic, functional foods, glycaemic

INTRODUCTION

Diabetes mellitus is a chronic endocrine disorder characterized by hyperglycaemia, resulting from deficiency in insulin secretion, inaction of insulin or both [1]. The global prevalence of diabetes for all age-groups worldwide was estimated to be 2.8% in 2000 and 4.4% in 2030 [2]. In 2006, one in five adults in Sri Lanka has either diabetes or pre-diabetes while one-third of those with diabetes are undiagnosed [3]. Many different cultures of mushrooms have been used traditionally in the prevention and treatment of various diseases [4]. Recent studies have investigated and proven the traditional use of mushrooms as remarkable therapeutic agents. The main areas of medicinal studies include hepatoprotective, anti-inflammatory, anti-diabetic, anticancer and antimicrobial activity [5].

Two oyster mushrooms, *Pleurotus ostreatus* (Jacq.:Fr.) P. Kumm. and *P. cystidiosus* O.K. Miller (Pleurotaceae, higher Basidiomycetes) are culinary-medicinal mushrooms. These mushrooms are commonly known as American oyster and abalone respectively, were shown to possess antioxidant, antitumour, antinociceptive, antifungal, hypocholesterolaemic and hepatoprotective activity [6]. In our previous studies, we have demonstrated the anti-inflammatory activity of *P. ostreatus* [7] and the oral hypoglycaemic potential of *P. ostreatus* and *P. cystidiosus* [8] using animal models.

There is a lack of clinical evidence on *Pleurotus* mushrooms as an anti-diabetic agent despite the promising hypoglycaemic potential exhibited in animal models [9]. Since, promising acute and chronic oral hypoglycaemic potential of *P. ostreatus* and *P. cystidiosus* has already been established in both normal and alloxan-induced diabetic Wistar rats in our previous studies [8], there is a need to establish the effect in humans.

Hence, this study was designed to evaluate the effect of *P. ostreatus* and *P. cystidiosus* on fasting and postprandial glycaemia in healthy human volunteers. Functional foods based on medicinal mushrooms which are also called 'mushroom nutraceuticals' are becoming popularized [10]. Therefore, this study will also evaluate the safety of long term consumption of the two mushrooms.

MATERIALS AND METHODS

Place of study

This study was conducted at the Family Practice Centre and Department of Biochemistry, Faculty of Medical Sciences, University of Sri Jayewardenepura, Sri Lanka.

Ethical clearance

Ethical clearance (No. 599/11) was obtained from the Ethics Review Committee of the Faculty of Medical Sciences, University of Sri Jayewardenepura, Sri Lanka. Written informed consent was obtained from healthy volunteers.

Collection and preparation of mushrooms

Fresh mushrooms, *P. ostreatus* and *P. cystidiosus* were collected from a local farm. These were washed with water to remove soil particles and freeze-dried (Eyela, FD-5N, Japan) and ground with a commercial blender (Sonica, SA-317, China). Powdered samples of mushrooms were stored air-tight at 4 °C. The identification and authentication was done by studying the spore print and the shape of the cap and the stipe. Effect of long term administration of suspensions of freeze dried and powdered *P. ostreatus* and *P. cystidiosus* on fasting and postprandial serum glucose levels in healthy volunteers was studied.

A group of healthy volunteers were selected by an open advertisement (n=44) and fasting serum glucose levels were estimated using the glucose oxidase reagent kits (Biolabo reagents, France), following an overnight fast. All subjects received distilled water as the control at zero time. Thirty minutes later, 75 g of glucose in 300 ml of water was administered for two weeks. Two hours after the glucose load, postprandial serum glucose levels were measured. The subjects were divided into two groups and allocated to the two types of mushroom preparations *P. ostreatus* and *P. cystidiosus*. The two groups received the suspensions of freeze dried and powdered mushrooms at a dose of 50 mg/kg body weight daily for two weeks. After two weeks, the fasting serum glucose levels were assessed. Followed by this two groups received the respective mushroom suspension and glucose. Postprandial serum glucose levels were measured after two hours from the glucose load.

Effect of long term administration of suspensions of freeze dried and powdered *P. ostreatus* and *P. cystidiosus* on serum levels of key hepatic enzymes (ALT, AST, ALP and γ -GT), creatinine and creatinine clearance of healthy volunteers was studied. Base line values of alanine amino transferase (ALT), aspartate amino transferase (AST), alkaline phosphatase (ALP), gamma glutamyltransferase (γ GT) and creatinine levels of healthy volunteers were measured. Creatinine clearance was calculated using Cockcroft- Gault equation [1]. Serum levels of ALT, AST, γ -GT and creatinine were measured by using the reagent kits (Biolabo reagents, France) and serum ALP levels were measured by using the reagent kits from Stanbio Laboratory, Texas.

The subjects were divided into two groups as *P. ostreatus* and *P. cystidiosus* and received the respective mushroom at a dose of 50 mg/kg body weight daily for two weeks. The subjects were monitored for one month for any adverse effects and at the end of one month serum levels of ALT, AST, ALP, γ GT and creatinine were determined. Creatinine clearance was calculated.

Statistical analysis

Statistical analysis was done using SPSS 17. 'Student's *t* test was used to analyse the results for statistical significance. Final results were presented as mean \pm SEM. *p* values <0.05 were considered as significant.

RESULTS AND DISCUSSION

Effect of long term administration of suspensions of freeze dried and powdered *P. ostreatus* and *P. cystidiosus* on fasting and postprandial serum glucose levels in healthy volunteers

This study evaluated the oral hypoglycaemic activity of *P. ostreatus* and *P. cystidiosus* on healthy human volunteers. Fig. 1 and Fig. 2 shows the fasting and postprandial serum glucose levels of healthy volunteers at the two groups of *P. ostreatus* and *P. cystidiosus*. The fasting serum glucose levels of *P. ostreatus* group was reduced by 6.1% and that of *P. cystidiosus* group by 6.4%. The percentage reduction in the postprandial serum glucose levels of *P. ostreatus* group was 16.4% and the group *P. cystidiosus* shows a reduction by 12.1%.

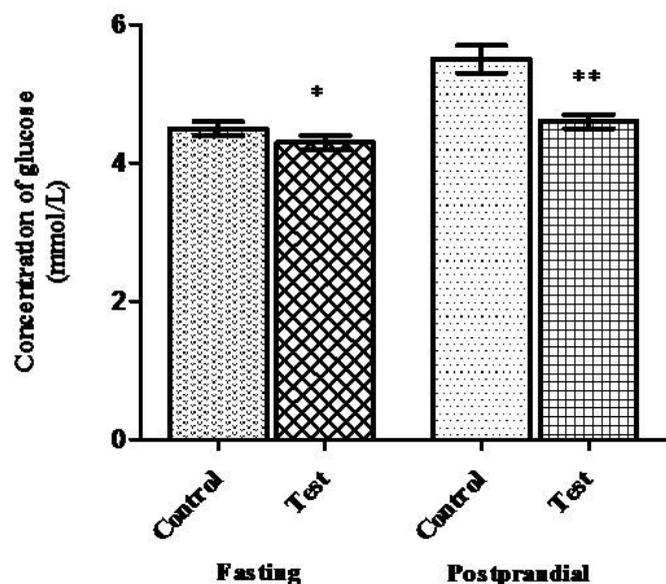


Figure 1. Effect of long term administration of suspensions of freeze dried and powdered *P. ostreatus* on fasting and postprandial serum glucose levels of healthy volunteers

Values are expressed as mean±SEM. * $p < 0.05$ and ** $p < 0.001$ when compared with the control group.

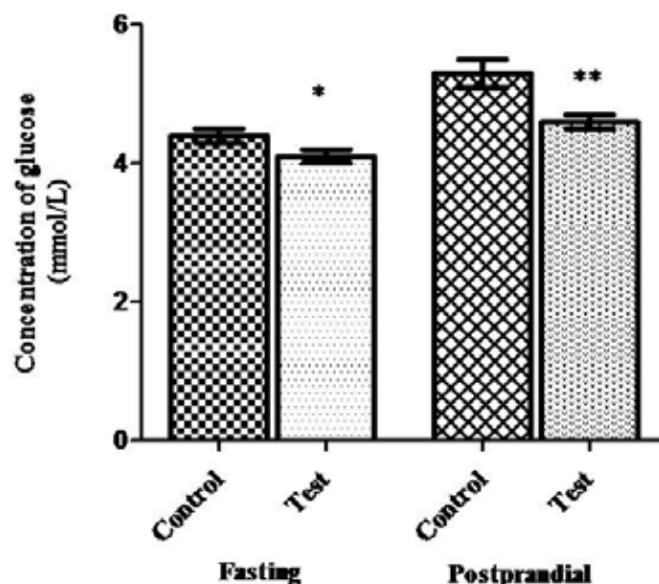


Figure 2. Effect of long term administration of suspensions of freeze dried and powdered *P. cystidiosus* on fasting and postprandial serum glucose levels of healthy volunteers

Values are expressed as mean±SEM. * $p < 0.05$ and ** $p < 0.01$ when compared with the control group.

When consumed for 2 weeks, both fasting and postprandial serum glucose levels were decreased significantly in healthy volunteers. Hence, this study suggest that long-term consumption of *P. ostreatus* and *P. cystidiosus* may be beneficial to humans by improving the glycaemic status. It has been reported that *P. sajor-caju* significantly reduced blood glucose level in diabetic subjects [11]. Effect of long term administration of suspensions of freeze dried and powdered *P. ostreatus* and *P. cystidiosus* on serum levels of key hepatic enzymes (ALT, AST, ALP and γ -GT), creatinine and creatinine clearance of healthy volunteers.

The serum levels of key hepatic enzymes and creatinine as well as calculated creatinine clearance at base line and after one month from the treatment was represented at Table 1. There were no significant differences in serum levels of ALT, AST, ALP, γ -GT and creatinine as well as calculated creatinine clearance at baseline and after one month from the treatment ($p > 0.05$). Hence, the consumption of *P. ostreatus* and *P. cystidiosus* over a period of time did not cause any hepato-renal damage in the healthy volunteers. According to our previous findings, the *P. ostreatus* and *P. cystidiosus* did not exert any toxic effects after long term administration to rats [12]. This study confirms the safety of long term consumption of *P. ostreatus* and *P. cystidiosus* by humans.

Table 1. Effect of long term administration of suspensions of freeze dried and powdered *P. ostreatus* and *P. cystidiosus* on serum levels of key hepatic enzymes (ALT, AST, ALP and γ -GT), creatinine and creatinine clearance of healthy volunteers

Treatment (50 mg / kg/b.w.)	ALT (IU/l)	AST (IU/l)	ALP (IU/l)	γ -GT (IU/l)	Creatinine (mg/dl)	Creatinine clearance (mL/min)
Base line	24.8±2.9	25.5±2.9	30.7±1.5	10.9±1.2	0.85±0.04	103.2±9.3
<i>P. ostreatus</i>						
After one month from the treatment	25.3±2.8	28.5±3.9	28.5±2.2	10.6±1.5	0.89±0.04	94.0±5.8
Base line	23.8±2.8	29.8±2.6	32.1±2.4	15.8±2.5	0.84±0.06	117.6±14.1
<i>P. cystidiosus</i>						
After one month from the treatment	24.2±2.6	29.5±2.2	33.2±2.9	15.6±2.1	0.89±0.05	104.2±9.6

Values are expressed as mean±SEM.

No statistically significant differences were observed between the base line and after one month values of tested parameters in each group.

CONCLUSION

The *P. ostreatus* and *P. cystidiosus* exerted significant hypoglycaemic effect in healthy volunteers challenged with glucose. The mushrooms are neither hepatotoxic nor nephrotoxic. Hence, this study confirms the suitability of *P. ostreatus* and *P. cystidiosus* as a hypoglycemic functional food for glycaemic control.

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