Australian Journal of Medical Herbalism **2010** 22(2)

Effect of oyster mushroom on glycemia, lipid profile and quality of life in type 2 diabetic patients

*Agrawal RP, Chopra A, Lavekar GS, Padhi MM, Srikanth N, Ota S, Jain S
Diabetes Care and Research Centre, SP Medical College, Bikaner, Rajasthan, India 334003
*Corresponding author email: drrpagrawal@yahoo.co.in

Aims and objectives: The aim of the study was to evaluate efficacy of oyster mushroom (*Pleurotus* spp) on glycemic control, lipid profile and diabetic quality of life in type 2 diabetic patients.

Material and method: Total 150 type 2 newly onset diabetics were recruited. After one month stabilisation period, 120 randomly selected patients were divided into three groups of 1, 2 and 3 given type A, B and C biscuits respectively by a dietician blindly. All three groups were given conventional treatment i.e. diet and exercise for 3 months. Anthropometric parameters, FBS and BP were recorded weekly and HbA1c, lipid profile, diabetic quality of life questionnaire were performed before and after treatment. After 3 months decoding was done and concluded that type A, B and C biscuits were ajwain, ajwain+mushroom and mushroom biscuits respectively.

Results: After 3 months period blood sugar (225.41±3.35 to 113.83±4.03; $p<0.005$), HbA1c (8.47±0.17 to 7.27±0.14; $p<0.02$) and blood pressure reduced in ajwain+mushroom group as well as in mushroom group (fasting blood sugar 212.9±4.29 to 112±1.37; $p<0.005$; HbA1c8.00±0.13 to 6.99±0.12; $p<0.05$). Significant improvement in lipid profile was also observed in same groups (ajwain+mushroom group 190.69±4.39 to 166.83±2.47; $p<0.001$; mushroom group 186.77±3.43 to 157.39±2.32; $p<0.05$). Diabetes quality of life also improved significantly. No extra effect was observed due to supplementation of ajwain.

Conclusion: Oyster mushroom (*Pleurotus* spp) consumption appears to be effective in controlling glycemic control, lipid profile and diabetic quality of life.

Statistical method: Using ANOVA, confidential limit and correlation.

Introduction

Health is a birth right of every individual and there is increasing evidence that the dietary habits of people are important determinants of health. Proper dietary substances can protect people from chronic diseases such as coronary heart disease, cancer, obesity and diabetes mellitus. Diabetes mellitus is a universal health problem affecting human society at all stages of development (Rai, Sohi 1998). Diabetes mellitus is a relatively common disorder in India, which has been defined in the genetically and clinically heterogeneous group of disorders. It is primarily caused by degeneration and inactivation of the β cells of islets of langerhans. There is a serious defect of carbohydrate, fat and protein metabolism in this disorder (Bahl 2000).

There are two major types of diabetes. Type 1 diabetes known as insulin dependent diabetes mellitus (IDDM), which is usually diagnosed in childhood. In this case the body makes little or no insulin and daily injections of insulin are required. Type 2 diabetes, known as non-insulin dependent diabetes mellitus (NIDDM) which is more common being about 90% of all diabetes cases and usually occurs in adulthood. In this type of diabetes diet, exercise or oral antidiabetic drugs may be sufficient to control the increased blood sugar levels (Visanthamein, Savita 2001).

Diabetes is a condition frequently controlled by proper dietary management. In recent years studies have indicated that a low glycemic index of food has a significant influence on blood glucose levels.

Traditional medicines such as mushrooms are very useful for treatment of certain health problems. Mushrooms are an edible fungi which have been used as an antidiabetic drug since ancient time. Mushrooms are nutritive and are richer in protein then cereals, pulses, fruits and vegetables on dry weight (Ghosh 1990). Due to their low calorific value mushrooms can be consumed by patients with hyperlipidemia (Bano 1982). They are completely devoid of starch and are an excellent inclusion in the diet of diabetic patients. Edible fungi produce secondary metabolites which possess various therapeutic properties. Mushrooms also contain ample minerals such as calcium, phosphorous, potassium, iron and copper. They have traditionally been used in the treatment and prevention of diabetes, obesity, heart disease, hyperacidity, constipation, cancer, blood pressure and hypertension (Suguna 1995).

Mushrooms are extremely useful in the prevention of diabetes mellitus due to the presence of polysaccharides and their low glycemic index, lack sugar and starch. This study was undertaken with the objective of incorporating mushrooms into Indian food products so that diabetic patients may get low fat, low calorie and sugar free products. Extracts and powders of mushrooms in the form of capsules or sugar coated tablets are being marketed (Yang, Jong 1989). Active principles are said to be immune stimulating polysaccharides strengthening health and immunity. Research has also shown that the maitake fraction may benefit people with non insulin dependent diabetes mellitus (King 1998).

Methods

A total of 150 type 2 newly onset diabetic patients were recruited from the outpatient department of Diabetes Care & Research Centre, SP Medical College, Bikaner. The patients were advised to follow a strict diet and exercise for one month. During this period frequent self monitoring of blood sugar was done to maintain euglycemic level. After one month of a stabilisation period 120 patients were selected having blood sugar levels 126-250 mg/dL. These 120 patients were randomly divided into three groups: group 1 (n=40), group 2 (n=40) and group 3 (n=40). Group 1 received biscuits of type A, group 2 received biscuits of type B and group 3 received biscuits of type C. Biscuits were given by a dietician who was unaware of the nature of biscuits.

Standardisation was done of the oyster mushroom before clinical trials.

Proximate composition of the *Pleurotus sajor-ciju*

Moist.	Protein	Fat	CHO	Fibre	Ash	Calories
90.2%	2.5%	0.2%	5.2%	1.3%	0.6%	35

Study design

The study was a randomised double blind study with history and clinical examinations carried out for suitable inclusion criteria. Dietary survey by 24 hour recall system was done. Anthropometric parameters, fasting blood sugar and blood pressure were recorded weekly and HbA1c, lipid profile, diabetic quality of life questionnaire (Rai 1988, 1998) were performed initially as well as after 3 months. Initial approval was from Ethics Committee, SP Medical College, Bikaner.

After 3 months decoding by a statistician it was concluded that type A biscuits were ajwain biscuit, type B were ajwain + mushroom and type C were mushroom biscuits. Patients were closely observed for any untoward effect during the study period.

Inclusion criteria

- Subjects with a diagnosis of type 2 diabetes mellitus (American Diabetes Association guidelines).
- Fasting blood sugar levels greater than 126 but less than 250 mg/dL.
- Written consent showing willingness to participate in the study.

Exclusion criteria

- Patients suffering from kidney disease, liver disease, arthritis, pulmonary tuberculosis, malabsorption, or alcoholism.

Anthropometry

Anthropometric measurements were taken viz height in cm and weight in kg with the use of a digital machine accessorised with a movable headboard. Participants were shoeless and wore light clothing. Waist/hip ratio was estimated; waist circumference was measured at the mid point between the lower border of the rib cage and the iliac crest. Hip circumference was measured at the level of maximum prominence of the buttocks parallel to the floor, the horizontal girth measured around the buttocks at the level of greatest lateral trochanteric projectors.

- Blood pressure: by sphygmomanometer
- Fasting blood sugar: by glucose oxidase method
- Lipid profile: by auto analyzer
- HbA1c: by DS5 Drew Scientific machine (ion exchange chromatography)
- Diabetes quality of life questionnaire was assessed every month.

Statistical analysis

Data was presented as means ± SEM. Comparisons between baseline characteristics of each group were made by using ANOVA, confidential limit and correlation tests. At p value <0.05, differences were considered significant.

Results

The demographic and clinical profiles of three groups (ajwain, ajwain + mushroom and mushroom) were studied for different variables in the beginning of the study and there was no significant difference in baseline characteristics (Table 1).

After a 3 month period the blood sugar levels were found reduced in the ajwain + mushroom group as well as in the mushroom group (225.41±3.35 to 113.83±4.03; $p<0.005$ and 212.9±4.29 to 112±1.37; $p<0.005$). Systolic blood pressure was reduced in both the groups (ajwain + mushroom 130.75±2.10 to 121.50±1.16; $p<0.05$ and the mushroom group 126.8±1.73 to 121.65±1.3; $p<0.05$). Diastolic blood pressure was reduced in the ajwain + mushroom group (85.00±1.31 to 79.70±0.70; $p<0.05$) and in the mushroom group (82.00±0.96 to 79.95±0.79; $p<0.05$).

There was a significant effect on glycemic control (HbA1c) in both groups (ajwain + mushroom group 8.47±0.17 to 7.27±0.14; $p<0.02$; the mushroom group 8.00±0.13 to 6.99±0.12; $p<0.05$).

There was a significant reduction in lipid profile i.e. total cholesterol in the ajwain + mushroom group (190.69±4.39 to 166.83±2.47; $p<0.001$) and the mushroom group (186.77±3.43 to 157.39±2.32; $p<0.05$); HDL in the ajwain + mushroom group (40.42±0.92 to 45.40±0.91; $p<0.005$) and in the mushroom group (45.81±2.03 to 49.30±1.47; $p<0.05$); LDL in the ajwain + mushroom group (110.05±2.55 to 98.21±1.38; $p<0.05$) and the mushroom group (103.04±3.41 to 96.99±3.30; $p<0.05$); VLDL in the ajwain + mushroom group (42.62±2.03 to 28.62±1.26; $p<0.05$) and in the mushroom group (42.42±2.35 to 31.40±1.81; $p<0.05$); serum triglyceride in ajwain + mushroom group (213.93±14.24 to 144.73±7.01; $p<0.05$) and in the mushroom group (210.71±12.49 to 157.41±7.79; $p<0.02$); diabetes quality of life improved significantly. There was no significant change in BMI and waist hip ratio (Tables 2 and 3).

Table 1
Comparison of different clinical and biochemical parameters at baseline

Parameters		Ajwain	Mushroom + ajwain	Mushroom	Anova	Anova
		Mean±SE 0 month	Mean±SE 0 month	Mean±SE 0 month	Ajwain v/s mushroom + ajwain	Ajwain v/s mushroom
Age		52.5±1.22	49.95±1.2	51.10±1.32	NS	NS
Sex (M:F)		28:13	24:6	31:9	-	-
BMI (body mass index)		26.87±.86	26.15±.61	26.67±0.71	<.4	<0.4
Waist /hip ratio		.95±.01	.94±.009	1.00±0.10	<.9	<0.8
FSB (fasting blood sugar)		225.65±4.32	225.41±3.35	212.9±4.29	<.8	<.02
BP (blood pressure)	Systolic	131.25±1.90	130.75±2.10	126.8±1.73	<.1	<.05
	Dialostic	83.55±1.31	85.00±1.31	82.00±0.96	<.1	<0.1
HbA1c		8.60±.12	8.47±.17	8.00±0.13	<.2	<0.2
S.Cholesterol		190.22±2.68	190.69±4.39	186.77±3.43	<.1	<0.1
HDL (high density lipoprotein		44.50±.87	40.42±.92	45.81±2.03	<.1	<0.1
VLDL (very low density lipoprotein)		39.52±.74	42.62±2.03	42.42±2.35	<.1	<0.5
LDL (low density lipoprotein)		99.39±1.35	110.05±2.55	103.04±3.41	<.1	<0.1
S.Triglyceride		195.70±5.32	213.93±14.24	210.71±12.49	<.1	<0.1
DQL (diabetes quality of life)	Satisfactory	38.00±2.87	36.17±2.17	39.51±2.09	<.1	<0.1
	Impact	44.83±4.11	35.07±2.89	42.50±2.98	<.2	<0.1
	Worry	25.5±2.17	23.98±1.79	24.87±1.93	<.1	<0.1

Table 2
Effect of different treatment regimen on clinical and metabolic parameters

Parameters		Ajwain			Mushroom + ajwain			Mushroom		
		Mean±SE 0 month	Mean±SE 3 month	Anova	Mean±SE 0 month	Mean±SE 3 month	Anova	Mean±SE 0 month	Mean±SE 3 month	Anova
Age		52.5±1.22		NS	49.95±1.2		NS	51.10±1.32		NS
Sex (M:F)		28:13		-	24:6		-	31:9		-
BMI		26.87±.86	27.03±0.89	NS	26.15±.61	25.87±0.86	NS	26.67±0.71	26.3±0.65	NS
W/H Ratio		.95±.01	0.94±0.01	NS	.94±.009	0.93±0.009	NS	1.00±0.1	0.97±0.2	NS
FBS		225.65±4.32	310.33±3.13	<0.005	225.41±3.35	113.83±4.032	<0.005	212.9±4.29	112±1.37	<0.005
BP	Systolic	131.25±1.90	138.15±2.21	<0.05	130.75±2.10	121.50±1.16	<0.05	126.8±1.73	121.65±1.34	<0.05
	Dialostic	83.55±1.31	87.55±1.18	<0.05	85.00±1.31	79.70±0.70	<0.05	82.00±0.96	79.95±0.79	<0.05
HbA1c		8.60±.12	9.98±0.14	<0.005	8.47±.17	7.27±0.14	<0.02	8.00±0.13	6.99±0.12	<0.05
S.Cholesterol		190.22±2.68	251.45±4.01	<0.005	190.69±4.39	166.83±2.47	<0.001	186.77±3.43	157.39±2.32	<0.05
HDL		44.50±.87	36.82±0.46	<0.005	40.42±.92	45.40±0.91	<0.005	45.81±2.03	49.30±1.47	<0.05
VLDL		39.52±.74	55.2±0.69	<0.005	42.62±2.03	28.62±1.26	<0.05	42.42±2.35	31.40±1.81	<0.05
LDL		99.39±1.35	104.43±1.18	<0.02	110.05±2.55	98.21±1.38	<0.05	103.04±3.41	96.99±3.30	<0.05
S.Triglyceride		195.70±5.32	276.20±5.32	<0.02	213.93±14.24	144.73±7.01	<0.05	210.71±12.49	157.41±7.79	<0.02
DQL	Satisfactory	38.00±2.87	32.25±2.36	<0.05	36.17±2.17	40.87±1.42	<0.05	39.51±2.09	42.40±0.98	<0.001
	Impact	44.83±4.11	41.5±1.22	<0.02	35.07±2.89	39.74±1.18	<0.05	42.50±2.98	44.4±1.68	<0.001
	Worry	25.5±2.17	20.33±1.97	<0.05	23.98±1.79	18.78±2.88	<0.005	24.87±1.93	20.85±1.83	<0.001

Table 3
Comparison of different clinical and biochemical parameters among different plans

Parameters		Ajwain	Mushroom + ajwain	Mushroom	Anova	Anova
		Mean±SE 3 month	Mean±SE 3 month	Mean±SE 3 month	Ajwain v/s mushroom + ajwain	Ajwain v/s mushroom
Age		52.5±1.22	49.95±1.2	51.10±1.32	-	-
Sex (M:F)		28:13	24:6	31:9	-	-
BMI (body mass index)		27.03±.89	25.91±.56	26.3±.65	<.8	<.1
Waist /hip ratio		.95±.01	.94±.009	0.97±.0.15	<.05*	<.02*
FSB (fasting blood sugar)		310.33±3.31	113.83±4.02	112±1.37	<.001*	<.001*
BP (blood pressure)	Systolic	138.15±2.21	121.50±1.16	121.65±1.34	<.005*	<.001*
	Dialostic	87.55±1.18	79.70±.70	79.95±.79	<.005*	<.02*
HbA1c		9.98±.14	7.27±.14	6.99±.12	<.02*	<.005*
S. cholesterol		251.45±4.01	166.43±2.47	157.39±2.32	<.001*	<.001*
HDL (high density lipoprotein		36.82±.46	45.42±.91	49.30±1.47	<.02*	<.001*
VLDL (very low density lipoprotein)		55.20±.69	28.8±1.26	31.4±1.81	<.001*	<.001*
LDL (low density lipoprotein)		104.43±1.18	98.21±1.38	96.99±3.30	<.05*	<.001*
S. triglyceride		276.20±5.32	144.73±7.00	157.41±7.79	<.005*	<.001*
DQL (diabetes quality of life)	Satisfactory	32.25±2.36	40.87±2.42	42.40±.98	<.02*	<.05*
	Impact	36.5±1.23	39.74±1.18	44.4±1.68	<.05*	<.05*
	Worry	20.33±1.97	18.78±2.40	20.85±1.83	<.2	<.2

Discussion

Oyster mushroom (*Pleurotus* spp) is known in the Indian traditional system of medicine for its antihyperglycemic and antihyperlipdemic potential. Mushrooms are edible fungi confirmed to have definite human health properties and nutrition. Oyster mushrooms have been demonstrated to have beneficial effects in animal and human studies individually as well as in combination.

The present study was performed to observe the effect of oyster mushroom (*Pleurotus* spp) on glycemic control, lipid profile and diabetes quality of life.

We observed that blood sugar was reduced in the ajwain + mushroom group and in the mushroom group. There was significant effect on glycemic control (HbA1c) in both groups. The significant fall in fasting blood sugar and HbA1c may be attributed to the hypoglycemic potential of the oyster mushroom supplement. It was reported that mushroom significantly reduced blood glucose level in diabetic subjects (Khatun 2007). Reduction in glycated hemoglobin in streptozotocin diabetic mice after mushroom supplement was observed (Swanston 1989).

In both the ajwain + mushroom group and the mushroom group there was a significant reduction in lipid profile i.e. total cholesterol, HDL, LDL, VLDL and serum triglyceride. Results of present study show that oyster mushroom lowers blood lipid levels. Reduction in total serum cholesterol, VLDL, LDL and serum triglyceride and increased serum HDL was observed in the study. It was found the cholesterol concentration was decreased by more than 40%, the lipoprotein profile was upgraded by the decrease of the cholesterol in both the low density and very low density liproproteins in rats (Chorvathova 1993). Oyster mushroom significantly reduced serum triglyceride and serum cholesterol in diabetic subjects (Khatun 2007). Oyster mushroom diet effectively prevented the progress of hypercholesterolemia (decreased by 38%) and cholesterol accumulation in liver (decrease by 25%) that were induced by the cholesterol diet in rats (Bobek 1995).

We observed slight reduction in mean BMI in the ajwain + mushroom group and the mushroom group although it was not statistically significant. We also found the W/H ratio was slightly decreased in the ajwain + mushroom group and increased in the mushroom group. This change was also not statistically significant.

Both systolic and diastolic blood pressure decreased significantly in the ajwain + mushroom group and mushroom group. Treatment of diabetic zucker fatty rats with mushroom supplements resulted in lower systolic blood pressure and maintained body weight compared with control animals (Talpur 2003). Another study concluded that the soluble fraction of maitake mushroom lowers systolic blood pressure significantly (Talpur 2002).

We observed that there was a statistically significant improvement in diabetes quality of life score, when biscuits supplement was added along with usual care.

Despite the limited size of this study population we were able to demonstrate a significant association between mushroom supplementation and gradual reduction in hyperglycemia in type 2 diabetic subjects. Further studies are needed to verify these observations. In conclusion the results throw light on the potential use of oyster mushroom for better glycemic control, positive effect on lipid profile and better quality of life.

Reference

Bahl N. 2000. Food value of mushrooms. New Delhi: Oxford & IBH publishing.

Bano Z. 1982. Pleurotus mushroom as nutritional food. Tropical mushroom – biological nature and cultivation method. Hong Kong: The Chinese University Press.

Bobek P, Ozdin O, Mikus M. 1995. Dietary oyster mushroom (Pleurotus ostreatus) accelerates plasma cholesterol turnover in hypercholesterolaemic rats. Physiol Res 44:5;287-91.

Chorvathova V, Bobek P, Ginter E, Klvanova J. 1993. Effect of the oytser fungus on glycaemia and cholesterolaemia in rats with insulin dependent diabetes. Physiol Res 42:6;175-9.

Ghosh C. 1990. Nutritional value of edible mushroom. In the biology and cultivation of edible mushroom. New York: Academic press.

Khatun K, Mahtab H, Khanam PA, Sayeed MA, Khan KA. 2007. Oyster mushroom reduced blood glucose and cholesterol in diabetic subjects. Mymensingh Med J 16:1;94-9.

King H. 1998. Mushrooms the ultimate health food but little research in US to prove. Mushroom news 41(2);26-9.

Rai RD, Sohi. 1988. The food value of mushrooms (pleurotus). Indian horticulture 33:3;10-12.

Rai RD, Sohi. 1998. How protein rich are mushrooms. Indian Hort 33:2; 2-3.

Suguna S, Usha M. 1995. Cultivation of oyster mushroom. Journal of food science and technology 32;351-2.

Swanston-Flatt SK, Day C, Flatt PR, Gould BJ, Bailey CJ. 1989. Glycaemic effects of traditional European plant treatments for diabetes. Studies in normal and streptozotocin diabetic mice. Diabetes Res 10:2;69-73.

Talpur N, Echard BW, Dadgar A, Aggarwal S, Zhuang C, Bagchi D, Preuss HG. 2002. Effects of Maitake mushroom fractions on blood pressure of Zucker fatty rats. Res Commun Mol Pathol Parmacol 112:1-4;68-82.

Talpur N, Echard BW, Yashmin T, Bagchi D, Preuss HG. 2003. Effects of niacin-bound chromium, Maitake mushroom fraction SX and (-)-hydroxycitric acid on the metabolic syndrome in aged diabetic Zucker fatty rats. Mol Cell Biochem 252:1-2;369-77.

Visanthamein G, Savita D. 2001. Hpoglycemic and hypocholesterolemic effect of selected powder. Indian J Nut Diabetic 38: 419-27.

Yang QY, Jong SC. 1989. Medicinal mushrooms in China. Mushrooms Science 12:1;631-43.