PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
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Pakistan Journal of Nutrition 12 (6): 538-543, 2013
ISSN 1680-5194
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The Effect of *Zizyphus jujube* on Serum Lipid Profile and Some Anthropometric Measurements

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Abstract: *Zizyphus jujube (Z. jujube)* is a thorny *Rhamnaceous* plant that is widely distributed in Europe and South-Eastern Asia. It's used in traditional medicine for its therapeutic properties. The aim of this study was to find out the possible anti-obesity and hypolipidemic activity of different doses (5, 15 and 30 g/day) of *Z. jujube* powder and to evaluate its effect on liver function. A group of 83 persons (41 men and 42 women) aged 20-57 years (32±13) participated in this study. They were divided into three groups according to their Body Mass Index (BMI). *Z. jujube* powder was prepared and a specific questionnaire was given to the participants. Blood specimens were collected and several tests were performed to determine lipid profile and serum alanine aminotransferase (ALT) and aspartate aminotransferase (AST). A group of anthropometric measurements were taken as well. This procedure was repeated after three months. The results indicated a significant reduction in Total Cholesterol (TC), Low Density Lipoprotein Cholesterol (LDL-C), BMI, fat percentage and body weight after administration of doses (5, 15 and 30 g/day) of *Z. jujube* powder in all groups. Triglycerides (TG) were reduced significantly after consumption 30 g/day of *Z. jujube* powder. A slight increase in High Density Lipoprotein Cholesterol (HDL-C) was observed. *Z. jujube* impact on weight status was significant after consumption 30 g/day of *Z. jujube* powder, While, the impact of other doses were not. It can be concluded that different doses of *Z. jujube* powder possess hypolipidemic and anti-obesity properties and didn't show any negative impact on liver function as measured by (ALT and AST).

Key words: *Zizyphus jujube*, traditional medicine, anti-obesity

INTRODUCTION

Nutrition disorders can be caused by an insufficient intake of food or certain nutrients, by an inability of the body to absorb and use nutrients, or by excessive intake of certain nutrients. One alarming problem is overweight and obesity which may be accompanied with hyperlipidemia or dyslipidemia, as the prevalence has steadily increased among both genders, all ages and all racial/ethnic groups since 1980 (Mokdad *et al*., 2003). Also, it's worth mentioning that obesity is associated with over 112, 000 excess deaths due to cardiovascular disease, over 15, 000 excess deaths due to cancer and over 35, 000 excess deaths from other causes each year in the United States (Flegal *et al*., 2007).

In traditional medicine, the use of medicinal plants is on the rise because of their treatment properties of various diseases especially diabetes and obesity (Hussain *et al*., 2004).

One important plant in the alternative medicine is *Zizyphus jujube*. *Z. jujube* is a thorny *Rhamnaceous* plant that is widely distributed in Europe and South-Eastern Asia (Li *et al*., 1997).

The major nutrients in *Z. jujube* fruit include carbohydrate (80.86-85.63%), protein (4.75-6.86%) and lipid (0.37-1.02%). Moisture and ash contribute to (17.38-22.52%) and (2.26-3.01%) respectively (Li *et al*., 2007). In addition, many functional components have been identified and isolated from *Z. jujube* such as, triterpenoides, flavonoids, saponins, tannins and polysaccharides (Cheng *et al*., 2000; Adzu *et al*., 2001; Zhao *et al*., 2006).

The medicinal properties of this plant depend on the part of the plant concerned and the extract used. For example, the root barks showed a significant anti-inflammatory and analgesic activity (Ghedira *et al*., 1993). Furthermore, a mixture of dried leaves and fruits is applied in the treatment of boils (Glombitza *et al*., 1994). Also, the seeds of *Z. jujube* has been used for their action on insomnia and anxiety besides their role on the improvement of blood glucose and lipid composition (Kim, 2002) and as reported by (Abdel-Zaher *et al*., 2005), the butanol extracts of *Z. jujube* leaves improved the oral glucose tolerance and potentiated glucose-induced insulin release in type 2 diabetic rats.

As there is a possibility for *Z. jujube* to play a role as an anti-obesity and hypolipidemic agent, the aim of this study was to investigate this hypothesis and to evaluate its effect on liver function.

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MATERIALS AND METHODS

Sample of the study: A group of 83 persons participated in this study were randomly chosen and consisted of 41 men and 42 women aged 20 to 57 years (32±13). They were divided into three groups according to their BMI classification proposed by WHO, 2010 as following:

- **First group:** Normal weight (BMI ranged from 18.5 to 24.9)
- **Second group:** Overweight (BMI ranged from 25 to 29.9)
- **Third group:** Obese (BMI over than 30)

They were randomly given 5, 15 and 30g of *Z. jujube* powder for a period of 2 months.

Questionnaire form: The questionnaire was divided into three sections; the first one was for personal information such as name, age and sex. The second was for body measurements such as height, weight, BMI, etc. and the third was about medical history and contained important questions such as:

- Are you now following a special diet or taking any prescribed medication for the purpose of losing weight
- Do you have a problem of dyslipidemia or hyperlipidemia? And what is your action related to it
- Are you now following a medication for purpose of reducing serum lipid profile

The participants were chosen based on their answers and the exclusion process was done for each person having any kind of diet or medication at the time of the study.

METHODOLOGY

Jujube powder preparation: First, the semi dried fruits were purchased from local markets in Damascus city during February 2012. The kernel stones were removed before cutting the fruits into small pieces to accelerate drying. Then the cut fruits were placed in under-vacuum drying machine as follows: temperature at 50°C, under-vacuum of 0.3 bar for 3 hours. The pieces were put in metal containers inside the dryer until they became dry enough to be ground. The obtained powder was kept in individual bags at refrigerator temperature until use.

Blood tests: Serum aspartate (AST) and alanine amino transferase (ALT), were estimated according to Reitman and Frankel (1957) and Draper and Hadley (1990), respectively.

Serum total cholesterol (TC), triglycerides (TG) and High Density Lipoprotein Cholesterol (HDLC) were determined by using enzymatic colorimetric methods (Abell *et al*., 1952; Buccolo and David, 1973; Kostener, 1977). Very low density lipoprotein cholesterol.

After the period of three months, the procedure was repeated in order to investigate the effect of *jujube* fruits powder on both lipid profile and serum ALT and AST enzymes.

Body measurements: Several body measurements were taken before and after consumption of *jujube* fruits powder for two months such as height waist circumference and body composition through TANITA device in addition to skinfold thickness (triceps, biceps, abdomen and subscapular region).

Statistical analysis: Collected data were presented as mean±SD and statistically analyzed using one way analysis of variance (ANOVA). Student "t" test was used for significance. Differences were considered significant at $p<0.05$ according to Artimage and Berry (1987).

RESULTS AND DISCUSSION

There is an increasing tendency by obese and overweight patients to use the natural products to overcome the toxicity of synthetic drugs. So the purpose of this work was to investigate the possible anti-obesity and hypolipidemic activity of *Z. jujube* and to evaluate its effect on liver function (World Health Organization, 2000).

The effect of *Z. jujube* fruits powder on serum lipid profile: The current data showed that treatment with different doses (5, 15 and 30 g/day) of *Z. jujube* powder for two months produced significant reduction in TC level for all participants regardless of their BMI, as compared to values taken at the beginning of the study. The highest dose of 30 g/day given to obese group tended to produce the highest reduction of TC by 37% (Table 1). This reduction could be of clinical importance as it normalized TC values. Because TC value of more than 200 mg/dL could be linked to increased risk of heart and blood vessel diseases (Fletcher *et al*., 2005).

The present data are in accordance with those of (Hala *et al*., 2006) that, showed significant reduction in total cholesterol level for rats given 100 mg/kg of *Z. jujube* extract (Hala *et al*., 2006).

Moreover, *Z. jujube* powder administration was found to normalize LDL-C level for all treatment groups. It's worth mentioning that, the dose of 5 g had LDL-C reduction came up to 27 and 36% in overweight and obese groups, respectively. While, in normal group only treatment with 15 or 30 g/day reduced LDL-C level significantly (Table 2). It should be noted that, the 30 g/day doses decreased the LDL-C for all tested groups. Statistically significant differences were observed in all groups, after consumption this dose. Additionally, considering the goal value of LDL-C is less than 110

Table 1: The effect of different doses of *Z. jujube* powder on serum Total Cholesterol (TC) (mg/dL)

Z. jujube		BMI					
(g)	Treatment	Normal	P-value	Overweight	P-value	Obese	P-value
5	Before	196±7	0.01*	227.6±27	0.0001*	212.8±25.4	0.0004*
	After	161±5.6		187.8±27.3		172.6±18.6	
15	Before	245.5±12	0.02*	188±24	0.0006*	213.2±33.2	0.0003*
	After	196.5±9.1		157.3±16.6		172.5±23.1	
30	Before	201.5±12	0.01*	220±24	0.0003*	221.2±33.2	0.0001*
	After	182.5±13.1		145.3±16.6		138.5±23.1	

*Statistically significant at p<0.05

Table 2: The effect of different doses of *Z. jujube* powder on serum Low Density Lipoprotein Cholesterol (LDL-C) (mg/dL)

Z. jujube		BMI					
(g)	Treatment	Normal	P-value	Overweight	P-value	Obese	P-value
5	Before	108±45.2	0.2	150.7±68.7	0.01*	146±27.4	0.01*
	After	65±22.6		109.1±46.5		94±26.6	
15	Before	169±12.7	0.01*	104.6±40.7	0.1	143.8±53.6	0.03*
	After	115±14.1		87.5±19.3		105.6±23.9	
30	Before	166±12.7	0.008*	110.6±40.7	0.004*	166.8±53.6	0.003*
	After	109±10.1		86.2±12.3		105.6±12.9	

*Statistically significant at p<0.05

Table 3: The effect of different doses of *Z. jujube* powder on serum High Density Lipoprotein Cholesterol (HDL-C) (mg/dL)

Z. jujube		BMI					
(g)	Treatment	Normal	P-value	Overweight	P-value	Obese	P-value
5	Before	40.5±12	0.05	37.6±18.7	0.1	37.4±14.5	0.9
	After	57±9.8		51.6±19.4		37±15.4	
15	Before	39±29.6	0.2	36.6±13.4	0.2	34.8±6.7	0.4
	After	53.5±20.5		44.6±13.9		38.3±15.2	
30	Before	41±19.6	0.04	38.6±14.3	0.4	34.8±6.7	0.2
	After	50.8±20.5		42.2±10.1		40.2±8.3	

mg/dL (Fletcher *et al*., 2005). Accordingly, the improvement noticed after administration of *Z. jujube* powder cannot be ignored.

The reduction of TC and LDL-C by different doses of *Z. jujube* may be due to the presence of saponins that form insoluble complex with cholesterol and increase fecal lipid excretion, they also increase the liver LDL-C receptor activity (Yugarani *et al*., 1992; Li *et al*., 2002; Zhao *et al*., 2005). Furthermore, another study has revealed that glycemic control following administration of *Z. jujube* extract was associated with its hypolipidemic effect as elevated serum insulin level increased the clearance rate of both very low density lipoprotein cholesterol (VLDL-C) and LDL-C subsequently (Newairy *et al*., 2002).

As demonstrated in Table 3, there was a slight increase in HDL-C level in all groups but there was no statistical significance differance was observed among these groups. The improvement in HDL-C level came up to 27% in overweight group and 9% in obese group. Also, the HDL-C was increased by 30, 27 and 21% in normal group after consumption of 5 g 15 g and 30 g/day of *Z. jujube* powder, respectively.

This finding is similar to that obtained by Shirdel *et al*. (2009) which, also showed an increase in HDL-C level in experimental rats after administration of 100 mg/kg of hydro-alcoholic extract of *Z. jujube*. Possible explanation was due to glucose metabolism improvement as this direct protein metabolism into anabolic instead of catabolic process which results in synthesis of proteins such as apolipoprotein A1 (Apo-A1) that constitute 70% of HDL-C structure which, in turn, results in increase of HDL-C concentration. It should be noted that, the improvement in HDL-C level provides a good impression as high level directly linked to a reduced risk of coronary heart disease (Fletcher *et al*., 2005).

The effect of different doses of *Z. jujube* powder on serum TG for different BMI subjects is illustrated in (Table 4). It's clear that *Z. Jujube* has reduced triglyceride level significantly in overweight group. This reduction estimated to be 46, 40 and 42% for participants consumed 5, 15 and 30 g of the fruit powder daily, respectively. Treatment with 30 g/day of *Z. jujube* powder for three months caused significant increases (P<0.05) in serum TG for all BMI groups. Also it's important to spot light the slight increase in triglyceride

Table 4: The effect of different doses of *Z. jujube* powder on serum Triglycerides (TG) (mg/dL)

Z. jujube		BMI					
(g)	Treatment	Normal	P-value	Overweight	P-value	Obese	P-value
5	Before	238±131.5	0.6	289.2±56.9	0.02*	148.4±40.7	0.7
	After	196±33.9		156.1±76.9		160.8±78.1	
15	Before	185.5±16.2	0.2	208.1±61.5	0.03*	178.7±98.6	0.3
	After	140±15.5		125.8±31.9		143.6±40.5	
30	Before	190.2±12.2	0.04*	198.2±11.2	0.02*	202.2±12.2	0.05*
	After	138±18.3		128±13.3		143±18.3	

*Statistically significant at P<0.05

Table 5: The effect of different doses of *Z. jujube* powder on serum alanine aminotransferase (ALT) and aspartate aminotransferase (AST) (U/L)

Z. jujube		ALT					
(g)	Treatment	Normal	P-value	Overweight	P-value	Obese	P-value
5	Before	6.5±4.9	0.6	11.3±8	0.6	9.1±5.2	0.08
	After	8.5±2.1		12±10.1		14±16.2	
15	Before	7±0	0.5	9.3±5.2	0.4	10±4.4	0.2
	After	10±9.8		13±10		16±12.7	
30	Before	7.3±0	0.3	9.6±5.2	0.1	12.6±4.4	0.2
	After	11±9.8		15±10		19.7±12.7	
Z. jujube		AST					
(g)	Treatment	Normal	P-value	Overweight	P-value	Obese	P-value
5	Before	12±2.8	0.1	14.25±10.8	0.5	22.4±12.8	0.08
	After	3±0		12.3±6.8		11±5.7	
15	Before	15.5±12	0.5	19±13.9	0.7	35.2±33.5	0.1
	After	6.5±4.9		16.3±12.2		14.8±11.9	
30	Before	13.2±10	0.6	18.2±12	0.4	16.2±12	0.6
	After	8.5±4.9		11±4.9		15.9±9	

*Statistically significant at P<0.05. From the data illustrated in Table 5 and 6 it could be concluded that serum AST and ALT level were not altered

level in obese group which estimated to be 8% after administration of 5 g dose in comparison with the 20% and 26% decrease noticed with 15 g and 30 g/day dose, respectively. It's obvious that the most valuable decrease occurred among overweight group.

The effect of *Z. jujube* fruits powder on liver function: To evaluate any side effect of *Z. jujube* fruits powder on liver function, serum ALT and AST enzymes were measured before and after administration of the *Z. jujube* fruit powder. Any damage to the hepatic cells will result in elevating serum ALT and AST as they leak out from the injured tissue and migrate to the blood stream (Stanely *et al*., 2000).

In the present study, data revealed that ALT value was increased by consumption several doses of *Z. jujube* powder. But, there is no any significant differences have been observed. In contrast, AST value has been decreased (Table 5). Fortunately, the increase in ALT didn't exceed the reference value of 56 U/L plasma (Helmi *et al*., 2011).

The data illustrated in (Table 5) showed an increase in ALT level in all study groups. The most notice able increase was in obese group which estimated to be 67% after administration of 5 g dose. Also, obese group was the one with noticeable decrease in AST value regardless of the dose given as shown in (Table 5).

The effect of Z. jujube powder on body measurement: The effect of *Z. jujube* on weight status was also investigated. The following section presents an overview of *Z. jujube* impact on several parameters. BMI is often used to assess weight status because it's relatively easy to measure and it correlates with body fat (Whitlock *et al*., 2005).

All investigated groups tended to have body mass index lower than initial body weight after consumption of *Z. jujube* powder for three months. Treatment of subjects with 30 g/day for three months of *Z. jujube* powder caused large decrease in BMI (Fig. 1). Data showed a decrease in Body Mass Index (BMI) after administration of *Z. jujube* powder especially with 15 and 30 g/day. Thus, it can be concluded that, the most potent effect was found in overweight and obese groups whom consumed 30 g/day (Fig. 1).

Furthermore, another investigation was made to evaluate the effectiveness of *Z. jujube* on both fat percentage and TBW. As illustrated in (Fig. 2 and 3), intervention with 5 g/day and 30 g/day of *Z. jujube* powder was accompanied with an average of 4 and 16%

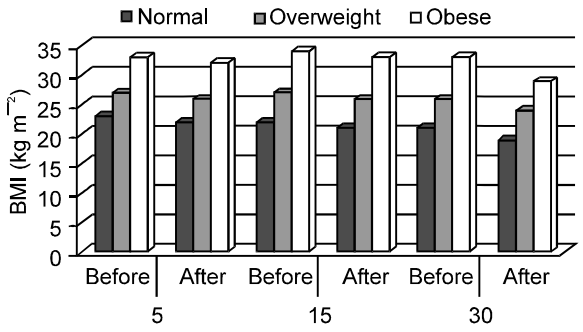

Fig. 1: The effect of different doses of *Z. jujube* powder on body mass index (BMI) (kg/m^2)

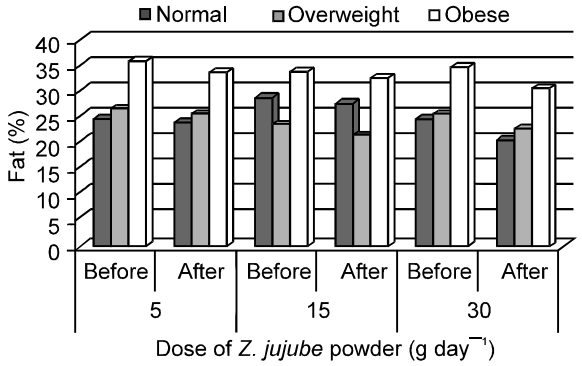

Fig. 2: The effect of different doses of *Z. jujube* powder on fat (%)

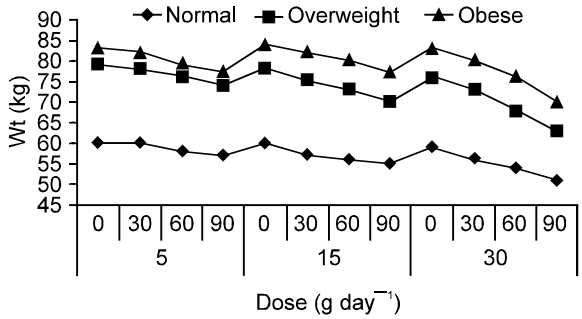

Fig. 3: The effect of different doses of *Z. jujube* powder on weight (wt) (kg)

decline in fat percentage, respectively. Moreover, approximately 1.5% increases in TBW was noticed among all treatment groups. From the data mentioned above, all investigated doses were effective regarding fat percentage in overweight and obese groups. With reference to TBW, the results were inconsistent after administration of 5 and 15 g and 30 g/day of *Z. jujube* powder.

Similar results for BMI were observed for fat percentage. Data showed very slight decrease in fat percentage for subjects consumed 5 and 15 g/day for three months. The most effective dose for reduction of fat percentage was 30 g/day.

The results illustrated in Fig. 4 demonstrated that the impact of consumption of low doses of *Z. jujube* on weight status was insignificant as a little reduction change was noticed in all groups. On contrast, overweight group who was given 30 g daily for 3 months suggesting higher effectiveness at this level and the weight reduction was approximately 16% of the entail weight.

Conclusion: Oral administration of *Z. jujube* fruit powder caused significant declines in the blood levels of triglycerides, total cholesterol, LDL-cholesterol but increased HDL-cholesterol. Moreover, it seemed that *Z. jujube* fruit powder had a hypolipidemic potential. This may be an indication of progressive metabolic control of *Z. jujube* on mechanisms involved in elimination of the lipids from the body, this hypolipidemic properties have been confirmed in many plant species and plant products in medicinal use (Abdul-Rahim and Taha, 2011).

From the above mentioned data discussed earlier confirmed that *Z. jujube* could have a good impact on several parameters like BMI, fat percentage and weight status, after long period of consumption.

Dose of 30 g/day of *Z. jujube* powder have therapeutic potential. They possess hypolipidemic and anti-obesity properties but the hypolipidemic effect was more pronounced. Also, they didn't show any negative impact on liver function.

This was only a preliminary study to prove the anti-obesity and hypolipidemic effect of *Z. jujube*. Further investigation should target determination the active constituents of *Z. jujube* fruits and the mechanism of *Z. jujube* fruit and many foods that have the hepatoprotective effect.

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