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Effect of *Zizyphus Jujuba* on serum lipid profile and some anthropometric measurements

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ABSTRACT

Zizyphus jujuba is a thorny *Rhamnaceous* plant that is widely distributed in Europe and South-Eastern Asia. It is 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. jujuba* powder and to evaluate its effect on liver function. A group of 83 persons (41 men and 42 women) aged 20 to 57 years (32 ± 13) participated in this study. They were divided into three groups according to their body mass index (BMI). *Z. jujuba* 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 cholesterols (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. jujuba* powder in all groups. Triglycerides (TG) were reduced significantly after consumption 30 g/day of *Z. jujuba* powder. A slight increase in high density lipoprotein cholesterol (HDL-C) was observed. *Z. jujuba* impact on weight status was significant after consumption of 30 g/day of *Z. jujuba* powder, while the impact of other doses were not. It can be concluded that different doses of *Z. jujuba* powder possess hypolipidemic and anti-obesity properties, and did not show any negative impact on liver function as measured by ALT and AST.

Keywords: *Z. Jujuba*, anthropometric measurement, lipid profile, obesity, diabetes.

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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 is 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 jujuba. Z. jujuba* is a thorny *Rhamnaceous* plant that is widely distributed in Europe and South-Eastern Asia (Li et al., 1997).

The major nutrients in *Z. jujuba* fruit include carbohydrate (80.86 to 85.63%), protein (4.75 to 6.86%) and lipid (0.37 to 1.02%). Moisture and ash contribute to 17.38 to 22.52% and 2.26 to 3.01%, respectively (Li et al., 2007). In addition, many functional components have been identified and isolated from *Z. jujuba* 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. jujuba* has been used for their action on insomnia and anxiety besides their role in the improvement of blood glucose and lipid composition (Kim, 2002), and as reported by Abdel-Zaher et al. (2005), the butanol extracts of *Z. jujuba* leaves improved the oral glucose tolerance and potentiated glucose-induced insulin release in type 2 diabetic rats.

As there is a possibility for *Z. jujuba* 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.

MATERIALS AND METHODS

Sample of the study

A group of 83 healthy 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 follows:

1. First group (n = 27): normal weight (BMI ranged from 18.5 to 24.9)
2. Second group (n = 29): overweight (BMI ranged from 25 to 29.9)
3. Third group (n = 27): obese (BMI over than 30)

They were randomly given 5, 15 and 30 g of *Z. jujuba* 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:

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

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

Z. jujuba 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 fruit chunks were placed in under-vacuum dryer as follows: temperature at 50°C, under-vacuum of 0.3 bar for 3 h. The chunks 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.

The total amount was divided into small portions (5, 10 and 30 g) in individual plastic bags to be used as a single dose.

Blood tests

Blood was collected from subjects after an overnight fast for the following serum tests: Ins, serum total cholesterols (TC), triglycerides (TG) and high density lipoprotein cholesterol (HDLc) were determined by using enzymatic colorimetric methods and very low density lipoprotein cholesterol (Abell et al., 1952; Buccolo and David, 1973; Kostener, 1977).

Moreover, serum aspartate (AST) and alanine aminotransferase (ALT), were estimated according to Reitman and Frankel (1957) and Draper and Hadley (1990), respectively.

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

Body measurements

Several body measurements were taken before and after consumption of *Jujuba* fruits powder for three months such as height, waist circumference and body composition using 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 repeated measure 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. jujuba* and to evaluate its effect on liver function (WHO, 2000).

Effect of *Z. jujuba* fruits powder on serum lipid profile

The current data showed that treatment with different doses (5, 15 and 30 g/day) of *Z. jujuba* powder for three months produced significant reduction in TC level for all participants regardless of their body mass index (BMI), as compared to values measured at the beginning of the study. The highest dose of 30 g/day given to obese group produced the highest reduction of TC (Table 1). This reduction could be of clinical importance as it normalized TC values. This is because TC value of more than 200 mg/dl can be linked to an increased risk of heart and

Table 1. Effect of different doses of *Z. jujuba* powder on serum total cholesterols (TC) (mg/dl).

Z. jujuba (g)	Treatment	BMI					
		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. Effect of different doses of *Z. jujuba* powder on serum low density lipoprotein cholesterol (LDL-C) (mg/dl).

Z. jujuba (g)	Treatment	BMI					
		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 $p < 0.05$.

blood vessel diseases (Fletcher et al., 2005).

There was reduction in total cholesterols with three treatment doses, but the reduction in normal group was less than the reduction in overweight and obese group (Table 1).

Moreover, *Z. jujuba* powder administration was found to normalize LDL-C level for all treatment groups. 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 of this dose. Additionally, considering the goal value of LDL-C is less than 110 mg/dl (Fletcher et al., 2005). Accordingly, the improvement noticed after administration of *Z. jujuba* powder cannot be ignored.

The reduction of TC and LDL-C by different doses of *Z. jujuba* 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. jujuba* 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 no statistically significant difference was observed for overweight and obese groups. On contrast, normal group that fed on 5 and 15 g/day of *Z. jujuba* powder tended to have HDL-C significant decrease as compared with baseline data.

This finding is partly in agreement with Shirdel et al. (2009) which showed an increase in HDL-C level in experimental rats after administration of 100 mg/kg of hydro-alcoholic extract of *Z. jujuba*. 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. jujuba* powder on serum TG for different BMI subjects is illustrated in Table 4. It is clear that *Z. jujuba* has reduced triglyceride level

Table 3. Effect of different doses of *Z. jujuba* powder on serum high density lipoprotein cholesterol (HDL-C) (mg/dl).

Z. jujuba (g)	Treatment	BMI					
		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	

*Statistically significant at $p < 0.05$.

Table 4. Effect of different doses of *Z. jujuba* powder on serum triglycerides (TG) (mg/dl).

Z. jujuba (g)	Treatment	BMI					
		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 $P < 0.05$.

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. jujuba* powder for three months caused significant increases ($P \leq 0.05$) in serum TG for all BMI groups. Also, it is important to spot light the slight increase in triglyceride 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 and 30 g/day dose, respectively. It is obvious that the most valuable decrease occurred among overweight group.

Effect of *Z. jujuba* fruits powder on some liver function

To evaluate any side effect of *Z. jujuba* fruits powder on some liver function, serum ALT and AST activities were measured before and after administration of the *Z. jujuba* 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. jujuba* powder. But, no significant differences have been observed. In contrast, AST value was decreased (Table 5). Fortunately, the increase in ALT did not 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 noticeable 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. From the data illustrated in Table 5, it can be concluded that serum AST and ALT level were not altered.

Effect of *Z. jujuba* powder on body measurement

The effect of *Z. jujuba* on weight status was also investigated. The following section presents an overview of *Z. jujuba* impact on several parameters. BMI is often used to assess weight status because it is 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

Table 5. Effect of different doses of *Z. jujuba* powder on serum alanine aminotransferase (ALT) and aspartate aminotransferase (AST) (U/L).

Z. jujuba (g)	Treatment	ALT						AST					
		Normal	P-value	Overweight	P-value	Obese	P-value	Normal	P-value	Overweight	P-value	Obese	P-value
5	Before After	6.5 ± 4.9 8.5 ± 2.1	0.6	11.3 ± 8 12 ± 10.1	0.6	9.1 ± 5.2 14 ± 16.2	0.08*	12 ± 2.8 3 ± 0	0.1	14.2 ±10.8 12.3 ± 6.8	0.5	22.4 ± 12.8 11 ± 5.7	0.08*
15	Before After	7 ± 0 10 ± 9.8	0.5	9.3 ± 5.2 13 ± 10	0.4	10 ± 4.4 16 ± 12.7	0.2	15.5 ± 12 6.5 ± 4.9	0.5	19 ± 13.9 16.3 ± 12	0.7	35.2 ± 33.5 14.8 ± 11.9	0.1
30	Before After	7.3 ± 0 11 ± 9.8	0.3	9.6 ± 5.2 15 ± 10	0.1	12.6 ± 4.4 19.7 ± 12.7	0.2	13.2 ± 10 8.5 ± 4.9	0.6	18.2 ± 12 11 ± 4.9	0.4	16.2 ± 12 15.9 ± 9	0.6

*Statistically significant at P < 0.05.

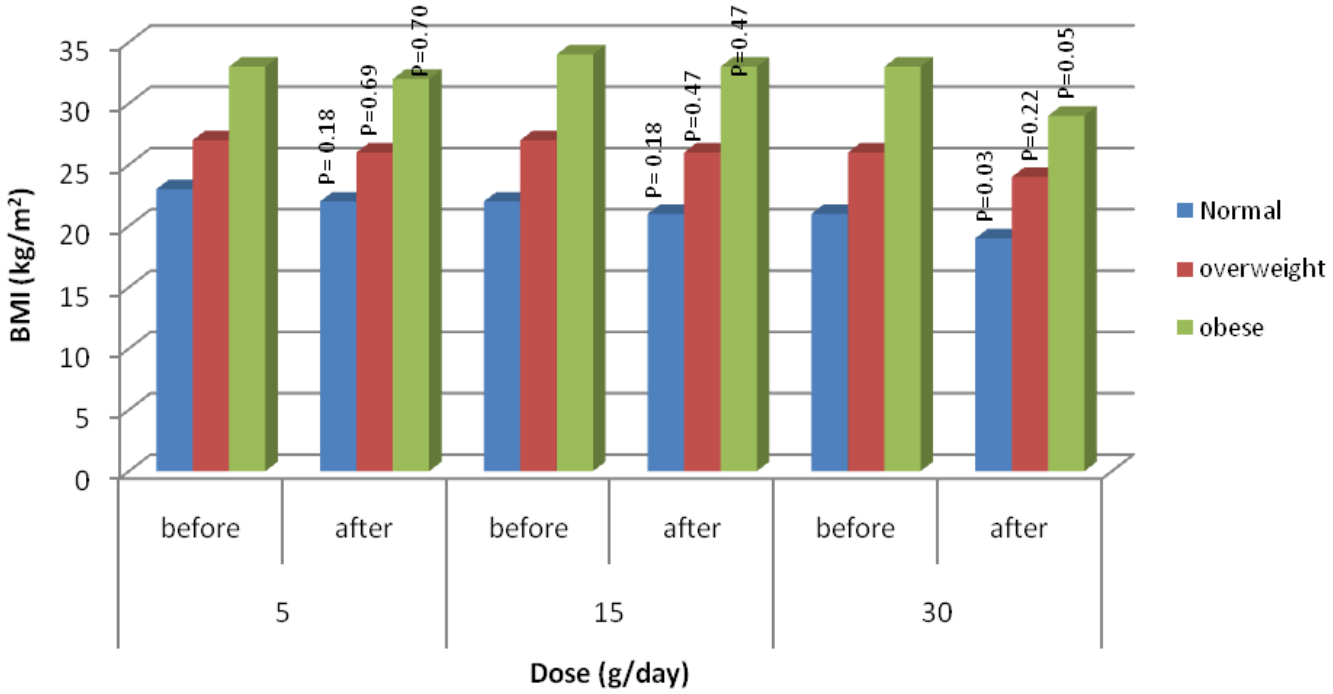

Figure 1. Effect of different doses of *Z. jujube* powder on body mass index (BMI) (kg/m^2). The p-value was calculated between groups and each treatment dose before and after.

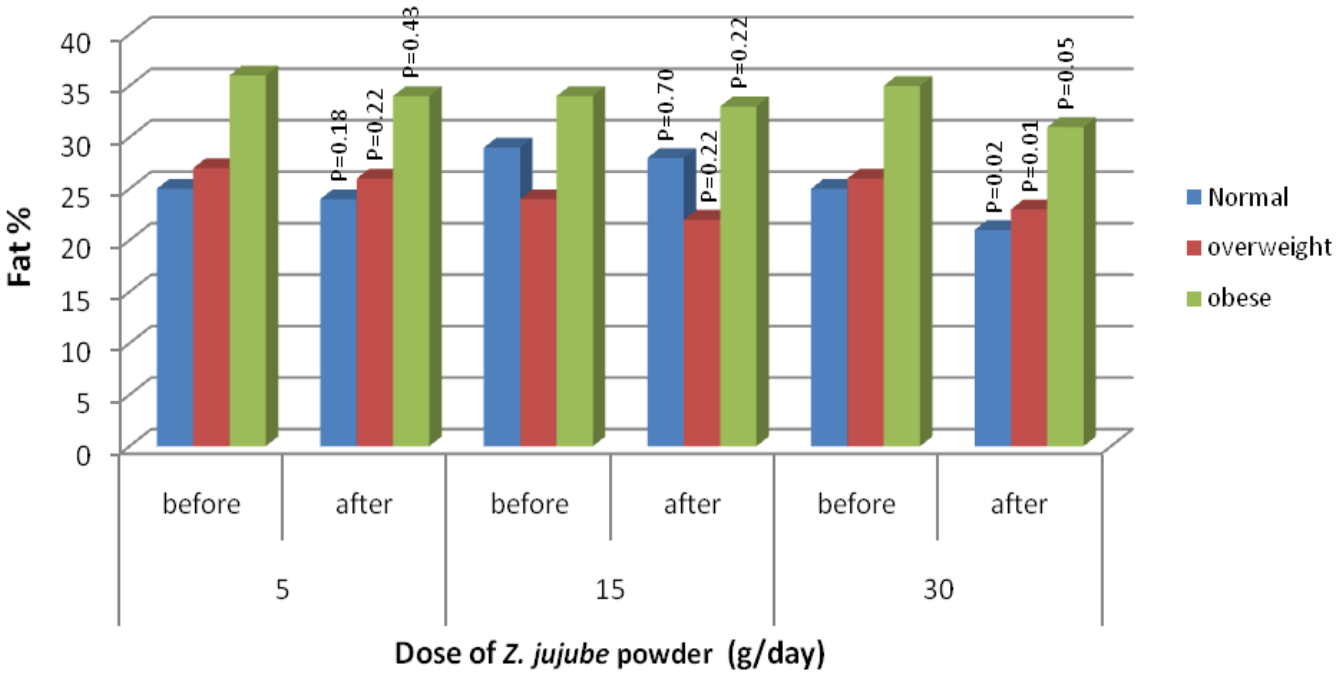

Figure 2. Effect of different doses of Z. jujube powder on fat %. The p-value was calculated between groups and each treatment dose before and after.

Z. *jujuba* powder for three months. Treatment of subjects with 30 g/day for three months of *Z*. *jujuba* powder caused large decrease in BMI (Figure 1). Data showed a decrease in body mass index (BMI) after administration of *Z*. *jujuba* 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 who consumed 30 g/day (Figure 1).

Furthermore, another investigation was made to evaluate the effectiveness of *Z. jujuba* on both fat percentage. As illustrated in Figure 2, intervention with 5 and 30 g/day of *Z. jujuba* powder was accompanied with an average of 4 and 16% decline in fat content, respectively. From the data aforementioned, 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 and 30 g/day of *Z. jujuba* powder.

Similar results for BMI were observed for fat percentage. Data showed very slight decrease in fat percentage of 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 Figure 3 demonstrated that the impact of consumption of low doses of *Z. jujuba* 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. jujuba* fruit powder caused significant declines in the blood levels of triglycerides, total cholesterols, and LDL-cholesterol, but increased HDL-cholesterol. Moreover, it seemed that *Z. jujuba* fruit powder had hypolipidemic potential. This may be an indication of progressive metabolic control of *Z. jujuba* 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 aforementioned data discussed earlier, it was confirmed that *Z. jujuba* 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. jujuba* powder have therapeutic potential. They possess hypolipidemic and anti-obesity properties, but the hypolipidemic effect was more pronounced. Also, they did not show any negative impact on liver function.

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

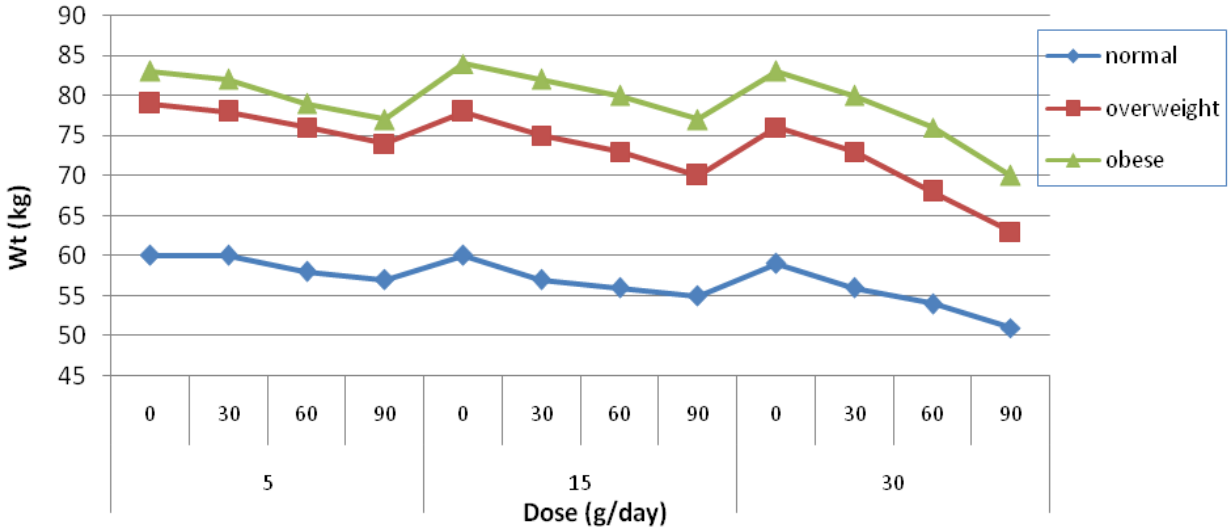

Figure 3. Effect of different doses of *Z. jujube* powder on weight (Wt) (kg).

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