The effect of date palm consumption on the serum levels of glucose, triglyceride, cholesterol, HDL, VLDL, and LDL in rat’s serum with experimental diabetes

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Abstract

This study was to evaluate dates effects on serum concentration of glucose, triglyceride, and cholesterol, VLDL, LDL and HDL in experimental diabetes mellitus in rat. 30 male Wistar rats with age of 8 weeks and weight of 200 ± 20 grams were selected. Then these rats were divided into five groups, 6 rats per group. Diabetic treatment group and diabetic control group received subcutaneous a single dose of Alloxan (100mg/kg BW) in saline solution. Injections after 1 week in all groups were repeated. The diabetic control group and control group were fed only with pellet. These groups were fed for 10 days. Blood samples collected from whole groups at the end of 10day. Evaluation of the serum levels of glucose, cholesterol and LDL revealed statistically significant increase between diabetic control group with control group and also between treatment group and diabetic treatment group with diabetic control group and control group(P<0.05). Evaluation of the serum levels of triglyceride did not reveal statistically significant differences in diabetic treatment group and treatment group with control group, but decreased significantly compared to the diabetic control group (P<0.05). Evaluation of the serum Levels of VLDL decreased significantly in diabetic treatment group and treatment group compared to the diabetic control group (P<0.05), but did not reveal statistically difference compared to the control group. Evaluation of the serum levels of HDL did not reveal statistically significant difference between groups. The dates can be used as a natural fruit for prevent than diabetes mellitus disorders.

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Introduction

Diabetes mellitus is syndrome occurs due to lack of insulin secretion or decrease in tissue sensitivity to insulin and results in disorder in carbohydrate, fat and protein metabolism (Hall, 2010). Regards to that diabetes is one of common diseases at world increasingly and there is no definite therapy by now, therefore only promising method includes proper care and controlled feeding and any overindulge may result in irretrievable consequences. In diabetes, in addition to serum levels of glucose, triglyceride, cholesterol, HDL, VLDL and LDL are increase significantly which each have related problems (Ganti, 1998- Nelson et al., 2008). The most important physiological event in diabetes mellitus includes hyperglycemia which occurs due to 3 cause: 1. Decrease in glucose arrival rate into different cells. 2. Decrease in glucose in different tissue. 3. Increase in glucose production by liver (gluconeogenesis) (Hall, 2010). Main symptoms of diabetes mellitus include: polyuria, polydipsia and losing weight unlike sufficient feeding. Diabetes is divided into two groups totally: 1. Diabetes type I or insulin-dependent diabetes mellitus (IDDM). 2. Diabetes type II or non-insulin-dependent diabetes mellitus (NIDDM) (Hall, 2010). The aim of this study is evaluating therapeutic effects of dates on biochemical tableau of experimental diabetes in rats so that to find whether dates can take role in decreasing effects of diabetes mellitus. The induction of experimental diabetes in the rat using chemicals which selectively destroy pancreatic B cells is very convenient and simple to use. The most usual substances to induce diabetes in the rat are alloxan and streptozotocin. Alloxan are widely used to induce experimental diabetes in animals. Alloxan and the product of its reduction, dialuric acid, establish a redox cycle with the formation of superoxide radicals. These radicals undergo dismutation to hydrogen peroxide. The action of reactive oxygen species with a simultaneous massive increase in cytosolic calcium concentration causes rapid destruction of B cells. Summing up, the toxic action of alloxan on pancreatic B cells are the sum of several processes such as oxidation of essential –SH groups, inhibition of glucokinase, generation of free radicals and disturbances in intracellular calcium homeostasis (Szkudelski, 2001). The fruits (dates) of the date palm (Phoenix dactylifera) contain a high percentage of carbohydrate (total sugars, 44.88%), fat (0.2-0.5%), 15 salts and minerals, protein (2.3-5.6%), vitamins and a high percentage of dietary fibre (6.4-11.5%). The flesh of dates contains 0.2-0.5% oil, whereas the seed contains 7.7-9.7% oil. The weight of the seed is 5.6-14.2% of the date. The fatty acid occur in both flesh and seed as a range of saturated and unsaturated acids, the seeds containing 14 types of fatty acids, but only eight of these fatty acids occur in very low concentration in the flesh. Unsaturated fatty acids include palmitoleic, oleic, linoleic and linolenic acids. The oleic acid content of the seeds varies from 41.1 to 58.8%, which suggests that the seeds of date could be used as a source of oleic acid. There are at least 15 minerals in dates.

The percentage of each mineral in dried dates varies from 0.1 to 916 mg/100 g date depending on the type of mineral. In many varieties, potassium can be found at a concentration as high as 0.9% in the flesh while it is as high as 0.5% in some seeds. Other minerals and salts that are found in various proportions include boron, calcium, cobalt, copper, fluorine, iron, magnesium, manganese, potassium, phosphorous, sodium and zinc. Additionally, the seeds contain aluminum, cadmium, chloride, lead and sulphur in various proportions. Dates contain elemental fluorine that is useful in protecting teeth against decay. Selenium, another element believed to help prevent cancer and important in immune function, is also found in dates. The protein in dates contain 23 types of amino acids, some of which are not present in the most popular fruits such as oranges, apples and bananas. Dates contain at least six vitamins including small amount of vitamin C, and vitamins B1 (thiamine), B2 (riboflavin), nicotinic acid (niacin) and vitamin A. The dietary fibre of 14 varieties of dates has been shown to be as high as 6.4-11.5% depending on variety and degree of ripeness. Dates contain 0.5-3.9% pectin, which may have important health benefits. The world production of dates has increased.
2.9 times over 40 years, whereas the world population has doubled. The total world export of dates increased by 1.71% over 40 years. In many ways, dates may be considered as an almost ideal food, providing a wide range of essential nutrients and potential health benefits (Al-Shahib and Marshall, 2003).

The aim of the current study was to evaluate dates effects on serum concentration of glucose, triglyceride, and cholesterol, VLDL, LDL and HDL in experimental diabetes mellitus in rat.

Materials and methods

Study Design

30 males Wistar rats with age of 8 weeks were selected. Weighted by true digital balance and divided into 5 groups, so that there were 6 rats per group. In order to get used to environment, first they were maintained one week into the special cage and maintained at 23-25°C with a 12h dark and light. Average weight of all groups was 200±20 gr. At first day, one of groups was bled and blood serum sample were separated and analyzed after centrifuge.

Diabetes induction

Alloxan monohydrate (by Fluka Co, in 10gr package) was used to induce type I diabetes mellitus. Diabetic treatment group and diabetic control group received subcutaneous a single dose of alloxan (100 mg/kg WB) in saline solution. Pour control group and control group received subcutaneous salinonormal (100 mg/kg WB). Injection after 1 week in all groups was repeated. After second injection, groups that received alloxan, showed diabetic symptoms including: polydipsia, polyuria, glucoesuria and hyperglycemia, which blood glucose was measured in fasting mood by digital glucometer one day after second injection, showed hyperglycemia (162.50±4.52 mg/dl) to healthy rats (86.6±3.16 mg/dl), and glucoesuria was confirmed with human urine tapes (by Manchereg-Nagel Co).

Nutrition Program

Groups were fed by bottom stock after observing diabetic symptom: Group 1: receiving physiological serum as a control group, was fed only with pellet 50±10 gr daily. Group 2: receiving physiological serum as a treatment group was fed with (25±5gr dates) + (25±5gr pellet). Group 3: receiving alloxan as a diabetic control group was fed only with 50±10 gr pellet. Group 4: receiving alloxan as a diabetic treatment group was fed with (25±5 gr dates) + (25±5 gr pellet).

These groups were fed with this method twice a day. Whole groups were fed and maintained 10 days under above mentioned conditions and were controlled everyday on certain time, then remaining food was weighted and after defining amount of last day consumed food, fresh food was fed. Meanwhile, during day from consuming dates by treatment group and diabetic treatment group was assured. Blood samples collected from whole groups at the end of 10 day and was gathered test tubes, tubes lids were closed with Para film then were centrifuged for 10 minutes at 2500 turn/minute and serum were separated and analyzed.

Biochemical Examinations

Whole rats were anesthesia by chloroform in glass jar then were bled by de-heading method and during bleeding care was performed to blood enter into the test tubes slowly and tangent with wall. Glucose, triglyceride, cholesterol and HDL serum levels were measured by enzymatic method with commercial kits built in BIOCHEMISTRY factory by producer Co, because of proposed waves with spectrophotometer BIOWAVE model F2100 built in England, and serum values of LDL and VLDL were calculated according to follow formula:

\[
VLDL = \frac{\text{triglyceride}}{5} \\
LDL = \text{cholesterol} - (\text{HDL} + \text{VLDL})
\]

Statistical methods

After obtaining results, comparing average parameters obtained were measured statistical experiment ANOVA and Paired student’s t-Test by software SPSS. Study design was completely randomized.
Result
Comparison of blood glucose (mg/dl) serum levels in pure control group, control group, diabetic control group, treatment group and diabetic treatment group revealed statistically meaningful difference between diabetic control group with pure control group and control group, and diabetic treatment group with pure control group and control group and diabetic control group (P<0.05). Blood glucose level in diabetic control group that receiving alloxan had meaningful increase as to pure control group and control group. In diabetic treatment group infected with experimental diabetes by drug and received dates, revealed meaningful decrease compared to diabetic control group but showed increase compared to pure control group and control group (Table 1).

Table 1. Serum levels of Glucose (mg/dl).

<table>
<thead>
<tr>
<th>Pure control group</th>
<th>Control group</th>
<th>Treatment group</th>
<th>Diabetic treatment group</th>
<th>Diabetic control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>86.63±3.16</td>
<td>80.30±8.90</td>
<td>77.96±10.25</td>
<td>110.4±15.92</td>
<td>162.5±4.52</td>
</tr>
</tbody>
</table>

Glucose

a

a

A

b

c

Similar letters in each row indicated no meaningful difference statistically (P>0.05)
No similar letters in each row indicated meaningful difference statistically (P<0.05).

Table 2. Serum levels of Triglyceride (mg/dl).

<table>
<thead>
<tr>
<th>Pure control group</th>
<th>Control group</th>
<th>Treatment group</th>
<th>Diabetic treatment group</th>
<th>Diabetic control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>77.90±9.73</td>
<td>82.30±13.07</td>
<td>90.33±11.01</td>
<td>87.25±18.18</td>
<td>97.25±14.62</td>
</tr>
</tbody>
</table>

Triglyceride

b

a

A

a

b

Statistical comparing of triglyceride among different groups, revealed statistical meaningful difference among diabetic control group with control groups, and treatment group and diabetic treatment group(P<0.05) (Table 2). Serum levels of triglyceride which was made by drug revealed statistical meaningful increase in diabetic control group compared to control groups(P<0.05). But in diabetic treatment group triglyceride level revealed statistical meaningful decrease compared to diabetic control group(P<0.05).

Table 3. Serum levels of Cholesterol (mg/dl).

<table>
<thead>
<tr>
<th>Pure control group</th>
<th>Control group</th>
<th>Treatment group</th>
<th>Diabetic treatment group</th>
<th>Diabetic control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>100.5±6.93</td>
<td>98.68±5.45</td>
<td>96.53±9.38</td>
<td>82.38±6.83</td>
<td>120.45±5.95</td>
</tr>
</tbody>
</table>

Cholesterol

a

a

A

b

c

Statistical evaluation of cholesterol among groups revealed statistically meaningful difference among cholesterol of diabetic control group with control groups, and also treatment group and diabetic treatment group with diabetic control group (P<0.05). Serum levels of cholesterol in diabetic control group had statistically meaningful increase compared to diabetic control group (P<0.05). Serum levels of cholesterol revealed also statistically meaningful decrease in diabetic treatment group compared to the control groups (P<0.05) (Table 3).

Statistical comparison of serum levels of VLDL among groups revealed statistically meaningful difference among diabetic control group with other groups. Serum levels of VLDL reveal meaningful increase in diabetic control group compared to other groups. But reveal meaningful decrease in diabetic treatment group compared to the diabetic control group (P<0.05) (Table 4).

Table 4. Serum levels of VLDL (mg/dl).

<table>
<thead>
<tr>
<th>Pure control group</th>
<th>Control group</th>
<th>Treatment group</th>
<th>Diabetic treatment group</th>
<th>Diabetic control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>120.45±5.95</td>
<td>118.5±4.78</td>
<td>116.3±9.25</td>
<td>114.3±6.83</td>
<td>112.4±5.95</td>
</tr>
</tbody>
</table>

VLDL

b

a

A

b

c

Statistical comparing between serum levels of LDL among groups shows statistically meaningful difference between diabetic control group with pure
control group and control group and diabetic treatment group and treatment group. Serum levels of LDL in diabetic control group had statistically meaningful increase compared to control groups. While serum levels of this parameter in treatment group and diabetic treatment group revealed statistically meaningful decrease compared to diabetic control and control groups (P<0.05) (Table 5).

**Table 4. Serum levels of VLDL (mg/dl).**

<table>
<thead>
<tr>
<th></th>
<th>Pure control group</th>
<th>Control group</th>
<th>Treatment group</th>
<th>Diabetic treatment group</th>
<th>Diabetic control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLDL</td>
<td>15.56 ± 1.94</td>
<td>19.90 ± 2.61</td>
<td>22.46 ± 2.20</td>
<td>23.00 ± 3.63</td>
<td>29.45 ± 2.92</td>
</tr>
<tr>
<td>a</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>b</td>
</tr>
</tbody>
</table>

Statistical comparison of average HDL among groups revealed no meaningful difference statistically (Table 6).

**Discussion**

Today diabetes mellitus is one of the important problems in human and animal society. Also, in veterinary diabetes mellitus occurs in most animal specially in pets and to encourage animals to do different works, using chocolate and sweetness is current (Ganti, 1998). What is important in diabetes mellitus is increasing of blood glucose level and change in insulin level or insulin receptors? As result, lack of consuming blood glucose results in sets of metabolic changes in body that can make significant changes including glycogenesis, lipolysis and gluconeogenesis. When consuming blood glucose does not occur. Glucagon hormone increases and cause to above changes, as result, stored glycogen level decrease and it is synthesis is lowered due to inhibitor of glycogen synthesis enzyme (Ganti, 1998- Nelson et al., 2008).

**Table 5. Serum levels of LDL (mg/dl).**

<table>
<thead>
<tr>
<th></th>
<th>Pure control group</th>
<th>Control group</th>
<th>Treatment group</th>
<th>Diabetic treatment group</th>
<th>Diabetic control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>LDL</td>
<td>49.67 ± 3.43</td>
<td>46.20 ± 0.14</td>
<td>37.76 ± 10.72</td>
<td>38.74 ± 7.00</td>
<td>65.40 ± 11.33</td>
</tr>
<tr>
<td>a</td>
<td>a</td>
<td>a</td>
<td>B</td>
<td>c</td>
<td>c</td>
</tr>
</tbody>
</table>

As result of gluconeogenesis, body proteins decomposed and blood glucose increase and ammonia and urea will be produced from protein metabolism to supply energy. On the other hand, body's fats will be decomposed due to sensitive of lipase enzyme to hormone, then it cause to increase of lipoproteins, triglyceride and cholesterol. Acetyl-coA resulted from metabolism must be reacted with oxaloacetate (C4) and enter to Krebs cycle as citric acid (C6) but cannot be used because of lack of oxaloacetate (Ganti, 1998- Nelson et al., 2008). As result have two ways:

A) 3 molecules of Acetyl-CoA combined together then gives cholesterol molecule. B) Chooses ketogenesis path gives rise ketone bodies (beta-hydro butyric acid, acetone, acetoacetic acid) (Nelson et al., 2008). There are different therapeutic methods in order to diabetes treatment including Glibenclamide (increase of insulin effect), Metformin (decrease of liver glucose exit and decrease of insulin strength) (Inzucchiet al., 1998- Melchior and Jaber, 1996), inhibitory drugs α-glycosidase (control of compound carbohydrate being decomposed and latency in monosaccharide’s absorption from digestive system) (Scheen, 1997-Sparano and Seaton, 1998), and Troglitazone (A mechanism including skeletal muscles in absorbing and taking glucose and increasing sensitivity to insulin).

The aim of study is evaluating therapeutic effects of dates on biochemical tableau of experimental diabetes in rats to find whether dates can take role in decreasing diabetes mellitus measuring blood glucose showed that after alloxan prescribing serum level of
glucose has meaningful increase in diabetic control group compared to control group. Alloxan influences on β-islets Langerhans cells and causes to cell decomposition which it is symptoms are polyuria and polydipsia. Alloxan effects in giving rise to diabetes mellitus is resulted from free radical production (superoxide and hydroxyl) and on the other hand it causes to these cells decomposition by increasing intracellular calcium concentration. Results of this study are accordance with research result of Szkudelski (1986) (Szkudelski, 2001), Kim et al. (1994) (Kimet al., 1994), Killiber et al. (1996) (Kliber et al., 1996) and Weaver et al. (1978) (Weaveret al., 1978).

Table 6. Serum levels of HDL (mg/dl).

<table>
<thead>
<tr>
<th>Pure control group</th>
<th>Control group</th>
<th>Treatment group</th>
<th>Diabetic treatment group</th>
<th>Diabetic control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>23.30 ± 0.53</td>
<td>25.24 ± 1.00</td>
<td>23.30 ± 0.82</td>
<td>20.64 ± 0.46</td>
<td>22.30 ± 0.53</td>
</tr>
<tr>
<td>a</td>
<td>a</td>
<td>A</td>
<td>a</td>
<td>a</td>
</tr>
</tbody>
</table>

Prescribing dates in diabetic treatment group and treatment group reveal statistically meaningful decrease compared to diabetic control group. But in treatment group using no Alloxan but only dates, reveal statistically meaningful decrease compared to control groups, and has lowered blood glucose under normal level. Analyzing dates structure showed that dates constituent materials contain sugars as saccharose, glucose, fructose and maltose. Among them glucose and fructose are at high level (Al-Shahib and Marshall, 2003). When there is problem of using glucose and animal or human cannot use glucose as energy source for a few reasons, fructose is consumed in cells, to supply energy as important factors. However, fructose arrives into the liver by blood after absorbed from intestine (Nelsonet al., 2008). Then by enzymatic processes such as fructokinase and one ATP molecule, it is converted to fructose 1-phosphate, while this material converted to dihydroxyacetone phosphate and glyceraldehyde by aldolase. Finally glyceraldehyde is phosphorylated at ATP present by phospho glyceraldehyde kinase and is converted to glyceraldehyde 3-phosphate and dihydroxyacetone phosphate that are compound resulted from glycolysis and converter into Krebs cycle (Nelsonet al., 2008). On the other hand during lack of glucose, liver tissue cells, muscles, brain and blood tissue cells can convert fructose to fructose 6-phosphate by certain hexokinase to supply energy (Nelsonet al., 2008). Therefore, it can be resulted that using no glucose on one hand, and providing fructose by dates and supplying energy by fructose, is a factor for decreasing blood glucose. On the other hand, fiber level is high in dates and this can prevent from diabetes mellitus spread. Mechanism is not clear but it can say that fiber prevents from fast increase of glucose by causing latency in stomach empty and cause to latency in hungry feeling. It also, can be decomposed into colon by micro-flora and give rise to short chain fatty acids, this fermentation cause to liver glucose production decrease and by this way cause to decrease glucose after meal. Obtained results from this study are accordance with other results of researchers (Alleret al., 2004- Hlebowicz et al., 2007).

Jueet al. (2003) have reported effect of dietary with high fiber as factor in decreasing blood sugar (Liet al., 2003). As dates contain as higher fiber, can perform this influence. Also Mg as element that it is lack is observed in diabetes mellitus and cardiovascular disease and in is resulted from urine excretion, decrease in absorption from intestine, glucosuria and urea excretion. Mg takes important role in carbohydrate metabolism and insulin function and as cofactor that acts in transport, Jointing and glucose secretion. Insulin cause to increasing of Mg arrival into the cell while this problem is observed in diabetes type I (IDMM). Mg level is relative high at dates, thus can interfere with carbohydrate metabolism and other mentioned cases adjusts increased level of glucose. Results of this research are in agreement with that of hanset al. (2002) (Hanset al., 2002). Ostovar (2008) evaluated effect of walnut on induced diabetes by Alloxan which are in
agreement with results of this study (Ostovaret et al., 2014).

Alizadeh (2008) evaluated effect of honey on induced diabetes by Alloxan which is in accordance with these results (Alizadeh, 2008). Zn is one essential element for insulin metabolism, and usually decreases in diabetes type I. As dates contains Zn, can be effective in preventing β-cells decomposition (Al-Shahib and Marshall, 2003). Miller et al. (2003) evaluated of dates and date/yoghurt mixed meals on blood glucose and reported decrease in glucose and fat which are in accordance with our study (Miller et al., 2003). Serum levels of cholesterol after prescribing Alloxan in diabetic control group reveal meaningful increase. In diabetes occurred, glucose cannot supply energy, β-cells of pancreases destroyed, insulin lowered in turn glucagon is increased. As result this increasing of lipolysis occurs. On one hand produced Acetyl-CoA cannot enter to Krebs cycle and from combining 3 molecules, cholesterol is produced (Ganti, 1998- Kandulskak et al., 1999- Nelson et al., 2008). At diabetic treatment group and treatment group also serum level of cholesterol reveal meaningful decreased compared to diabetic control group, pure control group and control group. Also decrease is high in diabetic treatment group and cholesterol level is lower compared to control group. Cause for cholesterol decreasing can be due to low level of cholesterol in dates (Al-Shahib and Marshall, 2003), on hand because fructose can supply needed energy of cells, then Acetyl-CoA losses the time of joint and producing cholesterol (Nelson et al., 2008). Also presence of fiber can cause to joint with cholesterol and decrease serum level of lipid and cholesterol.

Results of this study are in agreement with that of other researchers (Hlebowicz et al., 2007- Li et al., 2003- Weaver et al., 1978). Miller et al. (2003) reported effect of dates and date/yoghurt mixed meals in decreasing blood cholesterol (Miller et al., 2003). Alizadeh (2008) reported cholesterol decrease in using honey in induced diabetes with Alloxan (Alizadeh, 2008). Ostovar (2008) reported cholesterol decrease in using walnut in induced diabetes with Alloxan (Ostovaret et al., 2014). Serum level of triglyceride in diabetic control group have increased after prescribing Alloxan which is resulted from effect of Alloxan on β-cells of pancreases and decrease of insulin serum that follow increasing glucagon and induced lipolysis process (Ganti, 1998- Kandulskak et al., 1999- Nelson et al., 2008). At diabetic treatment group and treatment group serum level of triglyceride reveal increase which is not meaningful, but reveal meaning decrease compared to diabetic control group. On one hand presence of fiber in dates cause to decreasing serum triglyceride that probably is resulted from its excretion which are in agreement with result of Jue et al. (2003) (Liet et al., 2003). Presence of unsaturated fatty acid particularly ω-3 prevent from increasing lipid, and synthesis of fatty acid and triglyceride on liver, that these result are in agreement with that of Kinsell (1987) (Kinsella, 1987). Miller et al. (2003) have reported serum decrease of triglyceride in consuming dates and date/yoghurt mixed meals (Miller et al., 2003). Serum levels of VLDL have meaningful increase in diabetic control group by prescribing Alloxan which is resulted from inducing fat resulted from glucagon hormone (Ganti, 1998- Kandulskak et al., 1999- Nelson et al., 2008). In diabetic treatment group and treatment group there is meaningful decrease to diabetic control group, but there is no meaningful change compared to control groups. Decrease in VLDL to diabetic control group can be resulted from high level of fiber, presence of unsaturated fatty acid and particularly ω-3 and preventing VLDL synthesis in liver by this fatty acid which are agreement with study of other researchers (Kinsella, 1987- Liet et al., 2003). Serum level of LDL at diabetic control group induced by Alloxan revealed statistically meaningful increase to control groups. This increase is due to effect of glucagon hormone (Ganti, 1998- Kandulskak et al., 1999- Nelson et al., 2008). In diabetic treatment group and treatment group meaningful decrease is observed compared to diabetic control group and control groups. This decrease cause, on one hand due to lack of increasing VLDL because that is pre LDL. Similar study did not have performed at this field. LDL as lipoprotein is undesirable that is vector of
cholesterol and direct cholesterol into peripheral tissue.

Conclusion
Decreasing made in serum level of LDL is benefit for body and can make reduce in different cardiovascular disease. Decrease of cholesterol and LDL has reported in consuming fiber (Aller et al., 2004). Ostovar (2008) has evaluated effect of walnut on diabetes that LDL level has reduced by walnut (Ostovar et al., 2014). Evaluation of the serum levels of HDL did not reveal statistically meaningful difference between groups.

References
http://dx.doi.org/10.1080/09637480120091982

http://dx.doi.org/10.1016/j.diabres.2003.11.005


http://dx.doi.org/10.1186/1475-2891-6-22

http://dx.doi.org/10.1056/NEJM199803263381303


http://dx.doi.org/10.1016/0925-4439(94)90111-2

http://dx.doi.org/10.1016/0002-9149(87)90588-1


http://dx.doi.org/10.1038/sj.ejcn.1601565


Weaver DC, McDaniel ML, Naber SP, Barry CD, Lacy PE. 1978. Alloxan Stimulation and Inhibition of Insulin Release from Isolated Rat Islets of Langerhans. Diabetes. 27, 1205-1214. http://dx.doi.org/10.2337/diab.27.12.1205