
Study of Dried Apricot Effect on Type 2 Diabetic Patients as a Hypoglycemic Material

Bilal J.M. Al Rawi¹
PhD

Louwy M.A. Al Ani²
PhD

Ali K Alywee³
MSc

Abstract:

Background & objectives: apricot has constituents with antioxidant activity and some of them had been studied and showed good results against diabetes. Dried apricot is available during the year and its constituents are concentrated as well as apricot is desirable fruit and very safe. Therefore the aim of this work is to study the ability of apricot (*Prunus armeniaca L.*) in decreasing glucose concentration in patients with type 2 diabetes.

Methods: this study was undertaken on 67 patients with type 2 diabetes mellitus, (39-67 years old) with mean \pm SE (49.313 \pm 1.2968). The healthy control group consisted of 75 individuals which did not suffer from any problem, (19-69 years old) with mean \pm SE (48.65 \pm 2.15). The patients did not have other interfering health problems. Blood glucose concentrations were determined using enzymatic colorimetric method ENDPOINT for all subjects at beginning and the concentration labeled as (time 0). Directly after blood withdrawing, all subjects had 18 grams of dried apricot. The second time labeled as (time 30) which mean the concentration of glucose after 30 minutes of eating the apricot. After eating the apricot, another sample of blood was collected from every subject to determine the glucose concentration and this time the concentration called (time 60).

Results: the results showed that the apricot decrease glucose in blood of patients of type2 diabetes not healthy control and there is significant differences ($p < 0.01$). There are three expectation equations to estimate glucose level in experiment conditions.

Interpretation & conclusions: apricot is good food for diabetic patients. It is safe, desirable, it decrease glucose concentration, and it reduce the risk of diabetes complications. Apricots do all this activities because it has constituents with antioxidant activity and other compounds with hypoglycemic activity like anthocyanin, procyanidin, carotenoids, and others.

Keywords: apricot, type 2 diabetes, *Prunus armeniaca L.*

Introduction

Diabetes mellitus, according to the classical definition, is a disorder resulting from both genetic predisposition and favoring environmental factors, and is characterized by alterations in the metabolism of carbohydrate, fat and protein, which are caused by a relative or absolute deficiency of insulin secretion and different levels of insulin resistance¹. There are two types of diabetes, type-1 (insulin-dependent diabetes) and type-2 diabetes.

Type-1 diabetes results from autoimmune destruction of pancreatic β -cells, the cells that secrete insulin, which leads into insulin insufficiency².

Type 2 diabetes (previously also named non-insulin-dependent diabetes mellitus – NIDDM – or adult-onset diabetes) is more prevalent and occurs in approximately 90–95% of diabetic people in the Western world, resulting from insulin resistance and insufficient compensatory insulin secretion^{2,3}. The undiagnosed diabetes is a serious problem. Early detection and treatment are indispensable to reduce the late complications of type 2 diabetes⁴. Oral hypoglycemic agents that directly stimulate insulin release from β -cells (e.g., sulfonylurea-based drugs), however, have shown that insulin secretion from islets of type-2 diabetic patients can be elevated sufficiently to overcome peripheral insulin resistance and normalize blood glucose levels⁵.

One of the disadvantages of using sulfonylurea-based drugs is that it fails to control normal blood glucose levels⁶. These drugs also adversely affect the ability of β -cells to secrete insulin and cause weight gain⁶. Hence, there is a role for dietary

constituents that can regulate blood glucose levels or induce insulin production by pancreatic β -cells. In the treatment of diabetes mellitus, changes in lifestyle play a major role, in addition to treatment with insulin or oral glucose-lowering drugs. For most patients with type 2 diabetes, the changes in lifestyle (concerning diet and exercise) are the cornerstone of treatment whereas the pharmacologic intervention represents a supplementary treatment for those patients who do not respond adequately to lifestyle changes.

Apricot (*Prunus armeniaca L.*) is one of the most important fruits. It has a high nutritional value. This fruit is rich in most of the essential nutrients, especially, vitamin A, vitamin C, beta carotene, calcium, potassium, flavonoids, Kaempferol, etc. as well as high levels of lycopene⁸⁻¹⁴. Apricots are available in both fresh and dried forms. While, dried apricots are available throughout the year, fresh ones are seasonal. Both are nutritious and offer various health benefits. Dried apricots health benefits are said to be higher as compared to the fresh form¹⁵.

The previous studies showed that some of apricot constituents are anthocyanin, procyanidin, hydroxycinnamic acid derivatives, β -carotene, and others which had been proved that play roles in decreasing glucose by different mechanisms^{2,17-20}.

Because apricot has constituents having antioxidant activities and some hypoglycemic agents like anthocyanin, we think apricot can reduce the glucose concentration in blood of type 2 diabetic patients and reduce the risk of diabetes complications. So the aim of this work is to study the effect of dried apricot on glucose concentration

in patients with type 2 and comparing the results with healthy individuals as a control group.

Materials & Methods

Dried apricot which has been used in this study is Malatya type with 24% moisture, Turkey.

Instruments: UV-VIS double beam spectrophotometer from Bio Tech management Co.LTD. UK. was used to determine glucose concentration photometrically using glucose laboratory kit from cramatest linear chemicals; Spain.

Subjects: this study was undertaken on 67 patients with type 2 diabetes mellitus, (39-67 years old) with mean ± SE (49.313 ± 1.2968). The healthy control group consisted of 75 individuals which did not suffer from any problem, (19-69 years old) with mean ± SE (48.65 ± 2.15). The patients did not have other interfering health problems.

Method: Blood glucose concentrations were determined using Enzymatic colorimetric method ENDPOINT²¹ for all subjects at beginning and the concentration labeled as (time 0). It is important to note the period after medication for patients and it should be at least 3 hours. Directly after blood withdrawing, all subjects had 18 grams of dried apricot. The second time labeled as (time 30) which mean the concentration of glucose after 30 minutes of eating the apricot. After eating the apricot, another sample of blood was collected from every subjects to determine the glucose concentration and this time the concentration called (time 60).

Statistics: data were subjected to (ANOVA) using analysis of covariance. Also multiple regressions was used to get the equation of variables dependence.

Differences were considered significant at P<0.05. Statistical analyses were performed using MedCalc

$$\text{Glucose conc. (mg/dl) at time 0} = 85.2295 + (-37.7158 * \text{afflicting}) + (34.8289 * \text{Sex}) + (1.6853 * \text{age})$$

$$\text{Glucose conc. (mg/dl) at time 30} = 88.5282 + (-31.1596 * \text{afflicting}) + (33.1428 * \text{Sex}) + (1.57 * \text{age})$$

$$\text{Glucose conc. (mg/dl) at time 60} = 72.3834 + (-22.4497 * \text{afflicting}) + (22.6608 * \text{Sex}) + (1.6603 * \text{age})$$

statistical software (1993-2009 copyright © Frank Schoonjans., Norway.)

Results

The results showed that there is significant differences between groups (diabetic and healthy control) (p< 0.001) in different intervals (figure 1). There are significant differences according to sex (p< 0.01) in both groups (figure 2). We investigated the age effect and the subjects (diabetic and control) were divided into six subgroups; G1 represents the subjects under 20 yr old, G2 represents (21-30 yr old), G3 represents (31-40 yr old), G4 represents (41-50 yr old), G5 represents (51-60 yr old), and G6 represents above 60 yr old. The results showed that there is significant differences (p= 0.003). figure 3 shows the differences according to age subgroups in different intervals.

Using of multiple regression enable us to expect the concentration of glucose in any of experimental times (before eating apricot, after 30 minutes of eating, and after an hour) by applying the concluded equations. There are three variable in each equation, sex, age, and afflicting by diabetes. The general formula of equation is:

$$Y = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3$$

Where the b₀,b₁,b₂, and b₃ are constants. While X₁,X₂, and X₃ are variables represent afflicting, sex, and age respectively. The letter Y in equation is glucose concentration in (mg/dl).

Depending on symbols used in statistical analysis, afflicting would be 1 for diabetic patients and 2 for healthy control individuals. In the same way, 1 for male and 2 for female to substitute X₂. To substitute X₃, age should be represented in years.

The equations of time 0, time 30, and time 60 are as followed:

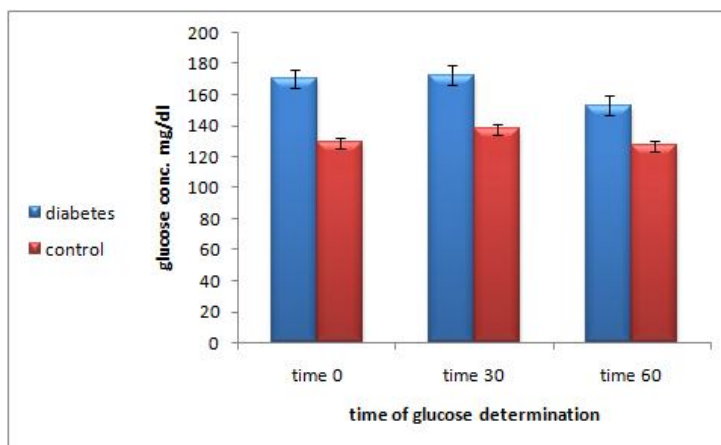


Figure 1: The effect of dried apricot on glucose concentration at different times.

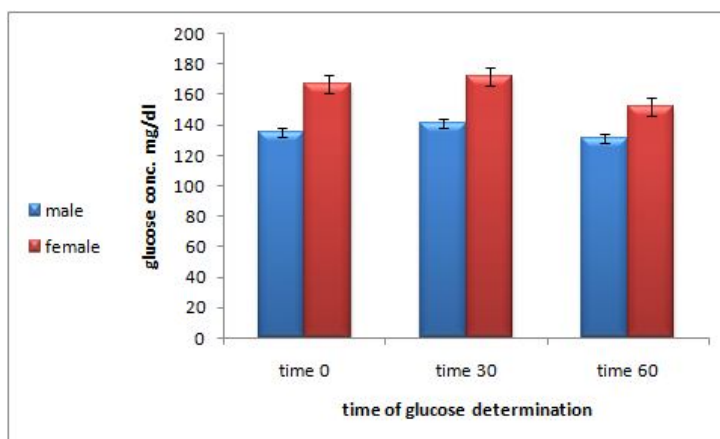


Figure 2: The effect of dried apricot on glucose concentration in different sex.

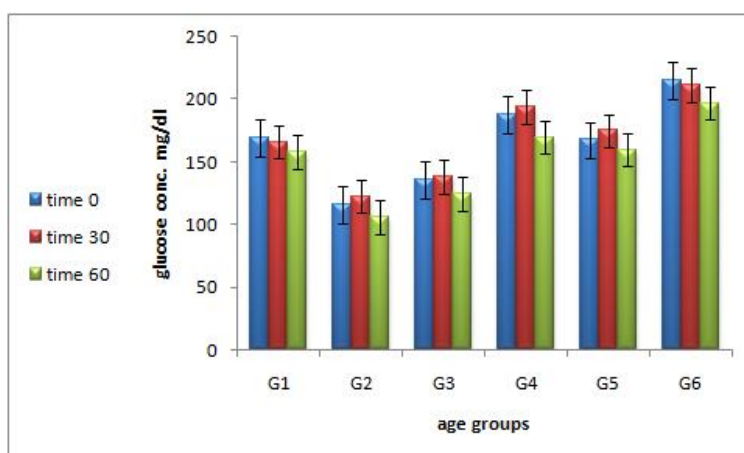


Figure 3: The difference of dried apricot effect on glucose concentration in different age subgroups.

Discussion:

Glucose concentration is maintained by a mechanism controlled mainly by insulin which secreted from islets of Langerhans. The first signal which stimulates insulin secretion is increasing of glucose concentration²². Figure 4 demonstrates the mechanism.

There are a defect in the control mechanism in patients with type 2 diabetes mellitus, which is, either a problem in insulin secretion²³ or a defect in insulin receptors²⁴. The increase in cell volume with fixed number of receptors may be, sometimes, the reason of the defect in insulin mechanism²⁵.

The apricot, from the results, improves the whole mechanism and then decreases the elevated glucose concentration in patients with type 2 diabetes. But in healthy control individuals the glucose did not decrease under the normal fasting level²⁶ (90-120 mg/dl).

This phenomenon confirms that the apricot is working on the whole mechanism.

The differences of apricot effect on different sex can be explained that the distribution and the quantity of fat are different between the two sexes²⁷ and that would reflect to the cell volumes. The increasing in fat layer affects on cell volume and may make (down regulation) which means the level of hormone is high but all the receptors are

saturated which give a signal as a local negative feedback²⁸ which affect the control insulin mechanism.

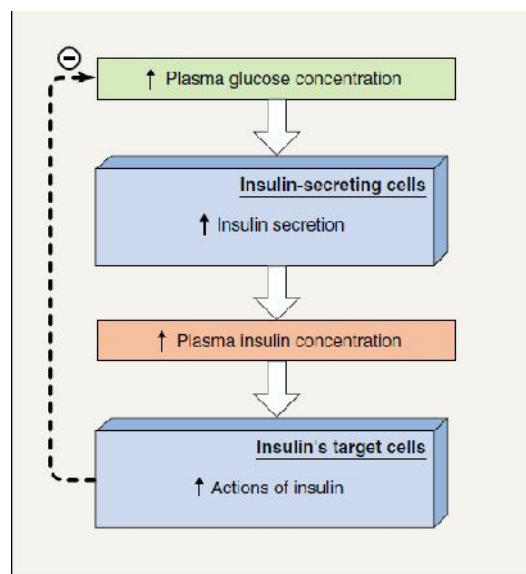


Figure (4): Example of how the direct control of hormone secretion by the plasma concentration of a substance, either organic nutrient or mineral ion, results in the negative-feedback control of the substance's plasma concentration.

The elevation of glucose at 30 minutes after eating apricot is probably because glucose of apricot absorbed directly but after that the other constituents worked on stimulating the β cells to secrete insulin.

There is a significant difference depending on the age that may be while age progressed the concentration of growth hormone decreased which has a direct effect on the concentration of insulin and consequently the whole mechanism of glucose regulation²². Eating food with low fat and rich in antioxidant compounds may reduce the risk of obesity and insulin resistance^{2,29,30}.

Previous studies indicated that eating of vegetable and fruits, especially those with high polyphenols, could decrease the probability of incidence of type 2 diabetes mellitus in case of insulin resistance³¹⁻³³.

Insulin resistance is a defect when insulin is insufficient to stimulate glucose transport in skeletal muscles and adipose tissues as well as insufficient stopping glucose production in the liver.

Apricot is rich with fibers and antioxidant compounds and these compounds may be the reason of apricot role in decreasing the glucose concentration. Four phenolic compound groups, procyanidins, hydroxycinnamic acid derivatives, flavonols, and anthocyanins, were identified by HPLC MS/MS and individually quantified using HPLC DAD in apricots¹³.

All of these compounds participate in ability of apricot to decrease glucose concentration in patients with type 2 diabetes. Anthocyanin prevent oxidative stress in β -cell in pancreas which affected by glucose³⁰. Jayaprakasam et al² showed that anthocyanin triggered insulin secretion and it has direct role in preventing type 2 diabetes and probably useful in treating type 2 diabetes.

On the other hand, it is proved recently that hydroxycinnamic acid derivatives stimulate insulin secretion¹⁸. Procyanidin is a group of polymeric flavonoids having the ability to diminish the concentration of glucose and enhancing the diabetic symptoms in mice with streptozotocin induced diabetes¹⁹.

There are many indicators about carotenoids that have antioxidant properties which prevent and treat some chronic disease, especially, atherosclerosis, diabetes mellitus, and asthma³⁴⁻³⁷.

Carotenoids are exist in numerous quantity in apricot and extractable compounds¹³. Also there is disproportion between β - carotene and glucose in blood²¹.

The presence of the different compounds like anthocyanin, procyanidin, hydroxycinnamic acid derivatives, carotenoids, which can decrease glucose in blood in diabetic patients make them work together in case of synergistic effect and consequently apricot become good source of preventing diabetes and good food for diabetic patients with type 2 diabetes.

Now we can conclude expected glucose level for everyone in circumstances like ours in the experiment depending on 3 parameters.

The parameters which have significant differences can be variables in equation of glucose dependence, age in years, afflicting of people with diabetes, and sex. The concluded equations can calculate glucose in any one before eating, after 30 minutes of eating 18 gram of dried apricot, and finally after 60 minutes of eating 18 gram of dried apricot.

Apricot has good ability to decrease glucose concentration in patients with type 2 diabetes and the good thing is eating apricot did not decrease glucose under normal value. We think that the constituents of apricot work together in way of synergistic effect and treat the whole insulin mechanism which controls the level of glucose in the blood. Apricot has a lot of constituents can reduce the risk of diabetes, so we advice patients with type 2 diabetes to eat dried apricot (available in all the year and has concentrated constituents) daily in quantity about 18 gram. We can estimate glucose level for everybody if we know his or her sex, diabetic or no, and age. Estimating glucose normally and approximately and expectation the glucose level after eating dried apricot in condition of our experiment.

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1 Dept. of Chemistry- Education College for Women- Al Anbar University.

2 Biology Dept.-College of Science –Al Anbar University.

3 Dept. of Chemistry- Education College for Women Al Anbar University.