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# Effect of *Moringa olieifera* on Glucose Tolerance in Type 2 Diabetic Patients

# ผลของใบมะรุมต่อระดับน้ำตาลในเลือดในผู้ป่วยเบาหวานชนิดที่ 2

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***Asawutmangkul S, Sathavarodom N, Supasyndh O, Pongthananikorn S. Effect of Moringa olieifera on Glucose Tolerance in Type 2 Diabetic Patients. Thai Journal of Hospital Phamacy, 2012; 22(2): 133-40.***

*This study examined the hypoglycemic effect of Moringa olieifera leaves-contained product in type 2 diabetic patients by oral glucose tolerance test (OGTT). Seventeen participants (6 males and 11 females) had completed the study. The mean age of participants was 54.12±5.85 years. The mean levels of fasting plasma glucose (FPG) and glycosylated hemoglobin (HbA1c) of the participants were 118.18±12.97 mg/dL and 6.10± 0.53%. At day 0 of the study, all participants were performed baseline OGTT. At day 7 of the study, they were tested for OGTT after taking 4 capsules of moringa 450 mg. The results showed that the oral administration of 1800 mg M. olieifera leaves were significantly decreased plasma glucose levels at 90, 120, and 180 min (p-value=0.026, 0.047 and 0.028 respectively). However, M. oleifera also had trend to decrease plasma glucose level at 60 and 150 min (p-value=0.142 and 0.124 respectively).*

*In conclusion, this study indicated that M. oleifera leaves may be beneficial for diabetic patients as the choice of alternative dietary supplement to improve the outcome of the treatment of diabetes.*

Key words: *Moringa oleifera*, glucose tolerance, type 2 diabetes

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***สุชาดา อัศวุตมางกุร, ณัฐพล สถาวโรดม, อุปถัมภ์ ศุภสินธุ์, สุญาณี พงษ์ธนานิกร. ผลของใบมะรุมต่อระดับน้ำตาลในเลือดในผู้ป่วยเบาหวานชนิดที่ 2. วารสารเภสัชกรรมโรงพยาบาล 2555; 22(2): 133-40.***

*การวิจัยนี้ เป็นการศึกษาผลของผลิตภัณฑ์ใบมะรุมในการลดระดับกลูโคสในเลือดโดยวิธีการตรวจวิเคราะห์ความทนต่อกลูโคส (oral glucose tolerance test) มีผู้เข้าร่วมการวิจัยทั้งหมดจำนวน 17 คน เป็นเพศชาย 6 คน และเพศหญิง 11 คน มีอายุเฉลี่ย 54.12±5.85 ปี ระดับน้ำตาลในเลือด 118.18±12.97 มิลลิกรัม/เดซิลิตร และระดับ HbA1c 6.10±0.53% ในวันแรกผู้เข้าร่วมการวิจัยทุกคนจะได้รับการตรวจวิเคราะห์ความทนต่อกลูโคส หลังจากนั้น 7 วัน ผู้เข้าร่วมการวิจัยจะได้รับการตรวจวิเคราะห์ความทนต่อกลูโคสหลังจากได้รับประทานแคปซูลผงใบมะรุมขนาด 450 มิลลิกรัม จำนวน 4 แคปซูล ผลการศึกษาพบว่าระดับน้ำตาลในเลือดของผู้ป่วยที่รับประทานแคปซูลผงใบมะรุม 1,800 มิลลิกรัมมีค่าลดลงอย่างมีนัยสำคัญทางสถิติที่เวลา 90, 120 และ 180 นาที (p-value=0.026, 0.047, 0.026 ตามลำดับ) ที่เวลา 60 และ 150 นาที พบการลดลงของระดับน้ำตาลในเลือดเช่นกัน แต่ไม่มีนัยสำคัญทางสถิติ (p-value=0.142 และ 0.124 ตามลำดับ)*

*จากผลการวิจัยนี้ แสดงให้เห็นว่าใบมะรุมอาจมีประโยชน์สำหรับผู้ป่วยโรคเบาหวานในการเป็นทางเลือกในการใช้ผลิตภัณฑ์เสริมอาหารเพื่อเพิ่มผลลัพธ์ของการรักษาโรคเบาหวานได้*

คำสำคัญ: มะรุม, ความทนต่อกลูโคส, โรคเบาหวานชนิดที่ 2

**Background**

Diabetes is one of the serious problems that people around the world have faced. It is estimated that the prevalence of diabetes would increase from 2.8% in 2000 to 4.4 % in 2030[1]. Thailand is now facing diabetes problems as well. According to the health survey of Thai population aged 15 years and above during 2008-2009, the result showed 6.9% were diabetic patients and 10.7% had pre-diabetic condition.[2] The Bureau non-communicable disease estimated that number of diabetes patients would increase to 501,299-553,941 people per year during the year 2011-2020.[3]

The control and treatment of high blood sugar levels can be achieved by dietary modification, weight control, regular exercise and advice on knowledge of diabetes for patients.[4] However, diabetes is a chronic disease, so patients must continue taking drugs to reduce blood sugar levels. Therefore, some patients seek other ways to treat diabetes. The survey conducted in the patients with diabetes who were admitted to Abass NDao Hospital, Senega showed that the type of herbs mostly used in the treatment of patients with diabetes was *Moringa oleifera*[5]. Many parts of moringa are used as a traditional herb for relieving pain and fever,

helping to sleep, and maintaining heart function, etc.[6] In the pharmacological study, moringa was effective in lowering blood sugar, blood pressure and cholesterol levels. It also showed, anti-inflammation, anticancer, and preventing hepatitis.[7,8]

There was a study of the effect of moringa leaf on blood sugar levels in rats[9]. The rats were devided into 4 groups according to glucose levels; normal, slightly higher than normal, moderate, and very high. The results showed that the extract of moringa leaves was effective in lowering blood glucose levels in all groups. Another study by Ndong et al[10] showed that moringa leaf powder could reduce blood sugar levels both in normal and type 2 diabetic rats, assessed by the oral glucose tolerance test (OGTT). The study on toxicity of the moringa leaf by Chiwapat[11] found that the rats given moringa leaf powder at dose of 5 g/kg did not show any signs of acute toxicity during the observation period.

Moringa is currently receiving attention from the public. Many experimental studies showed that moringa can be used to reduce blood sugar levels. However, most research was conducted in laboratory animals. The study in human was limited. Therefore, the researchers were interested in studying the effect of moringa leaves on reducing blood glucose level in the patients with type 2 diabetes.

## Materials and Methods

**Study Subjects** The screening and clinical period was performed on 1 December 2011 to 28 February 2012. The participants were type 2 diabetic outpatients of the department of medicine at Phramongkutklao Hospital, who meet all of these criteria were included in this study: male or female patients age between 20-65 years old; fasting plasma glucose concentration between 100-180 mg/dL, glycosylated hemoglobin less than 8%, and no any antidiabetic medication.

**Test Product** The moringa capsules were purchased from Khaolaor Labratories Co., Ltd (Lot. No. 52137). The capsule was brown-green color. Each capsule contains 450 mg. of moringa leaves.

**Hypoglycemic Effect Study by OGTT** All participants were measured plasma glucose levels by OGTT at day 0 and day 7. During 7 days before the experiment, the participants were asked to maintain usual daily lifestyle and avoid taking all food supplements, herbs and alcoholic beverages. At day 7, each participant received 4 capsules of moringa before blood sample collection to determine plasma glucose levels by OGTT. At day 0 and day 7 of the study, blood samples were collected at 30, 60, 90, 120, 150 and 180 minutes after the oral glucose load 75 g.

**Statistical Analysis** The data are expressed as mean±SD. The effects of moringa

leaves on glucose concentration were analyzed by paired t-test. Significance was accepted when p-value<0.05.

## Results

### 1. Characteristics of the Subjects

Seventeen participants aged between 45 and 65 years (54.12±5.85 years). The body mass indexes of the participants were between 21.92 and 29.98 kg/m$^2$ (26.58±2.74 kg/m$^2$). Eight participants (47.06%) were treated with oral antihypertensive drugs, 3 participants (17.68%) were treated with antihyperlipidemic drugs, and 4 participants (23.53%) were treated with both of those drug groups. More than 80% of them had diabetic knowledge prior to participate in the study (Table 1). The baseline clinical characteristics of the participants were summarized in Table 2. The mean levels of FPG and HbA1c of the

**Table 1.** Characteristics of the participants

| Demographic Data | Number | Percentage |
|---|---|---|
| **Sex** | | |
| Male | 6 | 35.29 |
| Female | 11 | 64.71 |
| **Age distribution (years)** | | |
| 40-49 | 4 | 23.53 |
| 50-59 | 10 | 58.82 |
| ≥60 | 3 | 17.65 |
| Mean±SD | 54.12±5.85 | |
| **Body mass index (kg/m$^2$)** | | |
| 18.5-24.9 (Normal weight) | 5 | 12 |
| 25.0-29.9 (Overweight) | 29.41 | 70.59 |
| Mean±SD | 26.58±2.74 | |
| **Occupation** | | |
| Government employee | 11 | 64.70 |
| Private business/merchant | 3 | 17.65 |
| No occupation/housewife | 3 | 17.65 |
| **Existing disease** | | |
| Hypertension | 8 | 47.06 |
| Dyslipidemia | 3 | 17.65 |
| Hypertension and dyslipidemia | 4 | 23.53 |
| None | 2 | 11.76 |
| **Having of diabetic knowledge** | | |
| Yes | 14 | 82.35 |
| No | 3 | 17.65 |
| **Family history of type 2 diabetes** | | |
| Yes | 7 | 41.18 |
| No | 1 | 58.82 |

**Table 2.** Baseline clinical data of the participants (n=17)

| Characteristics | Normal range | Mean±SD |
|---|---|---|
| FPG (mg/dL) | 68 - 110 | 118.18±12.97 |
| HbA1c (%) | 4 - 6% | 6.10±0.53 |
| AST (U/L) | | |
| Male | 0 - 37 | 24.00±5.80 |
| Female | 0 - 31 | 25.09±11.33 |
| ALT (U/L) | | |
| Male | 0 - 41 | 23.83±7.49 |
| Female | 0 - 31 | 18.55±7.02 |
| SCr (mg/dL) | | |
| Male | 0.67 - 1.17 | 0.92±0.17 |
| Female | 0.5 - 0.95 | 0.63±0.09 |
| HDL-C (mg/dl) | | |
| Male | > 55 | 46.83±10.03 |
| Female | > 45 | 59.18±10.82 |
| LDL-C (mg/dl) | < 100 | 129.00±40.80 |
| Total-C (mg/dl) | 120 - 200 | 198.18±40.98 |
| TG (mg/dl) | 50 - 160 | 121.35±59.28 |

FPG, fasting plasma glucose; HbA1c, glycosylated hemoglobin; AST, aspartate aminotransferase; ALP, alkaline phosphatase; ALT, alanine aminotransferase; SCr, serum creatinine; HDL, high density lipoprotein; LDL, low density lipoprotein; TC, total cholesterol; TG, triglyceride; mg/dL, milligram per deciliter; U/L, international unit/liter

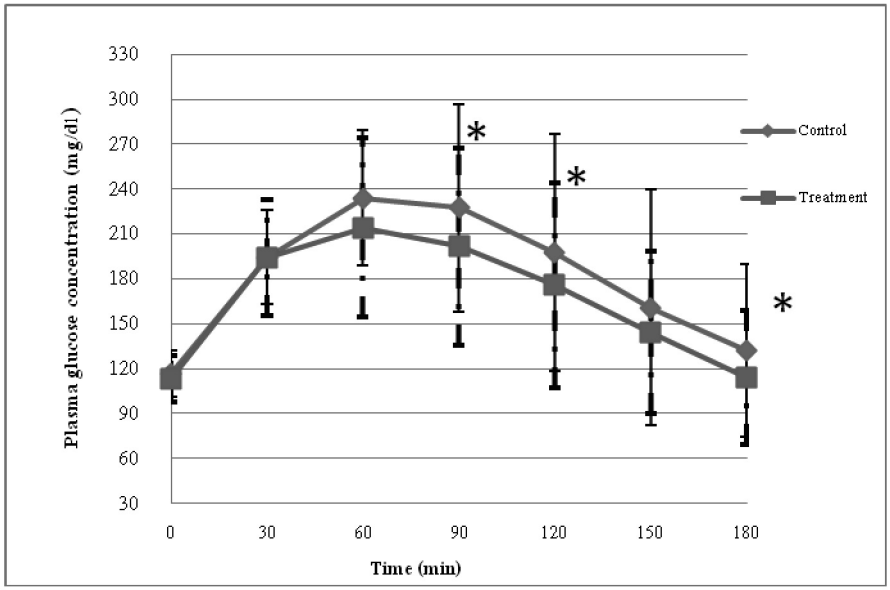
participants were 118.18±12.97 mg/dL and 6.10±0.53% respectively. In addition, baseline AST, ALT and SCr of all participants were within the normal ranges.

**Hypoglycemic Effect of *Moringa oleifera* in Type 2 Diabetes Patients** The results of this study were presented in Table 3 and Figure 1. The results were shown that the initial plasma glucose level (0 min) was 116.53±15.55 and 113.35±15.43 mg/dL for the control and treatment periods respectively. The final plasma glucose level (180

**Table 3.** Plasma glucose levels by OGTT in the control and treatment periods

| Time (min) | Plasma glucose concentration (mg/dL) (Mean±SD) | |
|---|---|---|
| | Control Period | Treatment Period |
| 0 | 116.53±15.55 | 113.35±15.43 |
| 30 | 194.47±31.29 | 194.24±38.48 |
| 60 | 233.94±45.25 | 214.29±59.51 |
| 90 | 227.41±69.18 | 201.65±65.76* |
| 120 | 197.76±79.01 | 175.76±68.70* |
| 150 | 160.82±79.01 | 144.06±54.32 |
| 180 | 132.53±57.70 | 114.41±44.79* |

* Statistical significant difference between the control and treatment periods, p-value<0.05




* p<0.05, compared with the control period at each time point

**Figure 1.** Hypoglycemic effect of Moringa oleifera

min) was 132.53±57.70 and 114.41±44.79 mg/dL for the control and treatment periods respectively. After the participants received a single dose of 1,800 mg *M. oleifera*, their plasma glucose levels were significantly decreased at 90, 120, and 180 min ($p<0.05$) when compared with the control levels.

## Discussion

From the result of this study, *M. oleifera* leaves reduced plasma glucose levels in type 2 diabetes patients. Similarly, Ndong et al[10] presented that *M. oleifera* significantly decreased the blood glucose levels at 20, 30, 45 and 60 minutes in diabetic rats and at 10, 30, and 45 min in normal rats. Jaiswal et al[9] reported that *M. oleifera* leaves reduce the blood glucose levels in normal rats; sub, mild, and severely diabetic rats by conducting OGTT study.

The possible mechanism of hypoglycemic effect of *M. oleifera* might be due to an inhibition of glucose uptake with quercetin-3-glycoside (Q-3-G) in *M. oleifera* leaves powder.[10,12] Glucose is absorbed through a sodium-dependent glucose transporter protein called SGLT1. This transport protein has high affinity for glucose and galactose but not fructose and this transporter is responsible for the absorption of dietary glucose and galactose across the brush border membranes of intestinal enterocytes.[13,14] The study on *M. oleifera* leaves showed that the leaves contained high amount of Q-3-G. Q-3-G can inhibit sodium-glucose cotransporter-1 (SGLT-1) in the small intestine, resulting in

the reduction of the transportation of glucose into bloodstream through the small intestine. The interaction of quercetin glucosides with the intestinal SGLT-1 was studied.[16] It was found that Q-3-G (isoquercitrin) competitively inhibit sodium ($Na^+$) dependent mucosal uptake of the non-metabolisable glucose analogue methyl-α-D-glucopyranoside via SGLT-1 using rat mid-jejunum. Furthermore, Cermak et al[17] in a similar experiment with SGLT-1-containing brush-border-membrane vesicles from porcine jejunum, showed that Q-3-G inhibited $Na^+$-dependent glucose of radioactively labeled D-glucose into brush border membrane vesicles.

## Conclusion

The result in this study indicated that *Moringa oleifera* was significantly decreased the plasma glucose levels in type 2 diabetes patients. There would be beneficial for diabetic patients in choosing dietary supplement to improve the treatment of diabetes. The further studies should be long-period intervention in larger sample size which can be the reference for long-term use of *M. olieifera* in general population.

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