

Original Article

Transcriptome analysis of the effects of *Moringa Oleifera* leaf extract in db/db mice with type 2 diabetes mellitus

Wen Sun^{1,2*}, Jing Liu^{4*}, Lili Wu^{1,2}, Xuan Guo^{1,5}, Lu Zhang^{1,5}, Yixin Fan³, Lixia Yang⁶, Xiangyu Guo², Yi Hou^{1,2}, Xiaohong Mu⁷, Lingling Qin³, David Yuewei Lee⁴, Tonghua Liu¹

¹Key Laboratory of Health Cultivation of The Ministry of Education, ²Beijing Key Laboratory of Health Cultivation, ³Department of Science and Technology, Beijing University of Chinese Medicine, Beijing 100029, People's Republic of China; ⁴Bio-Organic and Natural Products Research Laboratory, McLean Hospital, Harvard Medical School, Belmont, MA, 02478, USA; ⁵Dongfang Hospital of Beijing University of Chinese Medicine, Beijing 100078, People's Republic of China; ⁶Central Laboratory, Gansu Province Academy of Chinese Medicine, Gansu 730050, People's Republic of China; ⁷Dongzhimen Hospital of Beijing University of Chinese Medicine, Beijing 100700, People's Republic of China. *Equal contributors.

Received April 26, 2018; Accepted September 6, 2018; Epub June 15, 2019; Published June 30, 2019

Abstract: Type 2 diabetes mellitus (T2D) is a metabolic disorder that is considered a major public health issue worldwide. Etiopathogenesis of T2D is complex and still partially unknown. Many experimental studies have found that extracts of *Moringa oleifera* leaves had potent hypoglycemic effects. In this study, sixteen 6-week-old db/db male mice were randomly divided into the model group (M) and *Moringa oleifera* leaf extract (ME) administration group (120 mg/kg) (L). Another 8 male wild-type mice of the same age were used as the normal control group (N). This study measured physiological indicators and liver histological examinations were performed using HE and PAS staining. Illumina sequencing platform was used to analyze the transcriptome of mice liver. Compared with group M, N and L groups showed lower body weight, FBG, TG, CHO, and LDL, but higher HDL. Through sequencing, 439 differentially expressed genes related with T2D were enriched in 48 pathways. In summary, present evidence suggests that ME has positive effects on treatment of T2D by influencing expression *Per1* and *Per2*. In this study, it was concluded that ME can ameliorate liver damage in diabetic rats, possibly due to its anti-glycation activities.

Keywords: Type 2 diabetes, *Moringa oleifera* leaf, transcriptomics, pathway, gene

Introduction

Diabetes mellitus is a chronic metabolic disorder caused by either a lack of insulin secretion or hyposensitivity to insulin, including metabolic disorders of carbohydrate, fat, and protein. It is characterized by hyperglycemia and has become the most serious non-infectious disease in the world [1]. Diabetes mellitus can be divided into four main categories: type 1 diabetes (T1D), type 2 diabetes (T2D), other specific types, and gestational diabetes [2].

T2D is the main type of diabetes mellitus, accounting for more than 90%. Worldwide prevalence of T2D with long-term complications has rapidly increased due to growth of the popula-

tion, aging, and increasing prevalence of obesity and physical inactivity [3-5]. The pathogenesis of T2D is complicated. The exact etiology and pathogenesis are not well understood, but it is considered to be a result of the combined effects of genetic and environmental factors. The use of plants as natural medicament for treatment of T2D has been validated [6].

Moringa oleifera Lam. preparations have shown many active ingredients with nutritional and medicinal value, including phytochemicals, vitamins C, E, and A, and essential micronutrients, such as selenium and zinc [7, 8]. *Moringa* is a nutrient-rich medicinal plant with special biological properties. It has been widely used in the treatment of various diseases, particularly

Table 1. Effects of ME treatment on body weight, FBG, TG, TC, and LDL of mice in N, M, and L groups

Groups	n	Body weight (g)	FBG (mm)	TG (mm)	TC (mm)	HDL (mm)	LDL (mm)
N	8	24.60±0.94#	3.84±0.37#	0.71±0.07#	1.76±0.21#	0.80±0.13#	1.00±0.08#
M	8	33.49±1.76	30.82±2.55	1.41±0.14	2.48±0.16	0.39±0.05	1.79±0.05
L	8	28.02±1.29#	18.32±1.79#	0.79±0.17#	1.67±0.14#	0.71±0.07#	1.44±0.15#

All values represent the means ± SD. #Significant difference with the M group was designated as $P < 0.01$.

Table 2. Effects of ME treatment on FFA, INS, and HOMA-IR of mice N, M, and L groups

Groups	n	FFA (mm)	INS (μgL^{-1})	HOMA-IR
N	8	24.60±0.94#	3.39±0.12#	0.41±0.01#
M	8	33.49±1.76	25.54±1.70	20.72±1.47
L	8	28.02±1.29#	16.84±2.87#	10.46±1.86#

All values represent the means±SD. #Significant difference with the M group was designated as $P < 0.01$.

in South Asia and India [9]. In addition to the important medicinal properties and high nutritional value of various parts of this plant, it also has a potent water purifying property [10].

A study by S Ghasi [11] indicated that extracts of a leaf of *Moringa oleifera* Lam can decrease blood levels of cholesterol in high-fat diet fed Wistar rats. Yassa H D [8] revealed that the aqueous extract of *Moringa oleifera* leaves possesses potent hypoglycemic effects. In addition, the extract of the root of *Moringa oleifera* has potentiated, significantly, sleeping times and analgesic properties, causing significant protection against strychnine and leptazol-induced convulsions [12].

In PC Paula's study [13], a leaf protein isolate was obtained from *Moringa oleifera* leaves, named Mo-LPI. It reduced blood glucose levels and is a promising alternative or complementary agent for the treatment of diabetes.

Sushma G's [14] study confirmed the potential efficacy of *Moringa oleifera* in suppressing oxidative stress induced by hyperglycemia in rats. Administration of *Moringa* leaves extract, *Moringa* stems extract, and *Moringa* pods extract caused significant decrease in plasma glucose, HbA1C, and plasma and liver TBARS, with an increase in levels of FRAP (both plasma and liver), in diabetic treated rats.

The purpose of this study was to explore the effects of *Moringa oleifera* leaf extract (ME) in db/db mice with T2D via liver transcriptome analysis.

Materials and methods

Plant extract preparation

ME was provided by Dr. David Yuwei Lee of McLean Hospital/Harvard Medical School. Briefly, fresh leaves of *Moringa oleifera* were collected from Yunnan Province in China and extracted with an ethanol/water solvent mixture (80:20, v/v). Ethanolic extracts were filtered and concentrated under reduced pressure at 40°C. The concentrate was then freeze-dried as a brown powder and stored at -18°C.

Animals experiments

Db/db mice (Nanjing Model Animal Research Institute) and blood glucose test strips (Roche) were used. A random selection of sixteen 6-week-old db/db male mice with blood glucose levels greater than or equal to 16.7 mmol/l were randomly divided into the model group (M) and *Moringa* extract administration group (120 mg/kg) (L). Another 8 male wild-type mice of the same age were used as the normal control group (N). ME was dissolved in distilled water by gavage administration after weight and blood glucose was measured. Mice in N and M groups were given the same amount of distilled water and were fed once a day for 8 weeks.

Measurement of biochemical parameters in plasma

A. Weekly monitoring of glucose levels and oral glucose tolerance test (OGTT) was administered during the experiment. B. Serum fasting blood glucose (FBG), insulin (INS), triglyceride (TG), total cholesterol (TC), high density lipoprotein (HDL), low density lipoprotein (LDL), and free fatty acid (FFA) contents were measured every 4 weeks. Homeostasis model assessment of insulin resistance (HOMA-IR, insulin sensitivity index) was measured and calculated. C. Whole blood was collected from mice orbits after 8 weeks to detect the content of free fatty acids in the liver.

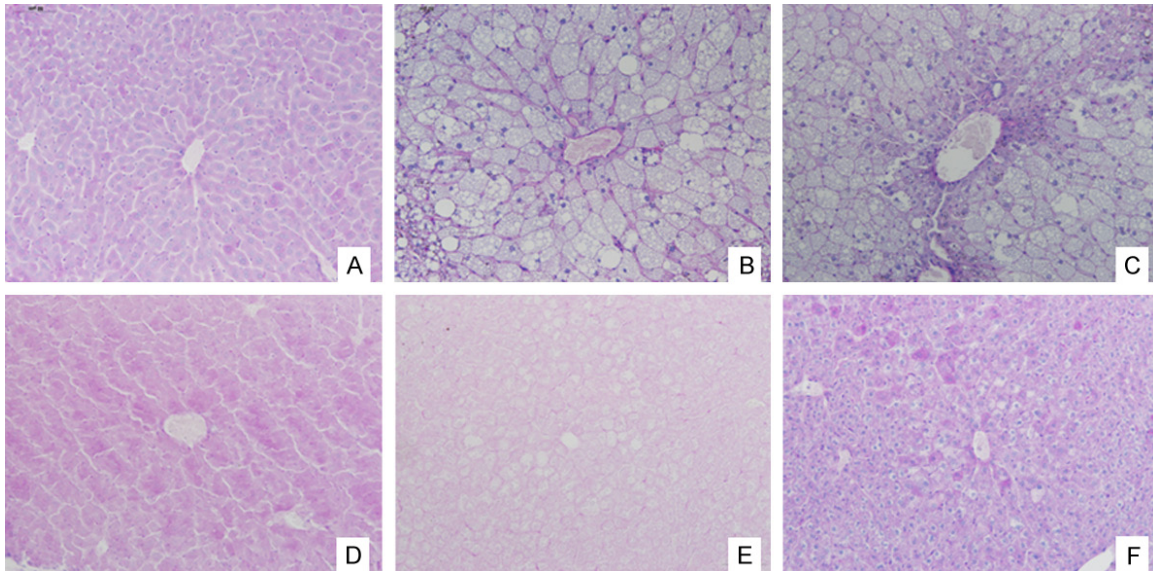


Figure 1. Histopathology images of livers from M, N, and L groups in mice. Photomicrograph of liver sections of mice from the following groups: (A): N group, HE ($\times 400$); (B): M group HE ($\times 400$); (C): L group, HE ($\times 400$); (D): N group, PAS ($\times 400$); (E): M group, PAS ($\times 400$); (F): L group, PAS ($\times 400$).

Table 3. DGEs were obtained by M vs N, L vs N, and L vs M, respectively

Comparison	Up-regulated	Down-regulated	Total DEGs
M vs N	1163	1209	2372
L vs N	597	778	1375
L vs M	586	737	1323

Table 4. Differential expression of T2D related genes under different comparisons

Comparison	Up-regulated	Down-regulated	Total DEGs
M vs N	94	108	202
L vs N	75	56	131
L vs M	58	49	107

Pathological observation

Liver tissue was collected and weighed, embedded in paraffin, sectioned, and stained with Hematoxylin-eosin (HE) and Periodic Acid Schiff (PAS). Pathological changes were observed under a light microscope.

RNA isolation and preparation

To study ME in diabetic mice, a total of nine samples were divided into 3 categories: normal group (N), disease model group (M), and

ME (L) treatment group. Each category had three duplicate samples. Total RNA was extracted from livers using the mirvanaTM mRNA Isolation Kit (Life Technologies, NY), according to manufacturer instructions. Total RNA quantity and purity were analyzed by Bioanalyzer 2100 and RNA 6000 Nano labchip Kit (Agilent Technologies, Santa Clara, CA), with RIN number ≥ 8.0 and ssp-3000Nanodrop spectrophotometer (Infinigen Biotechnology, Inc., City of Industry, CA) at 260 nm. The cDNA libraries were constructed for each pooled RNA sample using the TruSeqTM RNA sample preparation kit (Illumina, Inc.), according to manufacturer instructions. Tagged cDNA libraries were pooled in equal ratios and used for 101 bp paired-ends sequencing with an Illumina HiSeqTM 2500.

RNA-seq and data analysis

Clean reads were obtained from the raw reads by removing the adaptor sequences, reads with $> 5\%$ ambiguous bases (noted as N), and low-quality reads containing more than 30 percent of bases with qualities of < 20 .

Gene ontology (GO) analysis was performed to clarify the biological implications of expression of unique genes in significant or representative profiles of genes that were differentially expressed. GO annotations were downloaded

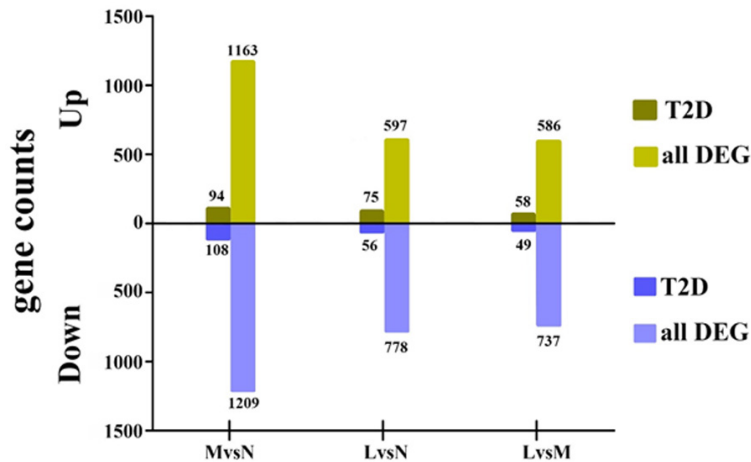


Figure 2. The number of DGEs of M vs N, L vs N, and L vs M. In each comparison, the left side was the number of DGEs associated with T2D. The upregulated was dark yellow and downregulated was dark blue. The number of DGEs was on the right side, upregulated genes were pale yellow, and downregulated was pale blue.

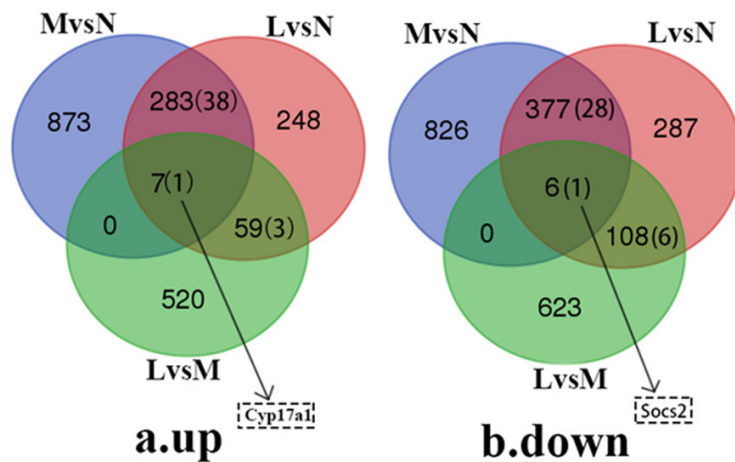


Figure 3. Relationship between DGEs. A Upregulated gene, b is downregulated. The same T2D genes in parentheses. As to the 283 (38), 283 said two of the more common upregulated genes and the number of brackets 38 said common upregulated genes related to T2D.

from NCBI (<http://www.ncbi.nlm.nih.gov/>), UniProt (<http://www.uniprot.org/>), and Gene Ontology Consortium (<http://www.geneontology.org/>). Fisher's exact test was used to identify significant GO categories and false discovery rates (FDR) were used to correct *P*-values [15].

Pathway analysis was used to determine significant pathway(s) of the differentially expression genes (DEGs), according to the KEGG database. Fisher's exact test was applied to select significant pathways and the threshold of significance was defined according to the *P* value and FDR

[16]. Moreover, differential genes were selected to build a genes-act-network according to the relationship between the genes, proteins, and compounds in the KEGG database [17, 18]. Gene co-expression networks were built to show relationships among genes [19], based on normalized expression values of genes selected from those genes in significant GO terms and pathway terms. For each pair of genes, Pearson's correlation was calculate, choosing the pairs with a significant correlation (FDR < 0.05) to construct the network [20]. When using network analysis, degree centrality was the simplest and most important measure to determine the relative significance of a gene to the network. Degree centrality was defined as the number of links of one node to the others [21].

Properties of the networks were also analyzed by k-cores, derived from graph theory as a method to simplify graph topology analysis. The k-core of a network is a sub-network in which all nodes are connected to at least k other genes. The k-core of a protein-protein interaction network usually contains cohesive groups of proteins [22].

Analysis of the trend of ME efficacy

In analyzing trends in DGEs, this study screened trends in drug efficacy that were characterized by consistent gene expression levels in N and L and significant changes in disease models. Significant trends were analyzed by pathway enrichment and biological pathways related to the regulation of these pharmacodynamic trends were analyzed. The union of the known T2D drug targets were downloaded from DrugBank and T2D related genes were extracted from GAD, OMIM, and DO databases, to be used as

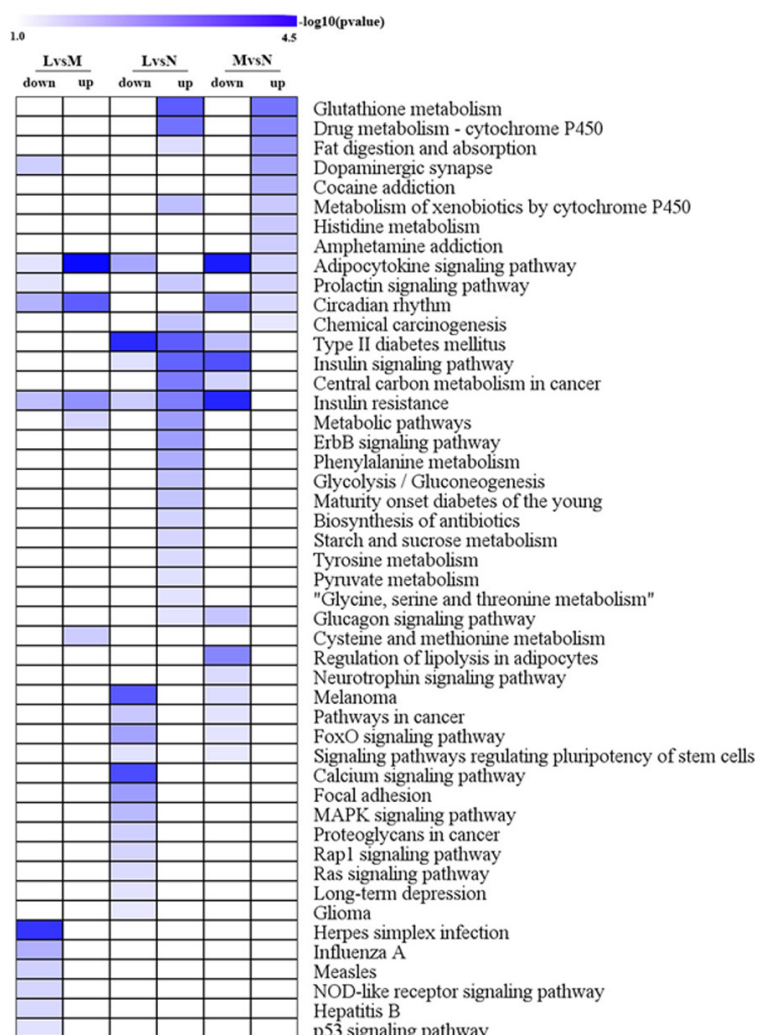


Figure 4. Pathway enrichment analysis of DGEs. Comparison of DEGs from the rat livers between L and M, L and N, and M and N groups. Data were analyzed using KEGG pathway mapping.

target genes [23]. Next, genes for drug action trend extraction from Gene-Act-Network were used to construct the Gene-Act-Network sub network. T2D related genes were mapped to the subnet, then constructed the ME related efficacy Gene-Act-Network. According to the relationship between T2D gene and other genes in the network. Expression levels of the gene were examined to screen potential drug targets of ME for diabetes.

Statistical analysis

Statistical differences were analyzed with ANOVA using SPSS software (17.0) (Chicago, IL, USA). Results are represented as mean $\pm$ standard deviation (SD) and differences are consid-

ered statistically significant at $P < 0.05$.

Results

Effects of ME treatment on body weight, FBG, TG, TC, and LDL of db/db mice in N, M, and L groups

Compared with the N group, the db/db mice showed higher body weight, FBG, TG, TC, and LDL, but lower HDL. Compared with the M group, N and L groups showed lower body weight ($P < 0.01$), FBG ($P < 0.01$), TG ($P < 0.01$), CHO ($P < 0.01$), and LDL ($P < 0.01$), but higher HDL ($P < 0.01$) (**Table 1**).

Effects of ME treatment on FFA, INS, and HOMA-IR of mice in N, M, and L groups

Compared with the M group, the three measurements of FFA, INS, and HOMA-IR were lower in the N group. After administration, related indexes of the L group were decreased significantly ($P < 0.01$) (**Table 2**).

Histology of the liver stained with HE and PAS

HE staining showed that liver tissue structures of the N group were regular, the hepatic sinusoid was clearly visible, and hepatic cords were arranged neatly. Liver cells of the M group showed diffuse fatty de-generation, increased volume, narrowed hepatic sinusoids, and infiltration of inflammatory cells. Compared with the M group, liver cells of L group were arranged in order, reducing the degree of fatty lesions.

Liver tissue PAS staining was used to observe intracytoplasmic brown sugar granules. Glycogen distributions of liver tissues of the N group were wide and the content was high. Compared with the N group, liver glycogen decreased in M group mice. Compared with the M group, liver glycogen significantly increased, as shown in **Figure 1**.

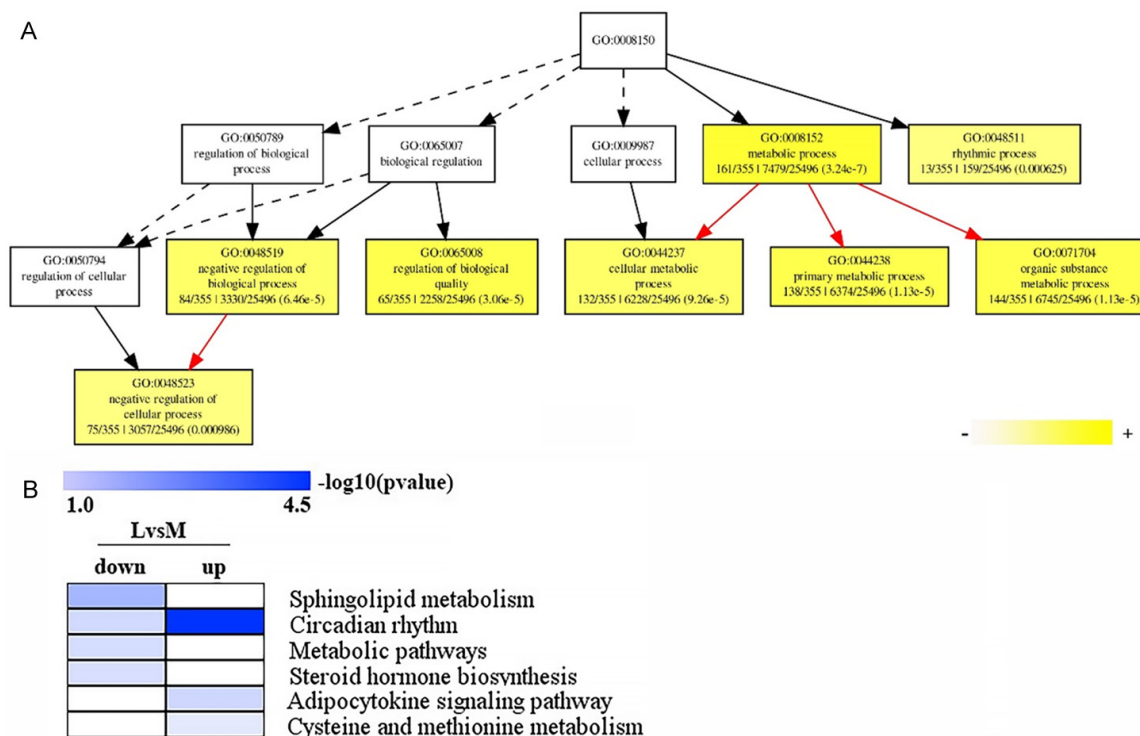


Figure 5. Functional analysis of potential medicinal genes. A. The dendrogram reflects the potential pharmacodynamic gene enrichment process. White indicates no significant enrichment of GO BP, yellow indicates significant enrichment, the darker the color, the more significant the GO BP. The dotted lines indicate that two function sets indirect relation. The solid line indicates that the two feature sets are direct parent-child relationships. The red line represents the relationship between the primary efficacy of potential pharmacodynamic genes which biological processes they involved in. B. Pathway enrichment analysis.

Differentially expressed genes

Samples were divided into three groups: N, M, and L. Differential expression genes were obtained in any of the two groups compared with each other.

A total of 2,372 DGEs were obtained by M vs N, while 1,375 DEGs were obtained by L vs N. L vs M was obtained with a total of 1,323 DEGs (Table 3). In addition, this study also obtained differentially expressed T2D related genes (Table 4).

A total of 202 DGEs related to T2D were obtained in M vs N, 131 in L vs N, and 107 in L vs M. The number of downregulated genes in the three comparisons is shown in Figure 2.

In addition, the relationship between DGEs and the number of T2D related genes was calculated using a Wayne chart (Figure 3).

It was found that T2D related gene Cpy17a1 was upregulated (Figure 3A) under three differ-

ent comparisons, while Socs2 was downregulated (Figure 3B).

Gene function analysis

Pathways of the DGEs of three common comparison patterns were analyzed by DAVID online. Pathways of *P* values < 0.05 were selected as significant pathways.

Results showed that drug metabolism-cytochrome P450 significantly changed in the disease and drug treatment group. Compared with the treatment group and normal group, ErbB signaling and NOD-like signaling pathways were significantly abnormally regulated in the treatment group (Figure 4).

Potential pharmacophore genes

If there are many genes, the expression trend in a disease states what was contrary to the medication. If the trend is the same in both drug therapy and normal conditions, then these genes are considered as medicinal genes. The-

	Normal/Mold	L/Mold	Gene expression	MvsN	LvsM	LvsN
class 0	-	-	0 1.0	43(6)	49(7)	202(17)
class 1	-	no change	1 4e-14	591(53)	34(3)	360(33)
class 2	-	+	2 2e-2	467(52)	279(37)	1(1)
class 3	no change	-	3 1.0	0(0)	178(1)	15(9)
class 4	no change	+	4 1.0	24(0)	212(18)	59(4)
class 5	+	-	5 2e-16	569(53)	416(29)	43(13)
class 6	+	no change	6 7e-16	438(45)	2(1)	238(46)
class 7	+	+	7 1.0	34(4)	22(1)	168(17)

Figure 6. Trend analysis of differential expression genes. The first column is the number of the profile and the second column is the number. Class 0 is the trend of 0. The second and three columns are trend of different genes in M vs N and L vs M. The “+” means that the trend is upward in this comparison, “-” means downward. If it does not change, it is “no change”. Fourth is the trend chart; From fifth to seven, respectively, M vs N, L vs M, and L vs N comparison, the total number of DGEs and T2D related genes. The number in parentheses indicates the number of T2D related genes.

refore, this study screened genes that were not differentially expressed in L vs N. Expression of M vs N was opposite to that of L vs M. Finally, a total of 418 potential drug related genes (Table S1) were obtained. Functional enrichment analysis was performed on these potential pharmacophore genes by GOEAST (<http://omicslab.genetics.ac.cn/GOEA-ST/>). Results showed that these genes were mainly involved in organic substance metabolism and negative regulation of cellular process (Figure 5A).

According to the gene expression of L vs M, pathway analysis was performed to screen potential pharmacophore genes with DAVID. Pathways with *P* values < 0.05 are highly enriched. These potential pharmacophore genes are mainly involved in Sphingolipid metabolism, Metabolic, and Circadian rhythm pathway (Figure 5B).

Expression trend analysis

To screen out pharmacophore genes in general, differential expression genes were analyzed according to expression value. Based on genes that expressed the same trend in one category, the three groups were divided into 8 profiles (Figure 6).

From the overall expression trend, profile 2 and 5 had more biological significance. this study performed functional enrichment analysis of profile 2 and 5 (Figure 7). Results showed that the two trends of genes significantly regulated adipocytokine signaling, circadian rhythm, PPAR signaling, and TNF signaling pathways. Genes of profile 2 specifically regulated Apoptosis, Cysteine, and metabolism and Cysteine and methionine metabolism pathways. Genes in profile 5 were specifically involved in the pathway regulation of the biosynthesis of fatty acids, p53 signaling, and metabolism of xenobiotics by cytochrome P450.

Using the KEGG database to analyze signal transduction of the genes, a gene regulatory network was constructed for two related profiles. T2D related genes were then mapped in a network (Figure 8).

In this figure, two significant genes interact with each other, affecting the treatment of drugs. To further study the relationship between gene expression of these two pharmacodynamic trends, co-expression analysis was performed (Figure 9A).

A total of 13 highly correlated modules were found using Cytoscape software MCODE (Figure 9B). Results of co-expression (Table S2) indicate that T2D related disease gene *Per1* is highly correlated with other genes. From module 5, it was found that *Per1* was highly negatively correlated with drug target *Fabp2*, which was highly correlated with drug target *Rps7*.

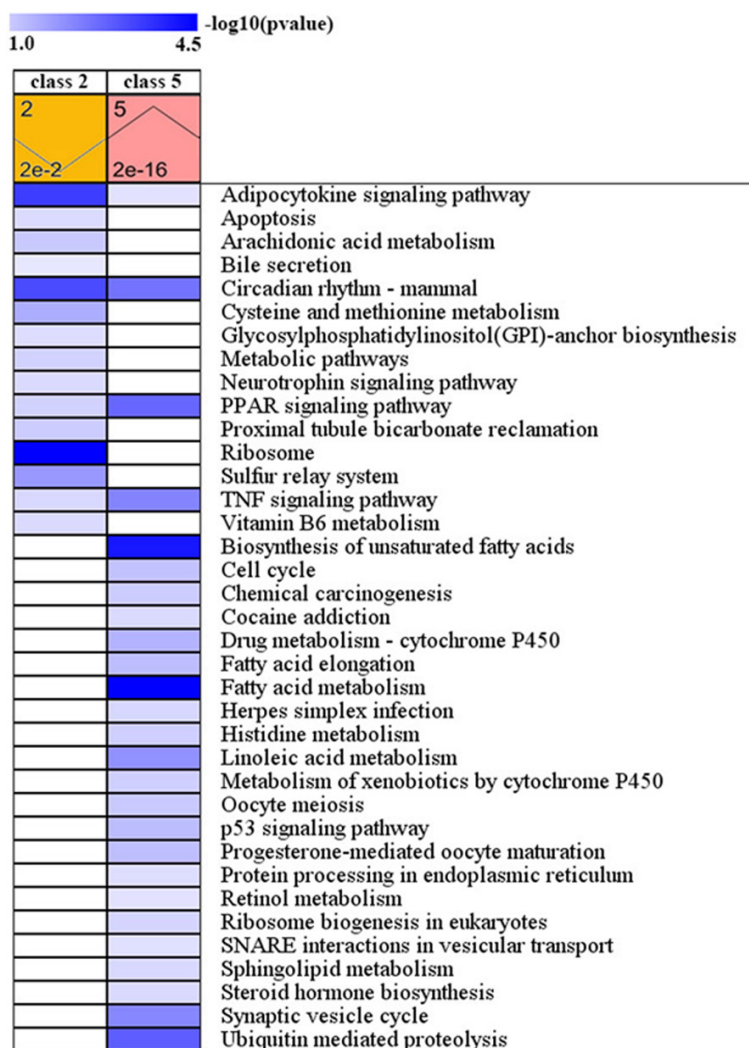


Figure 7. Pathway enrichment analysis of profile 2 and 5. Comparison of DEGs of profile 2 and 5 from the rat livers. Data were analyzed using KEGG pathway mapping.

T2D related genes in drug efficacy trends

To investigate the relationship between these two profiles and diabetes, a total of 27 T2D related genes were obtained in profile 2 and 17 T2D genes were obtained in profile 5 (Table 5).

Functional enrichment analysis of T2D related genes was performed in these two trends. T2D related genes in profile 2 were primarily involved in the circadian rhythm, cysteine and methionine metabolism, adipocytokine signaling pathway, and metabolic pathways. T2D related genes in class 5 were mainly involved in dopaminergic synapse, TNF signaling pathway, and tuberculosis (Figure 10A).

Mouse protein interaction was downloaded from Biogrid and String databases. A PPI network (Figure 10B) was then constructed for T2D related genes in two drug trends. By analyzing the topological properties of the network, properties of T2D related genes were obtained (Table 6).

In the topological properties of mice, the highest degree gene was Jak2. However, its clustering coefficient was 0, indicating that the effects of Jak2 on the network were very small when it was removed. The roles of *Per1* and *Per2* in the trend of PPI networks are of importance. It was found that *Per1* was positively correlated with T2D drug target Akt1, which was highly negatively correlated with *Fabp2*. *Per2* and T2D related genes *Apoa5* and *Acads* were highly positively correlated. Interaction between *Per1* and *Per2* was obtained from previous Gene-Act-network networks (Figure 8) and correlated with other T2D targets and T2D disease genes. It can be concluded that the interaction of *Per1* and *Per2* with other interacting proteins may affect the treatment of diabetes with *Moringa* leaves extract.

Discussion

T2D has become the third major noncommunicable disease and worldwide issue of human health. In 2015, an international survey reported that the number of diabetes patients in China was ranked first, reaching 109,600,000 people [24]. A worldwide epidemiology study showed that, of the 10 countries with the largest populations predicted to have diabetes mellitus in 2030, five are in Asia (China, India, Pakistan, Indonesia, and Bangladesh).

In recent years, plant extracts have been extensively studied in the treatment of T2D. Isolation and characterization of the bioactive compounds has played an important role in the

Moringa Oleifera leaf improves type 2 diabetes

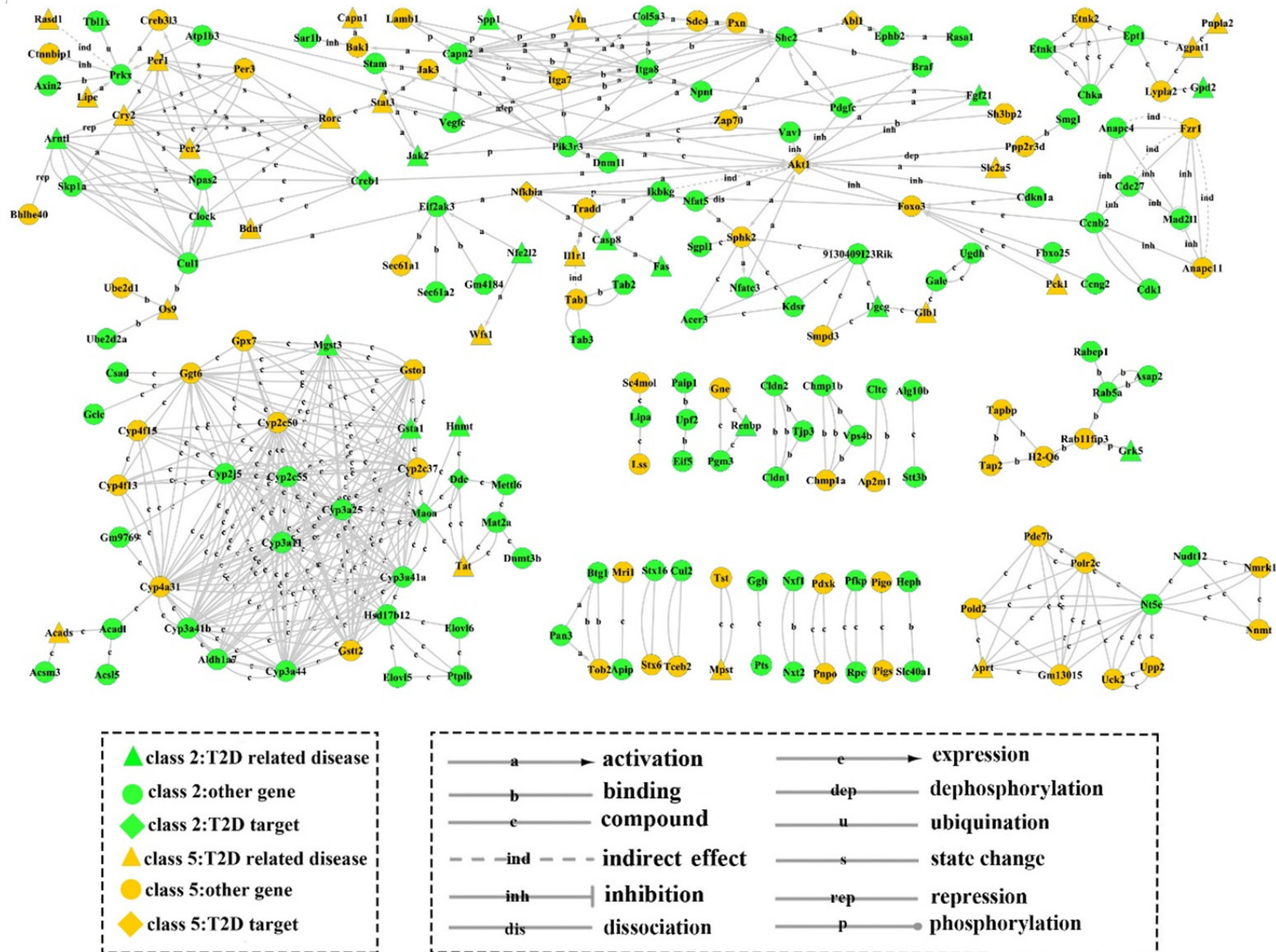


Figure 8. Gene-Act network of efficacy trend. Genetic relationships (genetic regulatory relationship) between the T2D related disease, T2D gene, and other gene in profile 2 and 5. Different-colored dots represent the genes from different profiles.

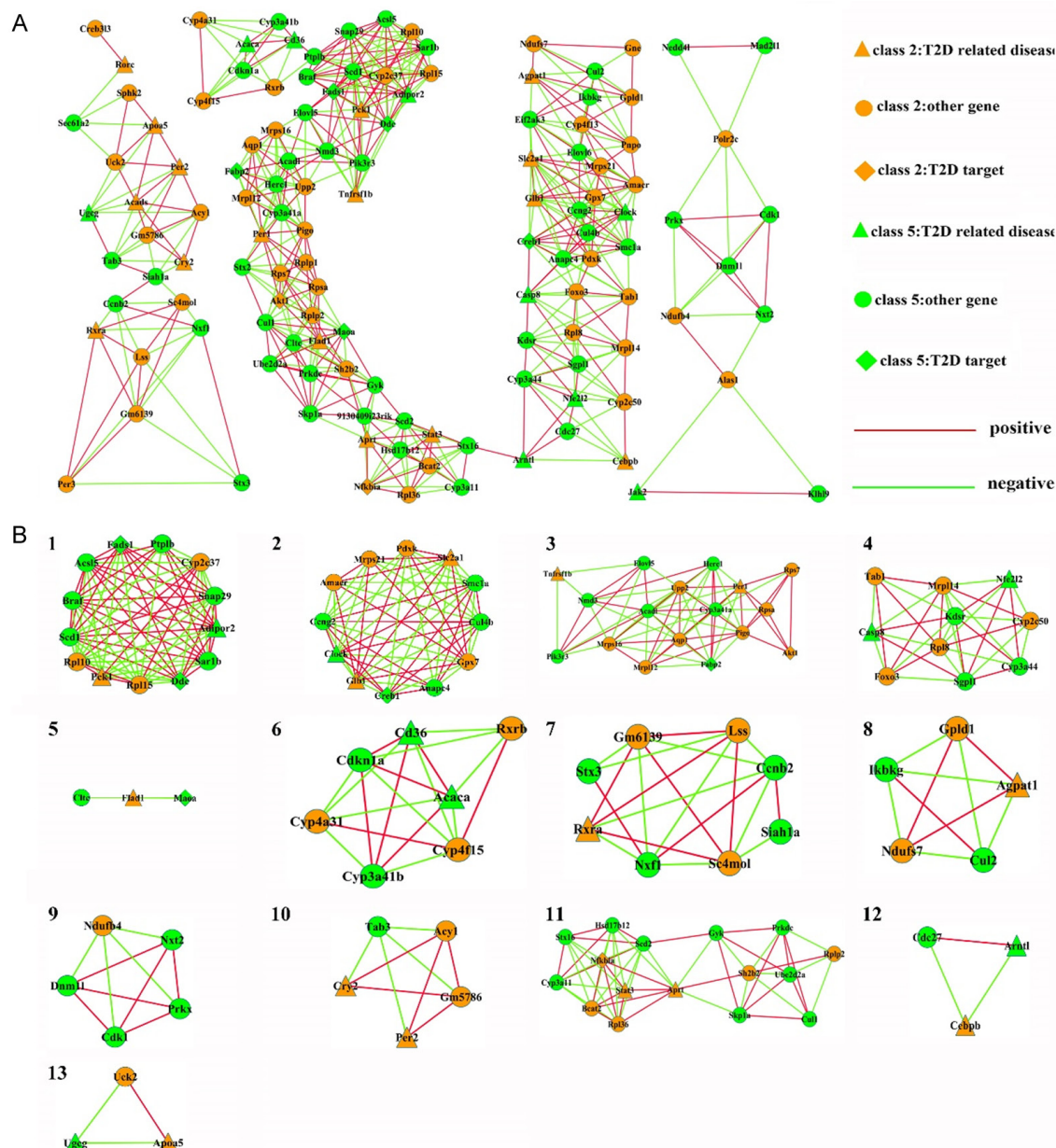


Figure 9. Co-expression analysis of drug effects. A. Global co-expression network; B. Highly correlated modules in the co-expression network.

therapy of T2D. Kumar EK's study [25] demonstrated the significant antidiabetic and regenerative potential of *Nervilia plicata*. Chuengsamarn S et al. [26] found that curcumin intervention in a prediabetic population may be beneficial. Shirwaikar A [27] found that the young leaves of the custard apple tree, *Annona squa-*

mosa L. (Annonaceae) have antidiabetic properties in diabetes mellitus. Xu J's [28] research found that *MDG-1* (300 mg/kg) decreased blood glucose. Another study found that 68 lactic acid bacteria with lower blood sugar levels are expected to be an effective drug for the treatment of T2D [29].

Table 5. T2D related genes in class 2 and 5

GeneSymbol	Log2FC_M vs N	Log2FC_L vs M	Class	Label
Acads	-0.61082	0.697443	Class 2	Disease
Acvr1b	-0.78114	0.637118	Class 2	Target
Aprt	-1.70662	1.321403	Class 2	Disease
Cebpb	-2.55303	2.279263	Class 2	Disease
Cry2	-0.99689	1.174579	Class 2	Disease
Dbp	-2.25984	2.092187	Class 2	Disease
F7	-1.33636	1.058454	Class 2	Disease
Flad1	-0.94798	0.669059	Class 2	Disease
Hmga1	-0.78173	0.79951	Class 2	Disease
Klf13	-0.84042	0.782802	Class 2	Disease
Klf15	-1.45584	1.125758	Class 2	Disease
Lipe	-0.99785	0.638051	Class 2	Disease
Mafb	-2.28863	1.635105	Class 2	Disease
Mpst	-0.88181	1.034377	Class 2	Disease
Ncald	-1.50605	0.891164	Class 2	Disease
Pck1	-2.13503	1.536692	Class 2	Disease
Pdk2	-0.68938	0.846758	Class 2	Disease
Per1	-2.24383	1.742697	Class 2	Disease
Per2	-1.16868	1.445399	Class 2	Disease
Rorc	-0.7208	0.9676	Class 2	Disease
Sds	-2.41677	2.644313	Class 2	Disease
Slc2a1	-1.32891	1.180513	Class 2	Disease
Tat	-2.04795	1.858016	Class 2	Disease
Tcirg1	-0.86945	0.911546	Class 2	Disease
Tnfrsf1b	-1.12456	0.74263	Class 2	Disease
Usp2	-3.08998	3.584319	Class 2	Disease
Wfs1	-1.20924	0.865044	Class 2	Disease
Arntl	4.206127	-2.08469	Class 5	Disease
Casp8	0.651444	-0.59729	Class 5	Disease
Clock	1.7871	-1.60423	Class 5	Disease
Creb1	1.256819	-1.11654	Class 5	Target
Dbi	1.03239	-0.86634	Class 5	Disease
Ddc	1.575866	-0.70082	Class 5	Target
Fas	1.016121	-0.66879	Class 5	Disease
Gprc5b	1.926662	-0.83376	Class 5	Disease
Igf2bp2	2.907715	-1.84944	Class 5	Disease
Jak2	0.672027	-1.0459	Class 5	Disease
Mthfr	1.71114	-2.3105	Class 5	Disease
Mtnr1a	2.522504	-0.85357	Class 5	Target
Nfe2l2	0.94327	-0.78705	Class 5	Disease
P2rx7	0.636941	-1.29825	Class 5	Disease
Rxrg	1.211673	-0.77735	Class 5	Disease
Slc25a27	2.081681	-1.77479	Class 5	Disease
Slc30a10	3.203617	-1.43044	Class 5	Disease
Spon2	2.582052	-2.58717	Class 5	Disease

In addition, some interesting observations have found that ME plays an important role in reduc-

ing blood glucose. JA Tende [30] discovered that ethanolic extract of the leaves of *Moringa oleifera* possesses hypoglycemic activity in STZ induced diabetic Wistar rats. A study [31] showed that ingestion of *Moringa oleifera* leaf powder resulted in marked improvement in plasma glucose disposal in Goto-Kakizaki (GK) rats. In this study, results indicated that treatment with *Moringa* leaves extract can significantly improve body weight (g), FBG (mm), TG (mm) TC (mm), LDL (mm), glucose tolerance, and HOMA-IR. The present study performed transcriptome of liver tissues of rats with drug treatment.

Many histological studies have found that extracts from some plants have hypoglycemic effects. A study [32] in STZ induced diabetic animals found that there was no considerable fatty change observed in green tea treatment diabetic rats, indicating the protective effects of green tea against hepatic complications of diabetes. Another research suggested that [33] histopathological changes, such as hypercellularity, glycosuria, and proteinuria, in tubules with mild mesangial expansion and proliferation in the glomeruli in the kidneys when the diabetic rats were supplemented with aged garlic extract. Similar histopathological changes were observed in the present study.

At total of 202 T2D related DGEs were obtained in M vs N, 131 in L vs N, while LM vs N found a total of 107 T2D related DGEs. It can be seen from the Venn diagram that T2D related gene *Cpy17a1* was upregulated (**Figure 3A**) under three different conditions. *Socs2* was downregulated in the three groups. Historical research has found cytokine signaling 2 (SOCS2) gene with type 2 diabetes in the Japanese population [34]. The present study also indicated that low expression of *Socs* may involve in the hypoglycemic process. In addition, *ErbB* and NOD-like signaling pathways are significantly abnormally regulated in the *Moringa* leaves extract treatment group. Previous studies have

shown that *ErbB* receptors and signaling pathways have been related with breast tumors,

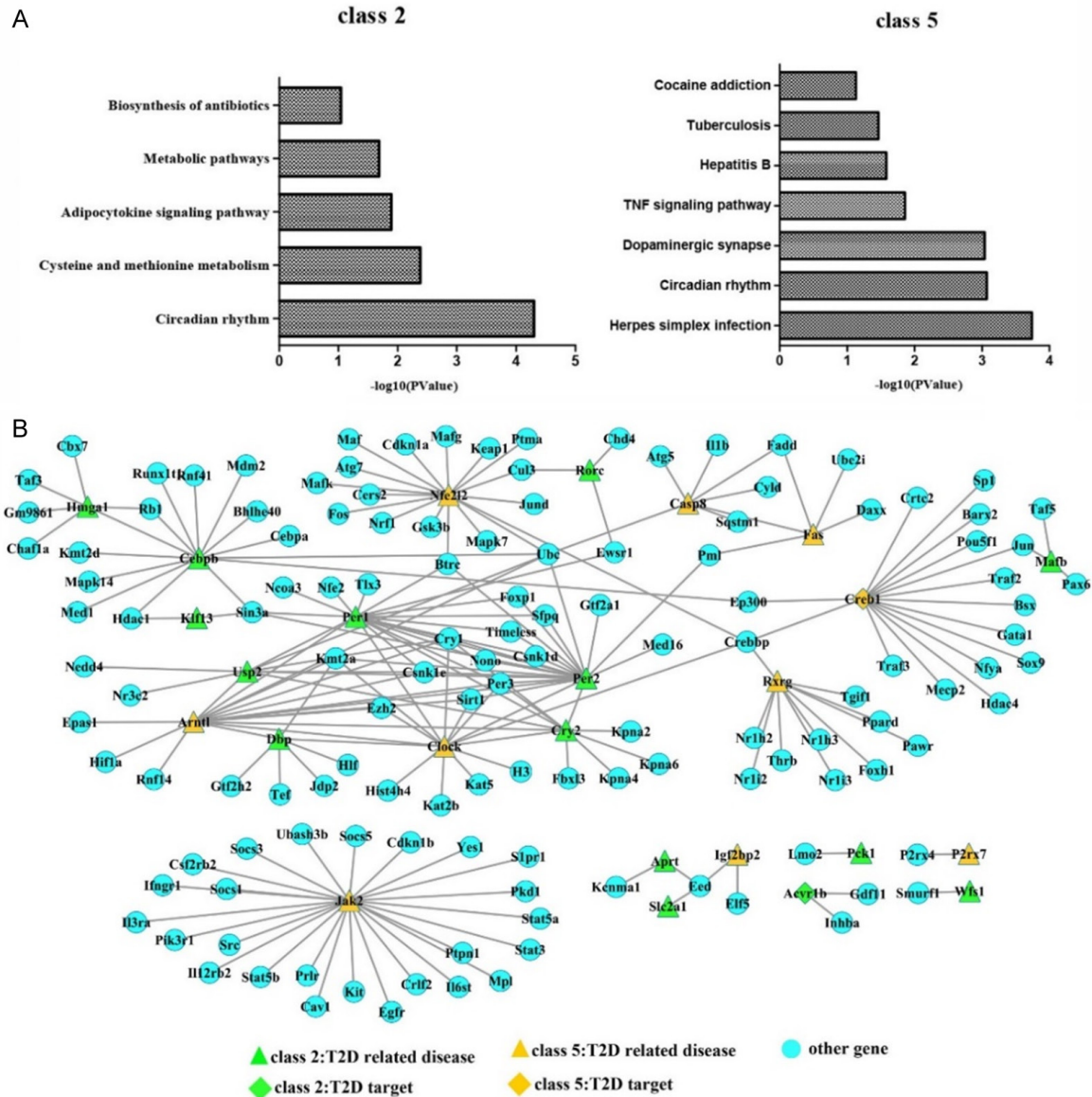


Figure 10. Analysis of T2D related genes in drug efficacy trend. A. Pathway enrichment analysis of T2D related genes in two drug trends; B. PPI network of Pharmacodynamic trend of T2D related genes.

non-small cell lung cancer [35], the nervous system [36], and estradiol rapidly activates Akt [37]. Moreover, *NLRs* (NOD like Receptors) have a significant role in the pathogenesis of inflammation mediated insulin resistance, which further develops metabolic complications. *NOD1* and *NOD2* are involved in the pathogenesis of diabetes, possibly through the recognition of gut microbiota [38].

In subsequent series-cluster analysis, the current study identified profile 2 and 5 as more biologically significant. These two gene expression trends consistent with the drug treatment process. A study of pre-diabetes and metabolic

disorders found that PPAR pathways play an important role in the development of T2D [39]. Moller DE [40] suggests that TNF signaling pathways play an important role in the treatment of diabetes. Circadian rhythm pathways possess very important biological significance. The present study [41] demonstrated that pioglitazone can restore nocturnal BP declines in parallel to reductions in the HOMA index, suggesting that insulin resistance may play an important role in the genesis of circadian BP rhythms.

As T2D related genes in class 2 and 5 and gene's topological properties in PPI networks

Table 6. Topological properties of T2D related genes in PPI networks

Name	Degree	Average Shortest Path Length	Betweenness Centrality	Closeness Centrality	Clustering Coefficient	Topological Coefficient	Label
Jak2	25	1	1	1	0	0	5_disease
Per2	21	2.724138	0.171704	0.367089	0.161905	0.128461	2_disease
Per1	19	2.801724	0.135497	0.356923	0.163743	0.134788	2_disease
Nfe2l2	17	2.793103	0.286151	0.358025	0	0.064706	5_disease
Arntl	16	2.767241	0.123127	0.361371	0.25	0.155556	5_disease
Clock	15	2.75	0.253634	0.363636	0.2	0.157724	5_disease
Creb1	15	3.181034	0.274523	0.314363	0	0.066667	5_target
Cebpb	14	3.008621	0.267069	0.332378	0.010989	0.091837	2_disease
Cry2	11	3.172414	0.070575	0.315217	0.327273	0.223587	2_disease
Rxrg	10	3.612069	0.149775	0.27685	0	0.1	5_disease
Usp2	9	3.137931	0.044756	0.318681	0.416667	0.249249	2_disease
Dbp	7	3.396552	0.068066	0.294416	0.142857	0.238095	2_disease
Casp8	7	3.508621	0.107671	0.285012	0.047619	0.171429	5_disease
Hmga1	6	3.922414	0.068066	0.254945	0.066667	0.190476	2_disease
Fas	5	4.172414	0.036819	0.239669	0.1	0.25	5_disease
Mafb	3	5.077586	0.034333	0.196944	0	0.333333	2_disease
Rorc	3	4.155172	0.019161	0.240664	0	0.333333	2_disease
Klf13	2	4.172414	0.001774	0.239669	0	0.666667	2_disease
Appt	2	1.8	0.4	0.555556	0	0.5	2_disease
Acvr1b	2	1	1	1	0	0	2_target
Igf2bp2	2	1.8	0.4	0.555556	0	0.5	5_disease
Pck1	1	1	0	1	0	0	2_disease
Slc2a1	1	2.2	0	0.454545	0	0	2_disease
Wfs1	1	1	0	1	0	0	2_disease
P2rx7	1	1	0	1	0	0	5_disease

showed in **Tables 5** and **6**, C Liu's research [42] found that *CRY2* are associated with T2D and impaired fasting glucose in Chinese Hans people. From co-expression network analysis, *Per1* was highly correlated with *Akt1* [43] and *Fabp2*, while *Per2* was highly correlated with *Apoa5* [44] and *Acads*. *Akt1* is an important downstream target of the insulin-signaling pathway and may be an important regulator of pancreatic beta cell growth. A study indicated that genetic variation in *Akt1* influences the development of T2D in the Korean population. Other research has suggested that *Fabp2* [45] promoter haplotypes or genotype combinations defined by the promoter and *Ala 54 Thr* polymorphism were not associated with BMI, body fat, leptin, HbA (1c), total cholesterol, or HDL.

Apolipoprotein A5 (ApoA5) [44] plays an important role in triglyceride (TG) metabolism, accelerating the catabolism of TG-rich lipoproteins. Previous research found that ApoA5-1131 CC

carriers are more susceptible to a higher fasting TG level and development of DM. There are few studies related to *Per2* and *Per1*. As mentioned above, genes associated with *Per2* and *Per1* are closely related to T2D. *Per1* and *Per2* have been researched very little. As mentioned above, it was found that genes associated with *Per2* and *Per1*, such as *Akt1*, *abp2*, *Apoa5*, and *Acads*, were closely associated with T2D.

Conclusion

In conclusion, this study conducted a comprehensive comparison of gene expression in db/db mice treated by ME. This study identified many genes responsible for T2D through transcriptome sequencing. Results indicated that genes associated with *Per1* and *Per2*, such as *Akt1*, *abp2*, *Apoa5*, and *Acads*, were closely associated with T2D. In combination with sequencing results, it was speculated that these genes were involved in diabetic treatment of ME. This

study provides the basis for functional study of diabetes related genes and molecular mechanisms of T2D.

Acknowledgements

This work was supported by the Science Foundation for Youth Scholars of Beijing University of Chinese Medicine (2014-JY13ZZ-JS017), International Scientific and Technological Cooperation Program of China (2010DFB33260), Beijing Municipal Education Commission to Build the Project in 2011: Technology platform constructing and prescriptions screening of Chinese medicine treatment of insulin resistance, International Joint Research Center of Prevention and Treatment of Diabetes with Traditional Chinese Medicine by Ministry of Science and Technology of China, Key Laboratory of Health Cultivation of the Ministry of Education. Key Laboratory of Health Cultivation of Beijing (BZ0259), and Beijing International Scientific and Technological Cooperation Base for the Prevention and Treatment of Diabetes with Traditional Chinese Medicine.

Disclosure of conflict of interest

None.

Address correspondence to: Tonghua Liu, Key Laboratory of Health Cultivation of The Ministry of Education, Beijing University of Chinese Medicine, No. 11 North Third Ring Road East Road, Chaoyang District, Beijing 100029, People's Republic of China. Tel: +8601064286950; Fax: +86010642-86935; E-mail: thliu@vip.163.com; David Yuewei Lee, Bio-Organic and Natural Products Research Laboratory, McLean Hospital, Harvard Medical School, Belmont, MA, 02478, USA. Tel: +1-617-855-2038; Fax: +1-617-855-2040; E-mail: dlee@mclean.harvard.edu

References

- [1] Zimmet P, Alberti KG and Shaw J. Global and societal implications of the diabetes epidemic. *Nature* 2001; 414: 782-787.
- [2] Ramachandran A, Snehalatha C and Nanditha A. Classification and diagnosis of diabetes. John Wiley & Sons, Ltd 2016.
- [3] Wild S, Roglic G, Green A, Sicree R and King H. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. *Diabetes Care* 2004; 27: 1047-53.
- [4] Forst T and Pflutzner A. Pharmacological profile, efficacy and safety of lixisenatide in type 2 diabetes mellitus. *Expert Opin Pharmacother* 2013; 14: 2281-96.
- [5] Stumvoll M, Goldstein BJ and van Haeften TW. Type 2 diabetes: pathogenesis and treatment. *Lancet* 2008; 371: 2153-6.
- [6] Gu J, Chen L, Yuan G and Xu X. A drug-target network-based approach to evaluate the efficacy of medicinal plants for type II diabetes mellitus. *Evid Based Complement Alternat Med* 2013; 2013: 203614.
- [7] Aslam M, Anwar F, Nadeem R and Rashid U. Mineral composition of moringa oleifera leaves and pods from different regions of punjab, pakistan. *Asian Journal of Plant Sciences* 2005; 4: 72-73.
- [8] Yassa HD and Tohamy AF. Extract of *Moringa oleifera* leaves ameliorates streptozotocin-induced diabetes mellitus in adult rats. *Acta Histochem* 2014; 116: 844-854.
- [9] Farooq F, Rai M, Tiwari A, Khan AA and Farooq S. Medicinal properties of moringa oleifera: an overview of promising healer. *Journal of Medicinal Plant Research* 2012; 6: 4368-4374.
- [10] Ashraf M. *Moringa oleifera*: a food plant with multiple medicinal uses. *Phytother Res* 2010; 21: 17-25.
- [11] Ghasi S, Nwobodo E and Ofili JO. Hypocholesterolemic effects of crude extract of leaf of *Moringa oleifera* Lam in high-fat diet fed wistar rats. *J Ethnopharmacol* 2000; 69: 21-25.
- [12] Gupta M, Mazumder UK and Chakrabarti S. CNS activities of methanolic extract of *Moringa oleifera* root in mice. *Fitoterapia* 1999; 70: 244-50.
- [13] Paula PC, Sousa DO, Oliveira JT, Carvalho AF, Alves BG, Pereira ML, Farias DF, Viana MP, Santos FA and Moraes TC. A protein isolate from moringa oleifera leaves has hypoglycemic and antioxidant effects in alloxan-induced diabetic mice. *Molecules* 2017; 22: 271.
- [14] Sushma G, Shivaprasad HN, Lvg N and Bhanumathy M. *Moringa oleifera* attenuates oxidative stress in STZ-induced diabetic rats. *International Journal for Pharmaceutical Research Scholars* 2013; 2.
- [15] Dupuy D, Bertin N, Hidalgo CA, Venkatesan K, Tu D, Lee D, Rosenberg J, Svrikapa N, Blanc A and Carnec A. Genome-scale analysis of in vivo spatiotemporal promoter activity in *Caenorhabditis elegans*. *Nat Biotechnol* 2007; 25: 663-8.
- [16] Draghici S, Khatir P, Tarca AL, Amin K, Done A, Voichita C, Georgescu C and Romero R. A systems biology approach for pathway level analysis. *Genome Res* 2007; 17: 1537-45.
- [17] Binder H, Schumacher M. Comment on 'Network-constrained regularization and variable

- selection for analysis of genomic data'. *Bioinformatics* 2008; 24: 2566-8.
- [18] Zhang JD and Wiemann S. KEGGgraph: a graph approach to KEGG PATHWAY in R and bioconductor. *Bioinformatics* 2009; 25: 1470-1.
- [19] Pujana MA, Han JD, Starita LM, Stevens KN, Tewari M, Jin SA, Rennert G, Moreno V, Kirchhoff T and Gold B. Network modeling links breast cancer susceptibility and centrosome dysfunction. *Nat Genet* 2007; 39: 1338-49.
- [20] Prieto C, Risueno A, Fontanillo C and De Las RJ. Human gene coexpression landscape: confident network derived from tissue transcriptomic profiles. *PLoS One* 2008; 3: e3911.
- [21] Barabasi AL and Oltvai ZN. Network biology: understanding the cell's functional organization. *Nat Rev Genet* 2004; 5: 101-13.
- [22] Ravasz E, Somera AL, Mongru DA, Oltvai ZN and Barabasi AL. Hierarchical organization of modularity in metabolic networks. *Science* 2002; 297: 1551-5.
- [23] Yang JO, Hwang S, Oh J, Bhak J and Sohn TK. An integrated database-pipeline system for studying single nucleotide polymorphisms and diseases. *BMC Bioinformatics* 2008; 9 Suppl 12: S19.
- [24] Yang WY. Application of low proportion of pre-mixed insulin analogues in patients with type 2 diabetes mellitus in China. *Chin J Diabetes Mellitus* 2016; 8: 126-128.
- [25] Kumar EK and Janardhana GR. Antidiabetic activity of alcoholic stem extract of *Nervilia plicata* in streptozotocin-nicotinamide induced type 2 diabetic rats. *J Ethnopharmacol* 2011; 133: 480-483.
- [26] Chuengsamarn S, Rattanamongkolgul S, Luechapudiporn R, Phisalaphong C and Jirawatnotai S. Curcumin extract for prevention of type 2 diabetes. *Diabetes Care* 2012; 35: 2121-7.
- [27] Shirwaikar A, Rajendran K, Dinesh KC and Bodla R. Antidiabetic activity of aqueous leaf extract of *Annona squamosa* in streptozotocin-nicotinamide type 2 diabetic rats. *J Ethnopharmacol* 2004; 91: 171-5.
- [28] Xu J, Wang Y, Xu DS, Ruan KF, Feng Y and Wang S. Hypoglycemic effects of MDG-1, a polysaccharide derived from *ophiopogon japonicus*, in the ob/ob mouse model of type 2 diabetes mellitus. *Int J Biol Macromol* 2011; 49: 657-62.
- [29] Yun SI, Park HO and Kang JH. Effect of *Lactobacillus gasseri* BNR17 on blood glucose levels and body weight in a mouse model of type 2 diabetes. *J Appl Microbiol* 2009; 107: 1681-6.
- [30] Tende JA, Ezekiel I, Dikko AAU and Goji ADT. Effect of ethanolic leaves extract of *moringa oleifera* on blood glucose levels of streptozotocin-induced diabetics and normoglycemic wistar rats. *British Journal of Pharmacology & Toxicology* 2011; 2: 1-4.
- [31] Ndong M, Uehara M, Katsumata S and Suzuki K. Effects of oral administration of *moringa oleifera* lam on glucose tolerance in goto-kakizaki and wistar rats. *J Clin Biochem Nutr* 2007; 40: 229-33.
- [32] Waer HF and Helmy SA. Cytological and histochemical studies on rat liver and pancreas during progression of streptozotocin induced diabetes and possible protection using certain natural antioxidants. *Egyptian Journal of Hospital Medicine* 2012; 48.
- [33] Shiju TM, Rajesh NG and Viswanathan P. Renoprotective effect of aged garlic extract in streptozotocin-induced diabetic rats. *Indian J Pharmacol* 2013; 45: 18-23.
- [34] Kato H, Nomura K, Osabe D, Shinohara S, Mizumori O, Katashima R, Iwasaki S, Nishimura K, Yoshino M, Kobori M, Ichiishi E, Nakamura N, Yoshikawa T, Tanahashi T, Keshavarz P, Kunika K, Moritani M, Kudo E, Tsugawa K, Takata Y, Hamada D, Yasui N, Miyamoto T, Shiota H, Inoue H and Itakura M. Association of single-nucleotide polymorphisms in the suppressor of cytokine signaling 2 (SOCS2) gene with type 2 diabetes in the Japanese. *Genomics* 2006; 87: 446-58.
- [35] Hynes NE and MacDonald G. ErbB receptors and signaling pathways in cancer. *Curr Opin Cell Biol* 2009; 21: 177-84.
- [36] Buonanno A and Fischbach GD. Neuregulin and ErbB receptor signaling pathways in the nervous system. *Curr Opin Neurobiol* 2001; 11: 287-96.
- [37] Stoica GE, Franke TF, Wellstein A, Czubayko F, List HJ, Reiter R, Morgan E, Martin MB and Stoica A. Estradiol rapidly activates Akt via the ErbB2 signaling pathway. *Mol Endocrinol* 2003; 17: 818-30.
- [38] Prajapati B, Jena PK, Rajput P, Purandhar K and Seshadri S. Understanding and modulating the Toll like Receptors (TLRs) and NOD like Receptors (NLRs) cross talk in type 2 diabetes. *Curr Diabetes Rev* 2014; 10: 190-200.
- [39] Li L, Yoshitomi H, Wei Y, Qin L, Zhou J, Xu T, Wu X, Zhou T, Sun W, Guo X, Wu L, Wang H, Zhang Y, Li C, Liu T and Gao M. Tang-nai-kang alleviates pre-diabetes and metabolic disorders and induces a gene expression switch toward fatty acid oxidation in SHR.Cg-leprcp/NDmcr rats. *PLoS One* 2015; 10: e122024.
- [40] Moller DE. Potential role of TNF-alpha in the pathogenesis of insulin resistance and type 2 diabetes. *Trends Endocrinol Metab* 2000; 11: 212-7.
- [41] Anan F, Masaki T, Fukunaga N, Teshima Y, Iwao T, Kaneda K, Umeno Y, Okada K, Wakasugi K and Yonemochi H. Pioglitazone shift circadian rhythm of blood pressure from non-dipper to

- dipper type in type 2 diabetes mellitus. Eur J Clin Invest 2010; 37: 709-14.
- [42] Liu C, Li H, Qi L, Loos RJ, Qi Q, Lu L, Gan W, Lin X. Variants in GLIS3 and CRY2 are associated with type 2 diabetes and impaired fasting glucose in Chinese Hans. PLoS One 2011; 6: e21464.
- [43] Jin HS, Hong KW, Lim JE, Lee GJ, Han JH, Go MJ, Lee JY, Woo JT, Park HK and Oh BS. RAP-GEF1 gene variants associated with type 2 diabetes in the Korean population. Diabetes Res Clin Pract 2009; 84: 117-22.
- [44] Elabd D and Fayad T. ApoA5-1131T→C polymorphism and its effect on triglyceride level in type 2 diabetes patients with nephropathy. J Diabetes Complications 2007; 21: 158-63.
- [45] Li Y, Fisher E, Klapper M, Boeing H, Pfeiffer A, Hampe J, Schreiber S, Burwinkel B, Schrezenmeir J and Döring F. Association between functional FABP2 promoter haplotype and type 2 diabetes. Horm Metab Res 2006; 38: 300-7.

Moringa Oleifera leaf improves type 2 diabetes

Table S1. A total of 418 potential drug related genes

GeneSymbol	Style.MvsN	Style.LvsM	N1	N2	N3	M5	M6	M7	L3	L4	L5
1600016n20rik	Up	Down	0.055	0.152	0.099	0.41	0.516	0.405	0	0	0.15
1810058i24rik	Down	Up	38.65	48.38	55.42	24.49	28.52	26.59	45.04	54.09	34.1
2010003k11rik	Up	Down	11.55	5.752	14.74	78.96	67.37	44.13	15.73	20.42	30.37
2210039b01rik	Up	Down	0.357	1.032	0.008	1.776	1.777	2.17	0.483	0.43	0.575
2410018m08rik	Down	Up	7.702	8.209	10.53	6.512	4.823	3.737	13.9	13	8.191
2610020h08rik	Up	Down	0	0.349	0.367	0.723	0.757	0.622	0.249	0	0.552
4930455c13rik	Down	Up	2.596	1.846	2.021	1.481	1.123	1.277	2.221	3.234	1.831
6430573f11rik	Up	Down	0.365	0.88	0.74	3.209	3.038	1.787	1.46	0.125	0.924
9030622o22rik	Up	Down	1.126	0.896	0.852	3.327	2.97	3.961	0.95	1	1.903
9130409i23rik	Up	Down	1.54	2.739	3.156	6.395	7.358	7.008	1.955	4.797	4.075
9930021j03rik	Up	Down	1.554	1.426	1.769	4.436	3.217	2.982	1.751	0.931	2.109
Aa986860	Down	Up	0.931	1.538	1.412	0.801	0.3	0.878	1.448	2.259	2.524
Abhd16a	Down	Up	12.21	12.61	15.26	12.88	10.2	7.459	16.66	18.87	12.29
Abi3	Up	Down	2.269	3.243	6.664	9.787	10.03	8.727	5.166	5.078	7.018
Acads	Down	Up	62.01	68.48	65.73	47.28	58.46	41.2	77.71	81.79	63.71
Acer3	Up	Down	0.658	1.518	0.914	4.433	2.886	2.816	1.875	2.211	1.83
Acnat1	Up	Down	8.231	11.01	12.15	27.29	21.66	22.58	11.3	9.778	17.09
Acvr1b	Down	Up	3.98	3.613	4.5	3.002	2.416	2.6	3.84	4.474	3.32
Adam10	Up	Down	4.273	3.728	5.09	10.05	6.804	7.423	5.376	3.467	4.97
Adamts1	Up	Down	0.861	1.024	2.819	5.863	4.961	2.789	1.396	0.697	2.585
Aida	Up	Down	1.472	1.807	1.754	3.671	2.494	3.013	0.487	1.106	1.828
Alas1	Down	Up	174.3	285.4	455.8	120.6	117.5	83.35	302.7	377.6	342.3
Aldh16a1	Down	Up	14.72	16.56	12.48	8.473	9.966	8.104	16.72	18.5	11.48
Aoah	Up	Down	0.049	0.788	0	8.67	0.896	1.914	0.48	0.054	0.469
Ap3s1-ps1	Up	Down	2.57	3.92	2.863	6.75	8.007	9.189	4.548	2.68	4.964
Apol9b	Down	Up	57.38	51.85	40.11	2.9	6.833	9.689	35.36	25.07	15.51
Aprt	Down	Up	42.65	52.66	31.12	17.72	14.89	12.83	51.88	31.17	23.17
Arf5	Down	Up	28.27	23.28	30.17	19.05	22.67	19.04	39.45	43.02	30.01
Arhgef37	Down	Up	2.497	1.304	3.636	0.641	0.578	1.327	2.361	1.318	2.726
Arl4d	Down	Up	12.79	28.57	11.02	3.092	1.798	1.761	7.401	14.09	8.004
Arrdc3	Up	Down	11.95	8.079	6.502	74.38	101	66.44	44.6	19.4	18.32
Art2a-ps	Up	Down	0	0	0.136	0.927	0.694	0.645	0	0	0
Asap2	Up	Down	0.935	0.73	0.897	1.85	1.361	1.552	0.771	0.706	0.736
Asgr2	Down	Up	85.63	86.81	83.22	49.58	72.43	57.33	136.6	112.9	83.79
Aspdh	Down	Up	22.3	29.58	22.98	11.61	10.03	11.61	27.04	24.33	14.99
Atg2a	Down	Up	11.44	11.81	8.309	5.557	5.991	5.6	8.332	10.55	7.732
Atg4d	Down	Up	4.739	9.292	8.262	2.729	3.775	3.111	6.201	10.37	6.636
Atp6v0c-ps2	Down	Up	52.35	57.41	57.7	40.25	36.14	32.14	51.16	64.56	53.9
Au041133	Up	Down	0	0	0	0.442	0.204	0.369	0.038	0	0.186
Avpi1	Down	Up	12.75	14.12	11.61	6.256	8.652	5.003	13.47	13.73	9.158
Bag6	Down	Up	13.71	16.65	17.46	12.27	10.87	8.963	14.03	17.84	13.7
Bc031361	Up	Down	0	0.125	0.02	0.301	0.384	0.271	0	0	0.187
Bhlhe40	Down	Up	20.75	27	32.61	24.95	21.94	13.65	35.24	32.22	31.98
Bmyc	Down	Up	4.144	3.747	3.857	1.267	1.195	0.673	3.926	7.137	3.019
C1galt1c1	Up	Down	4.258	6.157	8.687	11.15	10.87	10.06	4.592	0.946	7.73
Caprin1	Up	Down	16.54	16.08	21.38	45.46	34.41	41.83	18.53	17.67	29.49
Casp8	Up	Down	3.861	6.733	9.135	12.47	10.43	11.5	6.207	5.574	9.581
Cbfa2t2-ps1	Up	Down	0.087	0.401	0.104	2.25	2.538	1.78	1.04	0	1.134

Moringa Oleifera leaf improves type 2 diabetes

Ccdc141	Up	Down	0.282	0.78	0.988	1.549	1.173	1.417	0.442	0.313	0.758
Ccl3	Up	Down	0.722	0	0	5.531	1.7	1.437	0	0	0.124
Ccng2	Up	Down	1.429	2.058	2.573	6.775	5.115	4.179	1.206	2.158	3.336
Ccrn4l	Down	Up	1.612	3.488	6.303	0.396	0.388	0.37	1.021	6.082	3.501
Ccs	Down	Up	71.9	74.71	65.41	37.57	47.74	40.97	71.82	53.48	54.73
Cdc42se2	Up	Down	2.908	2.831	3.517	7.303	5.028	4.859	2.748	0.807	3.837
Cebpb	Down	Up	5.499	14.22	14.68	2.26	2.455	1.833	6.934	13.79	8.787
Cebpdl	Down	Up	2.114	3.582	3.824	1.031	0.416	0.574	1.464	2.032	3.162
Celf2	Up	Down	0.752	0.714	1.39	2.018	1.696	1.879	0.885	1.145	1.446
Cenpb	Down	Up	18.26	26.09	27.22	16.74	17.6	15.99	34.73	38.3	23.7
Cep350	Up	Down	2.56	1.314	1.879	4.472	3.721	3.59	2.03	1.185	2.419
Cep44	Up	Down	1.383	1.315	0.704	3.996	2.763	3.099	1.946	0.977	2.072
Chchd10	Down	Up	255.7	369.4	371.6	148.5	166.6	189	389.9	407.8	265.3
Chka	Up	Down	3.936	1.276	1.987	15.05	7.185	9.056	1.678	0.607	3.246
Chordc1	Up	Down	2.748	3.402	6.907	10.75	9.348	10.74	5.23	5.278	6.082
Clmn	Down	Up	14.1	16.42	15.47	10.6	12.97	10.38	17.09	16.59	18.05
Clock	Up	Down	1.043	1.392	1.667	6.94	3.922	5.175	1.25	1.057	2.624
Clpx	Up	Down	12.2	8.847	13.68	70.35	49.8	49.85	13.29	12.89	26.56
Cmtm8	Down	Up	39.07	35.84	29.11	19.99	21.52	19.51	37.51	31.62	25.76
Cnnm1	Up	Down	0.097	0.128	0	0.502	0.622	0.237	0	0	0.21
Cntnap2	Up	Down	0.012	0.009	0.01	0.02	0.022	0.02	0.01	0.009	0.015
Col4a3bp	Up	Down	3.071	3.608	4.866	10.32	7.6	6.729	3.459	1.432	4.855
Cpeb4	Up	Down	2.908	2.985	5.865	9.479	8.471	10.5	3.437	2.476	5.192
Creb1	Up	Down	0.271	0.727	1.016	2.3	1.403	1.632	0.589	0.799	0.895
Cry2	Down	Up	8.231	11.35	10.11	4.452	6.61	5.755	15.46	13	7.46
Cspp1	Up	Down	1.644	0.82	1.409	3.066	2.361	2.311	1.041	0.385	1.542
Ctcf	Up	Down	4.103	5.293	6.043	9.017	8.553	9.377	3.108	3.168	7.093
Ctnnbip1	Down	Up	0.417	0.721	0.633	0.227	0.325	0.296	0.582	0.526	0.404
Cul2	Up	Down	4.561	4.97	5.659	10.95	7.848	7.646	4.462	4.398	6.333
Cul4b	Up	Down	3.113	4.187	3.855	7.339	5.333	6.666	4.716	3.066	4.023
Cxcl10	Up	Down	0	0	1.088	3.351	2.5	1.915	1.457	0	0.711
Cyp2g1	Down	Up	0	1.421	0.646	0.105	0.018	0	0.758	2.307	0
Cyp3a11	Up	Down	882	676.6	878.7	2646	3742	3074	1292	947.2	1733
Cyp3a25	Up	Down	149.7	174.7	171.3	428.4	475.7	405	247.3	259.1	261.3
Cyp3a44	Up	Down	3.67	1.836	2.104	15.68	13.22	13.62	2.675	3.843	6.461
Cyp4f15	Down	Up	48.22	71.65	68.81	27.73	31.21	35.65	49.66	50.1	43.78
D2wsu81e	Down	Up	7.032	8.201	7.874	3.164	4.583	5.142	8.787	8.297	5.992
D930048n14rik	Up	Down	1.331	1.209	0.923	2.096	2.33	2.152	1.755	0.323	0.571
Dbi	Up	Down	350.5	472.2	505.4	1119	1102	863.3	545.5	438.4	602
Dbp	Down	Up	33.65	53.22	50.48	7.754	16.13	8.361	60.12	49.4	20.3
Dda1	Down	Up	5.531	7.738	5.717	5.015	3.689	2.923	7.053	8.734	6.368
Dennd4a	Up	Down	4.717	3.833	4.278	9.887	7.118	7.012	2.53	3.903	5.949
Desi2	Up	Down	2.267	2.842	3.492	8.48	5.911	6.755	4.022	1.146	4.902
Dexi	Down	Up	5.926	5.926	4.688	3.547	3.425	3.932	7.073	6.531	4.5
Dhx34	Down	Up	2.647	2	1.648	1.104	1.091	0.79	2.071	2.516	1.454
Disp2	Down	Up	0.452	0.437	0.787	0.088	0.314	0.147	0.696	0.717	0.871
Dmwd	Down	Up	7.647	7.725	10.28	4.469	4.426	4.555	9.504	6.113	6.529
Dnmt3b	Up	Down	0.047	0.049	0.144	0.427	0.415	0.182	0.056	0	0.22
Dzip3	Up	Down	0	0.037	0	0.207	0.067	0.196	0	0	0.028
E030018b13rik	Down	Up	1.054	2.14	1.855	0	1.058	0.32	0	17.24	3.761

Moringa Oleifera leaf improves type 2 diabetes

E030030i06rik	Up	Down	0.244	0.225	0.277	1.065	0.798	0.569	0.02	0.032	0.522
E130201h02rik	Up	Down	0.649	0.245	0.654	1.826	1.683	1.572	0.845	0	0.527
Ece2	Down	Up	0.296	0.32	0.405	0.196	0.195	0.231	0.273	0.384	0.313
Eef2k	Down	Up	2.167	1.969	1.954	1.101	1.216	1.035	2.038	2.12	2.105
Efhd2	Down	Up	11.65	19.86	21.72	13.01	11.1	8.427	19.15	21.27	14.64
Elovl6	Up	Down	1.51	3.748	7.416	23.49	14.67	11	3.975	4.353	5.672
Eppk1	Down	Up	1.449	1.784	1.854	1.482	0.978	1.106	2.181	1.876	1.756
Ept1	Up	Down	3.687	4.579	6.156	9.769	10.65	9.825	6.089	5.017	6.826
Erf	Down	Up	4.875	4.797	3.506	1.921	2.846	1.856	5.894	5.779	5.283
Ermp1	Up	Down	5.314	6.673	6.741	20.88	21.21	17.04	9.686	6.751	15.24
Esrra	Down	Up	7.071	8.222	9.214	5.472	6.101	3.951	10.89	11.79	7.056
Etnk2	Down	Up	99.92	170.3	115.9	28.59	42.66	44.91	132.6	170.4	103.5
Exosc5	Down	Up	12.14	17.13	13.41	8.486	8.771	6.357	25.93	22.32	12.08
F7	Down	Up	38.77	41.56	25.41	13.53	17.46	17.49	30.99	40.95	23.17
Fam132a	Down	Up	1.039	0.431	1.371	0.354	0.293	0.059	1.388	0.634	0.642
Fam47e	Down	Up	3.58	12.32	13.1	2.107	3.538	2.816	6.466	13.35	9.164
Fam49b	Up	Down	1.463	0.675	1.711	3.45	2.315	2.22	1.214	1.25	1.932
Fas	Up	Down	7.773	5.226	9.155	18.43	15.32	16.86	10.66	7.139	12.19
Fastk	Down	Up	13.18	14.24	23.86	10.96	8.675	9.328	22.38	20.42	15.78
Fbisl1	Down	Up	3.183	2.563	2.315	1.374	1.39	1.422	2.796	3.879	2.002
Fbxo31	Down	Up	17.14	18.71	22.01	10.44	11.59	8.089	21.83	24.01	22.05
Fchsd2	Up	Down	3.879	2.954	2.929	6.076	6.104	4.927	4.069	2.62	3.351
Flad1	Down	Up	18.09	18.44	21.33	10.19	12.21	11.49	18.33	17.73	14.72
Gale	Up	Down	0.637	1.639	2.022	4.34	3.902	2.797	1.665	0	0.875
Gclc	Up	Down	30.58	40.84	43.42	98.79	119.8	134.4	54.31	59.71	60.47
Gm10071	Down	Up	43.63	50.74	56.41	33.45	26.41	19.56	56.49	49.18	31.53
Gm10073	Down	Up	87.8	128.6	98.48	49.05	45.3	42.51	93.75	124.6	65.19
Gm10131	Up	Down	15.29	15.7	18.13	39.16	28.39	34.54	17.07	10.41	19.33
Gm10231	Down	Up	46.08	36.26	48.93	39.7	32.67	27.17	45.34	55.2	50.09
Gm10557	Up	Down	0.959	3.284	2.929	6.928	6.161	6.058	5.089	2.499	4.28
Gm10705	Up	Down	8.752	12.37	17.47	39.7	33.03	36.43	24.26	14.85	28.49
Gm11539	Down	Up	34.71	46.39	34.22	12.93	14.98	13.18	51.88	29.41	28.11
Gm11942	Down	Up	13.99	25.62	13.07	6.173	6.229	7.177	27.39	18.18	10.6
Gm12222	Up	Down	7.433	8.925	6.235	35.28	20.25	19.54	10.66	11.06	13.28
Gm129	Down	Up	4.529	13.68	7.901	0.892	1.199	0.579	13.79	16.96	12.09
Gm13015	Down	Up	3.104	3.929	2.448	1.329	0.668	0.706	3.742	3.446	3.125
Gm13416	Up	Down	0.864	1.628	2.867	3.379	3.392	3.47	1.292	2.244	2.523
Gm15387	Down	Up	6.238	5.921	8.908	4.74	4.635	4.559	8.162	6.185	5.622
Gm26596	Down	Up	2.364	2.901	1.354	0.732	1.012	0.703	1.322	2.744	2.471
Gm3375	Down	Up	20.3	21.12	24.66	13.27	17.58	15.97	32.99	31.08	18.99
Gm4294	Down	Up	77.61	50.48	63.26	37.77	38.45	25.25	69.25	72.52	50.78
Gm46	Down	Up	4.53	2.241	1.62	0	0.373	0	1.898	1.128	0.319
Gm4939	Up	Down	0.161	1.639	1.84	5.093	3.117	4.101	2.346	0.358	1.625
Gm5586	Up	Down	7.54	8.656	13.05	20.33	16.44	15.22	6.633	5.429	10.97
Gm5781	Down	Up	10.06	12.94	12.81	6.01	5.903	5.905	6.978	10.3	11.46
Gm6039	Up	Down	0.94	0.968	1.28	3.501	2.743	2.76	1.868	1.644	1.622
Gm6767	Up	Down	20.25	18.14	21.61	43.52	39.2	34.57	20.48	20.17	29.21
Gm7191	Up	Down	0.803	0.9	1.446	5.39	4.219	5.937	0.565	0.478	2.126
Gm7694	Down	Up	4.111	3.004	2.411	1.596	1.769	0.994	4.147	4.957	2.171
Gm7868	Up	Down	3.949	2.722	6.509	8.152	8.381	7.946	5.11	2.456	5.663

Moringa Oleifera leaf improves type 2 diabetes

Gm8722	Up	Down	4.85	4.497	7.461	11.27	10.47	12.22	3.96	6.75	7.984
Gm9114	Up	Down	0.442	0.36	0.666	2.323	2.054	1.94	0.816	0.463	1.72
Gm9146	Up	Down	0.441	0.36	0.666	2.321	2.053	1.939	0.815	0.463	1.719
Gm9176	Down	Up	0.748	2.928	1.362	0	0.389	0.205	3.519	1.833	2.656
Gm9843	Down	Up	349.7	431.8	288.1	230.1	202.2	182.4	480.7	333.2	284.8
Gnat1	Down	Up	25.22	20.37	9.416	3.166	3.862	2.718	8.629	15.56	9.177
Gne	Down	Up	34.81	34.72	33.51	20.25	21.54	19.78	30.25	41.05	33.04
Gpatch2l	Up	Down	1.736	2.036	2.122	4.043	3.682	4.798	2.19	1.405	2.45
Gpr12	Up	Down	0.202	0	0	0.826	0.789	0.624	0	0	0.476
Gpr64	Up	Down	0.154	0.271	0.286	1.201	1.147	0.836	0.315	0	0.836
Gprc5b	Up	Down	0.425	0.16	1.853	3.777	3.324	2.617	1.773	0.945	2.401
Gramd4	Up	Down	0.352	0.588	0.566	1.146	0.781	0.828	0.608	0.353	0.312
Grm8	Down	Up	0.704	0.693	0.319	0	0	0.071	0.242	0.365	0.086
Gsdmd	Down	Up	8.711	9.004	7.371	7.108	5.482	5.251	12.85	11.32	7.331
Hcfc1r1	Down	Up	28.22	29.14	30.63	14.69	20.53	19.7	33.52	25.35	25.52
Hmga1	Down	Up	6.778	7.815	5.721	4.91	4.177	4.641	7.481	8.842	5.992
Hmgcs1	Up	Down	27	17.98	14.88	51.54	49.06	38.1	32.85	27.8	14.18
Hsd17b12	Up	Down	34.78	42.51	61.74	99.32	112.2	84.3	52.13	55.4	68.61
Hsd3b2	Down	Up	11.65	17.49	22.7	8.331	7.938	9.702	11.81	11.94	13.94
Hsd12	Up	Down	18.29	24.52	39.59	57.71	58.85	62.56	26.32	25.91	44.22
Hspb8	Down	Up	81.72	77.86	92.64	51.98	62.51	59.84	82.3	118.5	111.6
Hspbap1	Up	Down	0.28	0.231	0.159	1.305	0.944	0.62	0.041	0.18	0.567
Id2	Up	Down	37.44	27.37	41.23	69.47	72.26	58.47	36.74	27.7	42.1
Iffo1	Down	Up	1.507	2.318	1.98	1.336	1.081	1.007	3.162	2.178	1.478
Ifitm2	Down	Up	298.2	323.6	216.1	133.3	121	158.2	278	268.1	193.8
Ifitm3	Down	Up	383.3	333.7	324.7	178.7	150.7	192.6	255.6	274.1	224.3
Igf2bp2	Up	Down	0.146	0.051	0.571	3.113	1.515	1.518	0.206	0.386	0.979
Il17rc	Down	Up	5.628	8.528	8.451	4.755	4.677	4.04	9.863	6.082	7.355
Inf2	Down	Up	3.81	3.562	2.67	1.424	1.607	1.429	3.477	3.987	2.972
Insig2	Up	Down	17.35	22.73	25.48	215.1	177.6	98.26	29.49	39.94	59.08
Itga7	Down	Up	1.906	3.064	4.048	1.507	2.157	1.573	4.15	3.208	2.659
Itga8	Up	Down	0.213	0.405	0.672	1.343	1.032	0.845	0.599	0.757	0.535
Jak2	Up	Down	2.059	2.148	2.674	5.436	3.44	3.658	2.222	1.096	2.363
Jak3	Down	Up	4.44	4.542	5.285	2.752	2.048	2.639	4.894	4.377	3.048
Jup	Down	Up	11.49	13.12	15.17	6.669	8.271	9.083	14.51	17.61	11.14
Kat2b-ps	Up	Down	0.789	0.651	1.404	2.139	1.884	1.954	1.284	0.783	1.584
Katnbl1	Up	Down	0.569	0.251	0.875	2.189	1.875	1.8	0	1.098	0.917
Kcnk5	Down	Up	5.807	17.82	12.84	2.021	3.034	3.399	8.988	17.7	8.788
Kdsr	Up	Down	1.686	2.523	3.755	8.211	8.805	8.383	3.521	2.695	3.963
Khsrp	Down	Up	6.793	4.986	6.59	4.225	4.634	4.573	7.974	8.334	5.312
Klf13	Down	Up	9.631	10.38	11.82	6.984	7.658	5.586	12.75	8.33	11.64
Klf15	Down	Up	37.7	47.1	43.13	14.98	20.42	17.51	33.39	40.08	35.34
Klhl2	Down	Up	9.984	10.44	14.61	6.397	8.132	7.422	12.26	13.68	8.959
Kpna4	Up	Down	4.516	5.934	7.486	12.27	10.07	11.08	5.544	6.14	9.195
Kremen1	Down	Up	4.242	2.963	3.992	2.691	2.545	2.247	6.171	5.008	3.092
Krit1	Up	Down	0.64	0.736	1.185	2.645	1.734	2.017	1.405	0.623	1.233
Krt18	Down	Up	106.8	101.3	90.24	70.01	61.94	45.08	87.15	95.12	69.99
Leo1	Up	Down	1.301	2.011	1.483	5.759	5.33	3.7	1.281	2.564	3.349
Lims2	Down	Up	30.72	30.9	28.82	20.79	21.73	17.84	34.74	41.76	25.32
Lipe	Down	Up	4.424	5.241	6.01	3.221	2.967	2.734	4.013	4.976	3.931

Moringa Oleifera leaf improves type 2 diabetes

Loc100534274	Up	Down	0.68	0.868	1.505	3.488	3.323	2.17	1.47	0.784	1.399
Loc101055763	Up	Down	0.482	0.296	0.096	1.64	0.839	1.492	0	0	0
Loc101055843	Up	Down	0.639	0.926	1.533	3.645	3.523	3.391	0.984	0.777	1.462
Loc101056014	Down	Up	12.96	25.69	18.47	4.962	4.385	2.85	9.573	17.23	10.35
Loc102631687	Down	Up	0.468	1.181	0.637	0.085	0.088	0.036	0.527	1.248	0.6
Loc102631693	Up	Down	2.802	1.857	2.384	7.424	8.566	6.027	2.15	1.754	5.596
Loc102631816	Up	Down	0.863	0.618	0.846	2.328	1.394	1.243	0.05	0.02	0.968
Loc102632388	Down	Up	2.338	9.547	4.946	0.216	0.448	0.541	9.867	4.401	3.483
Loc102632837	Down	Up	0.089	0.123	0.088	0.072	0.046	0.035	0.124	0.112	0.106
Loc102633526	Up	Down	0.109	0.034	0.049	0.235	0.183	0.215	0.066	0.035	0.064
Loc102633775	Up	Down	0.028	0.259	1.109	4.655	2.137	1.785	0.315	0	0.923
Loc102634746	Up	Down	0.122	0.008	0.693	2.37	1.417	1.214	0	0.117	0.276
Loc102635022	Up	Down	5.963	2.792	7.26	24.13	15.54	18.48	13.01	5.374	4.984
Loc102635071	Up	Down	0	0	0.071	1.529	1.224	0.538	0	0	0.649
Loc102637907	Up	Down	0	0.085	0	1.416	1.555	1.043	0.172	0	1.091
Loc102638256	Down	Up	2.112	6.807	6.186	1.121	1.134	1.27	2.586	3.308	3.942
Loc102638528	Up	Down	0.125	0.154	0.05	1.195	0.472	0.57	0.059	0	0.115
Loc102638816	Up	Down	0	0	0.34	1.157	0.755	1.771	0	0.314	0.065
Loc102639577	Up	Down	14.87	18.04	22.99	49.33	33.04	32.17	13.85	14.37	21.33
Loc102639747	Up	Down	0	0.076	0.198	1.906	1.396	0.843	0	0	0.791
Lypla2	Down	Up	12.41	15.28	13.64	10.03	10.77	8.806	17.55	13.51	12.57
Macrod1	Down	Up	11.12	15.6	17.56	8.42	12.91	9.133	26.51	20.24	16.7
Mad2l1	Up	Down	0.413	0.267	0.843	2.533	1.148	1.975	0.029	0	1.192
Mafb	Down	Up	6.585	20.49	18.11	3.352	3.259	3.721	8.063	10.31	11.8
Mal2	Up	Down	5.447	7.778	7.77	16.8	12.75	13.68	7.3	7.76	8.713
Map2k6	Down	Up	2.523	3.417	2.988	1.785	0.987	1.155	6.682	6.003	2.609
Mbni3	Up	Down	0	0	0.039	0.742	0.13	0.509	0	0	0.089
Mcm8	Up	Down	0.223	0.288	0	0.788	0.461	0.633	0	0.395	0.153
Mdn1	Up	Down	0.4	0.326	0.533	1.088	0.795	0.888	0.58	0.418	0.648
Med25	Down	Up	6.292	8.097	9.956	4.97	5.231	4.305	9.457	12.14	7.035
Mettl6	Up	Down	1.665	1.277	2.675	5.094	3.173	3.031	0.577	0.398	2.497
Mff	Up	Down	8.29	8.438	13.39	20.72	17.09	19.44	10.27	5.568	11.9
Mfi2	Up	Down	0.008	0	0	0.536	0.256	0.034	0.011	0	0
Midn	Down	Up	9.176	10.4	9.767	6.236	5.205	4.11	7.673	9.861	7.269
Mkks	Up	Down	3.481	2.451	4.606	7.051	6.483	6.397	4.834	2.552	5.086
Mlf2	Down	Up	60.82	65.79	66.89	43.11	46.94	49.93	95.7	85.19	59.03
Mpnd	Down	Up	22.55	23.37	17.35	9.419	11.25	11.16	28.53	27.13	18.76
Mpst	Down	Up	24.4	32.93	31.93	15.28	19.43	19.84	37.01	36.56	32.16
Mrpl12	Down	Up	65.85	72.91	66.31	39.77	40.4	36.32	66.73	63.36	43.53
Mrpl38	Down	Up	25.62	24.44	31.35	19.2	19.68	21.55	27.5	36.97	34.62
Mrpl54	Down	Up	17.61	28.92	31.63	20.43	15.44	16.03	25.28	35.06	22.85
Mrps16	Down	Up	24.12	30.29	33.86	13.04	15.54	15.05	21.62	28.81	21.53
Mt2	Down	Up	734.4	439.3	213	52.13	45.17	81.17	368.8	473.6	341.4
Mthfr	Up	Down	0.96	0.711	0.456	3.844	2.569	1.95	0.616	0.387	0.572
Mtss1	Down	Up	30.87	31.49	32.95	20.31	23.76	22.21	39.67	27.59	32.78
Myh14	Down	Up	3.353	2.768	5.014	1.829	1.952	1.648	3.541	3.969	2.367
Myo18a	Down	Up	1.982	1.846	1.775	1.055	1.248	1.34	1.817	2.184	1.652
Nat8	Down	Up	7.698	15.26	16.33	3.104	6.396	7.439	11.27	13.88	10.72
Nbea	Up	Down	9E-04	0.006	0.005	0.013	0.01	0.011	0.004	3E-04	0.008
Ncln	Down	Up	12.91	15.79	15.25	8.023	8.772	8.036	17.9	15.97	12.36

Moringa Oleifera leaf improves type 2 diabetes

Ncor2	Down	Up	3.4	4.319	4.188	2.698	2.472	2.541	5.149	4.105	3.672
Ndufs7	Down	Up	5.283	9.699	10.59	4.365	4.427	4.314	10.04	9.35	6.507
Nedd4l	Up	Down	2.518	2.129	2.446	5.951	4.878	5.254	1.911	1.8	2.73
Nek7	Up	Down	7.924	11.13	13.81	26.53	18.19	19.4	10.99	8.077	13.38
Nek8	Down	Up	1.345	1.532	1.69	0.685	0.995	0.586	3.077	1.703	1.485
Nfe2l2	Up	Down	13.72	14.77	21.1	35.4	37.67	33.73	21.49	14.27	22.68
Nfix	Down	Up	8.905	18.23	16.6	5.511	6.403	6.766	16.11	15.15	10.05
Ngef	Down	Up	11.49	14.41	11.49	2.37	4.399	3.907	11.43	7.347	5.548
Notum	Down	Up	7.732	10.68	6.689	3.637	4.533	3.956	7.25	9.016	6.054
Npas2	Up	Down	0	0.157	0.02	1.417	0.434	0.524	0	0	0.094
Npnt	Up	Down	0	0	1.222	1.427	2.044	2.094	0	0	1.13
Nup35	Up	Down	0.272	0.048	0	1.217	0.817	0.442	0	0.029	0.338
Nxt2	Up	Down	2.55	5.82	6.222	10.5	8.842	8.161	3.942	2.614	6.118
Oaf	Down	Up	94.02	128.4	93.57	40.95	47.25	42.11	91.59	100.1	60.83
Orm2	Down	Up	1605	751	94.02	83.89	61.9	104.6	167.2	146.8	109.7
Oser1	Up	Down	6.997	5.284	4.099	15.91	11.57	8.77	4.912	4.068	7.415
Ost4	Up	Down	38.04	50.92	85.09	100.6	99.41	107	48.26	47.05	63.71
Oxld1	Down	Up	9.186	11.47	11.5	5.481	6.097	2.886	13.29	12.92	6.486
P2rx7	Up	Down	0.621	0.453	0.797	1.348	1.129	0.838	0.284	0.69	0.258
P2ry2	Down	Up	4.278	8.16	7.586	3.334	3.201	3.001	10.4	8.629	4.927
P4ha1	Up	Down	1.781	1.139	1.333	2.714	2.857	2.628	0.546	0.411	1.429
Parp10	Down	Up	3.675	5.272	3.705	3.003	2.413	2.58	5.583	4.862	3.229
Pced1b	Down	Up	0.621	0.897	0.829	0.462	0.538	0.485	1.135	1.341	0.897
Pck1	Down	Up	1276	1526	1571	249.4	521.2	347.9	832.2	1267	967.2
Pcsk4	Down	Up	3.721	8.395	6.464	2.397	2.659	1.478	7.642	9.181	4.119
Pdcd10	Up	Down	0.556	0.838	0.934	2.727	1.641	2.045	0.626	0.041	1.527
Pde12	Up	Down	1.313	1.212	2.303	3.274	2.749	3.413	1.563	1.458	2.441
Pde7b	Down	Up	1.222	1.128	2.082	0.932	1.028	0.862	1.272	1.628	1.493
Pdia5	Down	Up	49.82	27.61	32.82	7.891	9.242	12.46	24.34	21.75	13.85
Pdk2	Down	Up	48.68	55.67	65.22	35.61	43.35	39.35	58.18	79.18	62.55
Per1	Down	Up	6.12	5.778	8.341	2.47	1.201	1.238	4.789	5.132	5.173
Per2	Down	Up	3.227	4.512	5.13	2.083	2.858	1.52	5.996	5.268	5.224
Per3	Down	Up	4.391	5.06	6.138	1.244	1.967	0.931	9.28	6.101	4.171
Pex1	Up	Down	4.638	4.816	6.282	13.51	12.03	11	7.293	4.139	8.825
Pex6	Down	Up	11.72	12.96	14.55	6.828	9.988	8.085	14.7	13.01	12.91
Pfkip	Up	Down	0.253	0.406	0.303	0.755	0.652	0.528	0.115	0.244	0.392
Pgm3	Up	Down	2.023	3.289	5.527	12.67	9.54	7.788	5.887	3.611	6.58
Phf3	Up	Down	3.456	5.244	5.704	9.947	7.243	7.519	3.695	3.862	6.557
Pigs	Down	Up	8.339	9.125	6.706	4.215	4.561	3.912	10.04	9.371	7.338
Pim3	Down	Up	13.44	32.56	40.78	5.54	4.941	4.593	16.29	21.5	17.36
Pinx1	Up	Down	0	0.731	0.38	2.516	2.584	1.861	0.594	1.172	1.739
Pkd2l1	Up	Down	0	0	0	0.508	0.228	0.654	0.142	0.078	0
Pkdcc	Down	Up	5.346	2.413	6.276	1.899	2.025	2.016	4.413	3.549	2.912
Pkhd1	Up	Down	0.483	0.319	0.224	1.003	0.823	0.637	0.44	0.342	0.513
Plin2	Up	Down	104.1	134	212.1	707.6	535.6	425.8	173.1	223.6	380.5
Plscr4	Up	Down	0.241	0.384	1.706	2.622	2.864	2.09	0.708	0	1.051
Por	Down	Up	12.8	18.4	12.51	5.867	7.296	5.311	16.07	16.43	14.51
Ppid	Up	Down	2.014	2.548	3.976	6.591	6.041	4.97	2.65	3.39	4.214
Ppp1r35	Down	Up	1.67	3.224	3.007	1.138	1.144	1.209	4.379	2.192	2.502

Moringa Oleifera leaf improves type 2 diabetes

Pptc7	Down	Up	3.232	5.138	8.053	3.117	3.247	2.348	5.372	4.309	4.097
Prpsap2	Up	Down	1.213	1.805	1.456	3.649	2.694	2.739	1.681	1.468	1.491
Psmc14	Up	Down	10.83	12	20.65	27.82	29.85	24.68	14.64	11.2	21.12
Pydc3	Up	Down	0.024	0.033	0.143	0.52	0.382	0.285	0	0	0.066
Rab4b	Down	Up	6.277	8.437	7.386	6.059	4.017	4.922	9.428	8.728	6.944
Rabac1	Down	Up	30.96	44.45	39.5	25.64	28.24	23.17	45.27	63.15	36.92
Rad18	Up	Down	0	0.351	0.08	0.548	0.59	0.559	0	0	0.184
Rad51b	Up	Down	1.948	0.456	1.024	10.89	7.399	10.31	2.308	1.052	3.205
Rad54b	Up	Down	0.04	0	0.048	0.271	0.412	0.407	0.067	0	0.24
Rgp1	Down	Up	6.743	6.706	6.612	4.791	5.143	3.856	10.14	9.484	6.957
Rgs12	Down	Up	0.508	0.662	1.079	0.426	0.282	0.297	1.467	1.332	0.528
Ring1	Down	Up	4.924	6.946	7.824	3.117	3.919	2.801	12.73	12.82	5.095
Rmdn1	Up	Down	1.597	2.948	5.065	9.218	6.732	5.19	4.707	3.04	3.341
Rn18s-rs5	Down	Up	232.4	341.4	248.2	145.2	155	148.7	252.8	227.9	271.4
Rnaseh2c	Down	Up	10.48	16.45	17.22	9.319	9.562	12.11	13.35	17.16	15.91
Rnf125	Up	Down	25.08	14.74	18.12	57.24	40.67	39.97	20.13	21.15	19.03
Rnf144a	Up	Down	0.78	0.261	1.162	2.821	1.685	2.252	0.624	0.702	0.942
Rorc	Down	Up	18.66	22.91	32.8	18.23	16.97	15.31	28.6	37.8	25.63
Rpgr	Up	Down	0.174	0.161	0.256	0.792	0.602	0.331	0	0	0.239
Rpl27-ps3	Down	Up	81.08	102	76.36	51.06	38.26	50.37	98.79	71.18	96.44
Rpl7a-ps5	Down	Up	6.669	6.877	7.522	4.981	5.627	3.966	8.93	7.671	6.998
Rplp2	Down	Up	16.2	25.3	16.95	7.067	6.922	4.893	15.71	17.44	13.22
Rps13-ps1	Down	Up	38.82	41.91	57.17	23.87	30.18	28.79	49.15	50.65	35.44
Rpsa	Down	Up	63.69	86.17	67.99	51.21	43.5	40.71	71.27	68.46	51.89
Rpsa-ps12	Down	Up	12.2	11.86	10.93	5.993	5.296	5.273	10.09	11.32	6.426
Rusc2	Down	Up	1.871	2.949	2.88	1.016	1.054	1.047	3.402	3.41	2.236
Rwdd3	Up	Down	0	0.073	0.851	1.502	1.818	1.21	0	0.437	0.649
Rxrg	Up	Down	2.174	1.96	1.084	5.784	4.693	3.842	2.869	1.56	3.398
Scand1	Down	Up	1.97	1.472	1.464	0.256	0.177	0.534	2.771	1.875	2.576
Scrn2	Down	Up	8.757	8.676	9.014	5.991	7.191	4.437	9.281	9.953	12.68
Sds	Down	Up	125.7	162.6	65.4	19.14	26.42	31.45	143.1	211.9	100.2
Selt	Up	Down	14.89	16.22	16.87	41.08	29.14	33.62	16.88	15.36	26.34
Sgpl1	Up	Down	10.08	12.03	10.36	20.42	19.38	19.49	14.03	10.12	12.01
Sh2b2	Down	Up	0.25	0.714	0.874	0.31	0.172	0.259	0.352	0.682	0.5
Shroom2	Up	Down	1.308	2.237	1.614	3.488	3.679	2.903	1.673	1.91	2.211
Sipa1l2	Down	Up	1.288	1.598	1.191	1.021	0.537	0.937	1.634	1.325	1.334
Sirt7	Down	Up	12.4	13.07	10.38	6.202	8.722	7.705	15.23	18.4	10.72
Slc13a5	Down	Up	2.203	0.745	0.707	0.059	0	0.099	0.706	0.436	0.24
Slc16a1	Up	Down	4.49	4.783	7.204	19.53	14.57	15.4	3.961	3.092	7.182
Slc25a11	Down	Up	31.2	41.79	43.22	31.64	32.69	23.54	42.01	46.93	34.88
Slc25a22	Down	Up	46.84	65.07	44.91	26.19	31.01	27.66	40.32	53.88	42.83
Slc25a27	Up	Down	0	0.118	0.182	0.642	0.399	0.336	0.292	0	0.088
Slc25a30	Up	Down	0.752	5.67	7.573	19.69	16.49	14.4	5.702	4.872	5.795
Slc2a1	Down	Up	5.043	2.711	4.689	1.698	1.957	1.954	4.716	4.307	2.968
Slc38a3	Down	Up	558.5	634.2	437.6	151.4	193.9	183.1	505.7	595	346.8
Slc39a10	Up	Down	0.197	0.182	0.377	1.249	0.811	0.686	0	0.396	0.439
Slc40a1	Up	Down	21.16	30.31	29.9	95.29	67.7	59.41	37.38	32.95	45.06
Slc5a6	Down	Up	2.563	4.367	3.885	2.317	2.228	1.758	3.853	5.126	3.219
Slc6a12	Down	Up	27.09	28.68	25	17.16	20.25	15.87	36.54	36.17	25.17
Slc8b1	Down	Up	17.51	15.53	12.07	7.432	7.252	5.581	15.34	14.25	8.496

Moringa Oleifera leaf improves type 2 diabetes

Slc9a3r1	Down	Up	56.77	82.34	85.49	27.46	38.34	44.18	73.36	106.4	71.97
Slmap	Up	Down	3.721	4.649	8.389	14.28	9.149	10.45	7.047	3.335	6.988
Sorbs3	Down	Up	27.7	20.93	14.25	5.512	4.353	4.152	13.39	12.73	11.64
Spata13	Up	Down	2.461	2.776	2.965	5.684	5.089	4.695	3.879	2.322	2.465
Spns2	Down	Up	7.525	6.907	8.942	5.729	5.216	3.583	10.94	7.933	6.646
Spon2	Up	Down	2.104	0.412	2.142	11.68	11.41	8.411	1.838	1.486	1.575
St5	Up	Down	1.902	1.899	2.563	11.08	8.191	7.482	3.442	1.713	5.115
Stx3	Up	Down	1.526	1.69	2.799	3.889	3.9	3.372	1.993	0.363	2.005
Sult1c2	Up	Down	1.363	1.887	1.11	9.743	6.783	8.47	4.792	0.216	5.012
Syncrip	Up	Down	1.748	1.376	2.561	4.552	3.235	3.223	2.068	1.547	2.732
Syng2	Down	Up	36.49	40.35	37.56	24.02	29.96	24.24	47.57	39.74	31.63
Tat	Down	Up	519.7	603.1	648.3	103.7	186.8	187.7	315.9	644	686.6
Tbc1d10a	Down	Up	5.218	6.192	5.725	3.401	2.527	1.781	4.823	4.138	3.326
Tcf3	Down	Up	4.08	3.31	2.242	2.252	1.133	1.124	3.368	2.194	2.27
Tcigr1	Down	Up	6.629	10.18	8.322	6.083	5.114	4.599	11.04	10.31	6.342
Tef	Down	Up	11.15	13.74	13.05	4.808	8.981	5.788	17.09	16.26	12.25
Tert	Down	Up	2.666	2.242	1.162	0.821	0.791	0.665	1.695	2.413	1.504
Tfpi2	Up	Down	9.342	7.094	12.49	23.48	17.84	18.89	9.915	10.09	12.07
Tfr2	Down	Up	143.5	166.4	115	55.64	81.36	80.47	154.3	149.1	100.9
Tjp3	Up	Down	4.039	4.503	3.502	11.57	10.22	10.6	7.093	5.21	4.295
Tmem201	Down	Up	4.373	5.084	6.313	2.757	1.87	1.89	3.948	5.926	3.172
Tmem38a	Down	Up	1.599	1.947	50.86	0.278	0.769	0.774	1.627	1.36	1.401
Tmem56	Up	Down	24.6	29.98	45.9	78.72	63.99	62.74	36.49	29.66	53.28
Tmem63a	Down	Up	3.739	4.788	5.079	2.99	2.592	2.986	5.908	3.904	4.566
Tnfrsf1b	Down	Up	7.503	7.173	9.596	5.712	3.444	3.582	6.348	6.687	6.695
Tob2	Down	Up	7.426	10.58	12.68	6.978	5.43	4.163	11.17	13.71	13.98
Topbp1	Up	Down	0.66	1.182	1.521	2.502	2.278	2.73	1.165	1.767	1.528
Topors	Up	Down	3.869	2.972	5.567	8.366	7.078	6.354	3.654	2.761	4.675
Tor3a	Up	Down	2.618	2.235	2.173	9.033	6.267	5.559	2.455	1.72	4.553
Tpgs1	Down	Up	7.188	6.874	5.984	5.115	4.574	4.125	9.382	13.59	7.913
Tpst1	Down	Up	6.908	5.927	10.75	4.68	3.661	3.672	5.712	6.591	5.147
Tpt1-ps5	Up	Down	7.242	6.212	13.38	24.63	18.72	24.86	4.198	4.964	15.78
Tradd	Down	Up	4.839	6.034	5.869	2.664	4.557	3.513	8.399	6.059	5.018
Trappc6a	Down	Up	7.454	5.797	6.833	3.478	3.575	2.944	5.728	6.131	4.264
Trappc8	Up	Down	4.513	4.434	6.698	15.54	9.219	8.573	4.271	4.026	6.632
Trim14	Down	Up	13.94	11.56	11.41	6.138	6.114	5.977	13.8	13.04	7.663
Trim2	Up	Down	2.021	1.609	1.375	7.124	6.956	5.691	3.293	1.824	3.134
Trim33	Up	Down	0.579	1.128	1.302	2.419	1.722	2.021	1.097	1.062	1.346
Trnq	Up	Down	14.56	19.93	40.37	73.85	45.39	87.1	14.12	10.04	14.25
Tspan4	Down	Up	38.27	27.54	29.68	11.47	12.18	13.38	26.25	28.19	21.93
Tspo	Down	Up	27.96	27.86	21.95	19.23	17.82	16.46	33.26	28.89	23.02
Ttc36	Down	Up	335.3	375.6	254	133	197.2	155.5	441.4	411.9	296.5
Tubb2a-ps1	Up	Down	0	0	0.196	1.678	0.904	0.958	0	0.302	0.099
Txn2	Down	Up	101.6	123.7	117.7	69.46	88.17	77.5	120.1	125	96.78
Ublcp1	Up	Down	4.935	7.726	8.244	18.03	14.76	12.4	9.287	6.517	10.35
Ubtd1	Down	Up	6.63	8.705	5.995	5.66	3.782	3.134	9.128	7.673	5.738
Uchl5	Up	Down	3.967	3.271	5.131	8.026	5.84	7.974	4.713	1.796	4.178
Upp2	Down	Up	8.663	16.8	11.59	0.71	1.409	1.191	6.775	9.632	8.392
Usp2	Down	Up	5.474	13.87	16.97	0.649	2.725	1.253	18.01	22.38	12.39

Moringa Oleifera leaf improves type 2 diabetes

Usp37	Up	Down	0.482	0.393	1	1.312	1.055	1.138	0.274	0.314	0.75
Usp40	Up	Down	2.3	3.198	3.493	7.014	6.049	5.87	4.61	2.339	4.568
Wbscr16	Down	Up	3.735	4.074	5.186	2.186	3.226	2.949	5.73	6.786	3.729
Wfs1	Down	Up	2.581	3.231	6.218	1.989	2.167	1.57	3.714	3.221	2.829
Yif1b	Down	Up	12.83	15.26	13.57	7.699	9.674	6.568	19.15	18.09	13.69
Ythdc1	Up	Down	1.392	2.939	3.674	7.023	5.096	5.438	3.109	1.345	3.956
Ythdf2	Up	Down	3.357	2.539	5.665	8.358	8.142	7.73	4.332	4.054	5.605
Zbtb41	Up	Down	0.495	0.553	1.082	2.402	1.541	1.652	1.134	0.665	1.14
Zfc3h1	Up	Down	1.291	1.258	2.276	4.383	3.07	2.88	0.692	1.377	1.97
Zfp101	Up	Down	0	0.241	0	0.889	0.344	0.475	0	0	0.143
Zfp157	Up	Down	0.309	0.335	0.613	1.172	0.658	0.917	0.416	0	0.461
Zfp36	Down	Up	28.6	35.4	38.25	10.95	19.71	11.86	34.2	39.38	41.76
Zfp395	Down	Up	10.57	13.58	11.65	2.681	6.06	6.238	11.49	9.166	7.677
Zfp472	Up	Down	0	0.084	0.476	0.831	0.575	0.486	0	0	0.126
Zfp524	Down	Up	8.189	8.641	7.01	5.683	3.856	6.17	9.023	6.776	8.808
Zfp53	Up	Down	0.486	0.085	0.417	1.608	1.069	1.08	0	0	0.699
Zfp605	Up	Down	0	0.033	0.227	0.466	0.3	0.416	0	0	0.276
Zfp704	Up	Down	0.67	0.542	0.828	1.859	1.295	1.318	1.014	0.457	0.686
Zfp715	Up	Down	1.312	1.097	2.057	3.091	2.152	2.634	0.782	1.32	1.759
Zfp78	Up	Down	0.001	0.081	0.002	0.139	0.439	0.285	0.061	0	0.04
Zkscan3	Up	Down	4.166	6.251	4.356	15.93	14.6	12.76	5.983	7.77	8.494

Table S2. Co-expression analysis of profile 2 and profile 5 genes

GeneSymbol	GeneSymbol-2	Pearson	P value	FDR	Style
Cltc	Maoa	1	0.00000277	0.00391049	Positive
Cyp4f13	Pnpo	1	0.0000156	0.01099109	Positive
Creb1	Anapc4	0.999999999	0.0000338	0.01192015	Positive
Acsf5	Snap29	0.999999996	0.0000556	0.01568192	Positive
Amacr	Mrps21	0.999999987	0.000103	0.01859548	Positive
Pigo	Per1	0.999999913	0.000266	0.02681515	Positive
Bcat2	Rpl36	0.999999857	0.00034	0.02768292	Positive
Mad2l1	Nedd4l	0.999999828	0.000373	0.02768292	Positive
Apoa5	Uck2	0.999999657	0.000527	0.0300238	Positive
Nfe2l2	Cyp3a44	0.99999963	0.000548	0.0300238	Positive
Rpsa	Rps7	0.999999247	0.000781	0.03660932	Positive
Scd2	Hsd17b12	0.999998769	0.000999	0.03778403	Positive
Creb1	Cul4b	0.999998592	0.00106822	0.03778403	Positive
Smc1a	Clock	0.999998506	0.00110056	0.03778403	Positive
Cul4b	Anapc4	0.999998502	0.00110204	0.03778403	Positive
Gpx7	Mrps21	0.999998309	0.00117085	0.03778403	Positive
Amacr	Gpx7	0.999997998	0.00127403	0.03778403	Positive
Glb1	Slc2a1	0.999997973	0.00128193	0.03778403	Positive
Aqp1	Mrpl12	0.999997853	0.00131914	0.03778403	Positive
Rpl8	Mrpl14	0.999997692	0.00136791	0.03778403	Positive
Scd1	Ddc	0.999997563	0.00140558	0.03778403	Positive
Sar1b	Snap29	0.999997255	0.00149156	0.03778403	Positive
Upp2	Mrps16	0.999997222	0.00150071	0.03778403	Positive
Dnm1l	Prkx	0.999997185	0.00151056	0.03778403	Positive
Adipor2	Braf	0.999997076	0.00153959	0.03778403	Positive

Moringa Oleifera leaf improves type 2 diabetes

Acs15	Sar1b	0.999997047	0.00154717	0.03778403	Positive
Lss	Gm6139	0.999996354	0.00171915	0.04018463	Positive
Rpsa	Akt1	0.999996255	0.00174233	0.04018463	Positive
Herc1	Fabp2	0.999996148	0.00176698	0.04018463	Positive
Rpl15	Rpl10	0.999995777	0.00185014	0.04045805	Positive
Pik3r3	Elovl5	0.999994285	0.00215233	0.04274523	Positive
Stat3	Rpl36	0.999993766	0.00224791	0.04305209	Positive
Gm5786	Acy1	0.999993331	0.00232506	0.0437112	Positive
Pnpo	Agpat1	0.999992541	0.0024589	0.04531217	Positive
Cyp4f13	Agpat1	0.999992446	0.00247449	0.04531217	Positive
Rps7	Akt1	0.999992143	0.00252365	0.04557041	Positive
Bcat2	Stat3	0.999991734	0.0025884	0.04557041	Positive
Cdkn1a	Cyp3a41b	0.999991431	0.00263547	0.04557041	Positive
Gne	Ndufs7	0.999991235	0.00266553	0.04557041	Positive
Nmd3	Pik3r3	0.999991189	0.0026724	0.04557041	Positive
Eif2ak3	Elovl6	0.999990907	0.00271483	0.04557041	Positive
Braf	Sar1b	0.999989819	0.00287273	0.0465581	Positive
Klhl9	Jak2	0.999988377	0.00306939	0.048066	Positive
Clock	Ccng2	0.999987548	0.00317696	0.048066	Positive
Ube2d2a	Prkdc	0.999984843	0.00350507	0.04921773	Positive
Herc1	Acadl	0.999983722	0.00363238	0.04921773	Positive
Rplp1	Rps7	0.999982742	0.00374013	0.04921773	Positive
Gyk	Skp1a	0.999981699	0.0038515	0.04921773	Positive
Cdkn1a	Acaca	0.999981642	0.00385753	0.04921773	Positive
Cltc	Cul1	0.999980861	0.00393877	0.04921773	Positive
Maoa	Cul1	0.999980834	0.00394154	0.04921773	Positive
Cyp2c37	Rpl15	0.999980313	0.00399472	0.04921773	Positive
Cul2	Ikbkg	0.999978056	0.00421749	0.04921773	Positive
Skp1a	Prkdc	0.999977666	0.00425482	0.04921773	Positive
Smc1a	Ccng2	0.999977427	0.00427753	0.04921773	Positive
Braf	Snap29	0.999976502	0.0043643	0.04921773	Positive
Foxo3	Tab1	0.999976008	0.00440993	0.04921773	Positive
Adipor2	Sar1b	0.999975982	0.00441233	0.04921773	Positive
Ddc	Fads1	0.999975973	0.00441312	0.04921773	Positive
Acs15	Braf	0.999975899	0.00441991	0.04921773	Positive
Stx16	Cyp3a11	0.999975677	0.00444022	0.04921773	Positive
Upp2	Aqp1	0.999975032	0.00449873	0.04921773	Positive
Rplp1	Rpsa	0.999974779	0.00452146	0.04921773	Positive
Nmd3	Elovl5	0.999971282	0.00482474	0.04934842	Positive
Smc1a	Cul4b	0.999971071	0.00484243	0.04934842	Positive
Ndufs7	Gpld1	0.999970589	0.00488264	0.04934842	Positive
Cyp4f15	Cyp4a31	0.999968471	0.00505536	0.04934842	Positive
Acads	Per2	0.999968173	0.00507916	0.04934842	Positive
Nfkb1a	Stat3	0.999967737	0.00511384	0.04934842	Positive
Fabp2	Acadl	0.999964034	0.00539937	0.04934842	Positive
Gm5786	Cry2	0.999963201	0.00546152	0.04934842	Positive
Arntl	Cdc27	0.999963051	0.00547266	0.04934842	Positive
Tnfrsf1b	Pck1	0.999960493	0.0056589	0.04934842	Positive
Upp2	Mrpl12	0.999958243	0.00581787	0.04934842	Positive
Scd1	Fads1	0.999958231	0.0058187	0.04934842	Positive

Moringa Oleifera leaf improves type 2 diabetes

Cyp2c37	Rpl10	0.999957854	0.00584485	0.04934842	Positive
Adipor2	Snap29	0.999956999	0.00590389	0.04934842	Positive
Smc1a	Creb1	0.9999569	0.00591065	0.04934842	Positive
Clock	Cul4b	0.999956427	0.00594299	0.04934842	Positive
Smc1a	Anapc4	0.999956405	0.00594447	0.04934842	Positive
Acsl5	Adipor2	0.999956185	0.0059595	0.04934842	Positive
Aqp1	Mrps16	0.999955595	0.00599943	0.04934842	Positive
Acsl5	Ptplb	0.999954095	0.00609993	0.04934842	Positive
Ptplb	Snap29	0.999953255	0.00615554	0.04934842	Positive
Rxra	Sc4mol	0.99995186	0.0062467	0.04934842	Positive
Rplp1	Akt1	0.999951596	0.00626379	0.04934842	Positive
Cdk1	Nxt2	0.999948267	0.0064756	0.04934842	Positive
Cyp3a41b	Acaca	0.999947989	0.006493	0.04934842	Positive
Sgpl1	Kdsr	0.999944774	0.00669068	0.04934842	Positive
Creb3l3	Rorc	0.999943993	0.0067378	0.04934842	Positive
Lss	Per3	0.999941122	0.00690836	0.04934842	Positive
Creb1	Clock	0.999939355	0.00701122	0.04934842	Positive
Clock	Anapc4	0.999938769	0.00704503	0.04934842	Positive
Rplp2	Akt1	0.999935643	0.00722264	0.04934842	Positive
Flad1	Rplp2	0.999934751	0.00727252	0.04934842	Positive
Mrpl12	Mrps16	0.999933922	0.00731858	0.04934842	Positive
Nfkbia	Rpl36	0.99993314	0.00736175	0.04934842	Positive
Ube2d2a	Maoa	0.999931519	0.00745043	0.04934842	Positive
Ube2d2a	Cltc	0.999931468	0.00745321	0.04934842	Positive
Gne	Gpld1	0.999929711	0.00754817	0.04934842	Positive
Scd1	Adipor2	0.99992947	0.00756109	0.04934842	Positive
Rxra	Gm6139	0.99992916	0.0075777	0.04934842	Positive
Fabp2	Cyp3a41a	0.999928399	0.00761831	0.04934842	Positive
Ptplb	Sar1b	0.999927856	0.00764711	0.04934842	Positive
Rplp1	Per1	0.999926909	0.00769715	0.04934842	Positive
Nfkbia	Bcat2	0.999926812	0.00770223	0.04934842	Positive
Ube2d2a	Skp1a	0.999925713	0.00775989	0.04934842	Positive
Cry2	Acy1	0.999925201	0.00778659	0.04934842	Positive
Rplp1	Pigo	0.999921765	0.0079634	0.04934842	Positive
Elovl5	Fads1	0.99992009	0.0080482	0.04934842	Positive
Gyk	Prkdc	0.999918932	0.00810632	0.04934842	Positive
Dnm1l	Cdk1	0.999918534	0.00812616	0.04934842	Positive
Slc2a1	Pdxk	0.999912664	0.00841388	0.04972554	Positive
Gm6139	Per3	0.999908172	0.00862752	0.04972554	Positive
Gyk	9130409l23Rik	0.99990505	0.00877296	0.04972554	Positive
Rplp2	Rpsa	0.999900848	0.00896496	0.04972554	Positive
Ddc	Adipor2	0.999900811	0.00896667	0.04972554	Positive
Scd1	Braf	0.999897824	0.00910068	0.04972554	Positive
Cul4b	Ccng2	0.99989739	0.00911995	0.04972554	Positive
Rxra	Lss	0.999893371	0.00929685	0.04972554	Positive
Herc1	Cyp3a41a	0.999891333	0.00938529	0.04972554	Positive
Nfkbia	Aprt	0.999890521	0.00942029	0.04972554	Positive
Gpx7	Glb1	0.999890233	0.00943266	0.04972554	Positive
Sphk2	Uck2	0.999886971	0.00957182	0.04972554	Positive
Prkx	Cdk1	0.999885433	0.00963672	0.04972554	Positive

Moringa Oleifera leaf improves type 2 diabetes

Glb1	Pdxk	0.999884024	0.0096958	0.04972554	Positive
Casp8	Kdsr	0.999882901	0.00974261	0.04972554	Positive
Rplp2	Rps7	0.999882813	0.00974629	0.04972554	Positive
Cyp3a44	Sgpl1	0.999874952	0.01006788	0.04972554	Positive
Apoa5	Sphk2	0.999874172	0.01009922	0.04972554	Positive
Creb1	Ccng2	0.999871946	0.01018818	0.04972554	Positive
Pik3r3	Fads1	0.999871635	0.01020054	0.04972554	Positive
Ccng2	Anapc4	0.999871094	0.01022199	0.04972554	Positive
Foxo3	Mrpl14	0.999867195	0.01037546	0.04972554	Positive
Ddc	Braf	0.999863825	0.01050626	0.04972554	Positive
Ptplb	Braf	0.999863473	0.01051984	0.04972554	Positive
Glb1	Mrps21	0.999861293	0.01060351	0.04972554	Positive
Nfe2l2	Sgpl1	0.999860978	0.01061553	0.04972554	Positive
Amacr	Glb1	0.99985858	0.01070669	0.04972554	Positive
Gpx7	Slc2a1	0.999858372	0.01071458	0.04972554	Positive
Cyp2c50	Rpl8	0.999851995	0.01095315	0.04972554	Positive
Prkdc	Maoa	0.999851931	0.0109555	0.04972554	Positive
Cltc	Prkdc	0.999851856	0.01095827	0.04972554	Positive
Scd2	9130409I23Rik	0.999850831	0.01099614	0.04972554	Positive
Cd36	Acaca	0.999847308	0.01112524	0.04972554	Positive
Ube2d2a	Cul1	0.999839898	0.01139197	0.04972554	Positive
Rps7	Per1	0.999838622	0.01143729	0.04972554	Positive
Apoa5	Per2	0.999836106	0.0115261	0.04972554	Positive
Gyk	Ube2d2a	0.999833672	0.01161139	0.04972554	Positive
Rps7	Pigo	0.999831021	0.01170354	0.04972554	Positive
Foxo3	Rpl8	0.999829869	0.01174337	0.04972554	Positive
Slc2a1	Mrps21	0.999825728	0.01188544	0.04972554	Positive
Acy1	Acads	0.999825694	0.01188658	0.04972554	Positive
Scd1	Sar1b	0.999823139	0.01197342	0.04972554	Positive
Amacr	Slc2a1	0.999822689	0.01198862	0.04972554	Positive
Hsd17b12	9130409I23Rik	0.999822502	0.01199496	0.04972554	Positive
Per2	Uck2	0.999820765	0.0120535	0.04972554	Positive
Ptplb	Adipor2	0.999820588	0.01205943	0.04972554	Positive
Rpsa	Per1	0.999815821	0.01221861	0.04972554	Positive
Cyp3a11	Hsd17b12	0.999814946	0.01224761	0.04972554	Positive
Cyp2c50	Mrpl14	0.999812719	0.01232107	0.04972554	Positive
Cyp2c37	Pck1	0.999808906	0.01244587	0.04972554	Positive
Ddc	Elovl5	0.999808431	0.01246133	0.04972554	Positive
Rpsa	Pigo	0.999807707	0.01248486	0.04972554	Positive
Cdc27	Nfe2l2	0.99980673	0.01251654	0.04972554	Positive
Flad1	Sh2b2	0.999804873	0.01257652	0.04972554	Positive
Skp1a	9130409I23Rik	0.999803383	0.01262446	0.04972554	Positive
Alas1	Ndufb4	0.999797257	0.01281963	0.04972554	Positive
Nmd3	Fads1	0.999795567	0.01287294	0.04972554	Positive
Cyp3a41a	Acadl	0.999790945	0.01301767	0.04972554	Positive
Cdc27	Cyp3a44	0.999789448	0.01306419	0.04972554	Positive
Scd2	Cyp3a11	0.999783533	0.01324643	0.04972554	Positive
Ikbkg	Eif2ak3	0.999781335	0.0133135	0.04972554	Positive
Ddc	Sar1b	0.999779179	0.01337899	0.04972554	Positive
Adipor2	Fads1	0.999779153	0.01337979	0.04972554	Positive

Moringa Oleifera leaf improves type 2 diabetes

Gpld1	Agpat1	0.99977695	0.01344636	0.04972554	Positive
Scd1	Snap29	0.999776331	0.01346498	0.04972554	Positive
Rplp1	Rplp2	0.999775618	0.01348642	0.04972554	Positive
Scd1	Acsf5	0.99977448	0.01352059	0.04972554	Positive
Pigo	Mrpl12	0.999770267	0.01364629	0.04972554	Positive
Gm6139	Sc4mol	0.999764232	0.01382439	0.04972554	Positive
Scd1	Elovl5	0.99976278	0.0138669	0.04972554	Positive
Mrpl12	Per1	0.999761216	0.01391254	0.04972554	Positive
Akt1	Per1	0.999759552	0.01396094	0.04972554	Positive
Nxf1	Ccnb2	0.99975768	0.01401517	0.04972554	Positive
Gm5786	Acads	0.999750839	0.01421165	0.04972554	Positive
Akt1	Pigo	0.999750293	0.01422719	0.04972554	Positive
Stx2	Cyp3a41a	0.99974924	0.01425716	0.04972554	Positive
Tab1	Pdxk	0.999746094	0.01434633	0.04972554	Positive
Flad1	Akt1	0.999740799	0.01449515	0.04972554	Positive
Stat3	Aprt	0.999739404	0.01453412	0.04972554	Positive
Dnm1l	Nxt2	0.999736972	0.01460177	0.04972554	Positive
Ddc	Pik3r3	0.999736544	0.01461366	0.04972554	Positive
Tab1	Mrpl14	0.999730316	0.01478538	0.04972554	Positive
Ddc	Snap29	0.9997272	0.01487056	0.04972554	Positive
Prkdc	Cul1	0.999726227	0.01489704	0.04972554	Positive
Braf	Fads1	0.999725406	0.01491938	0.04972554	Positive
Ddc	Acsf5	0.999725156	0.01492617	0.04972554	Positive
Nmd3	Acadl	0.9997239	0.01496023	0.04972554	Positive
Aqp1	Pigo	0.999723708	0.01496544	0.04972554	Positive
Cd36	Cdkn1a	0.999723068	0.01498277	0.04972554	Positive
Skp1a	Maoa	0.999714592	0.01521032	0.04972554	Positive
Skp1a	Cltc	0.999714488	0.0152131	0.04972554	Positive
Aqp1	Per1	0.99971379	0.01523169	0.04972554	Positive
Cyp4f15	Rxbp	0.999713278	0.0152453	0.04972554	Positive
Lss	Sc4mol	0.999701951	0.01554355	0.04972554	Positive
Tab3	Ugcg	0.999689203	0.01587248	0.04972554	Positive
Pnpo	Gpld1	0.999687918	0.01590526	0.04972554	Positive
Cyp4f13	Gpld1	0.999687306	0.01592085	0.04972554	Positive
Ccng2	Elovl6	0.999684203	0.01599965	0.04972554	Positive
Scd1	Pik3r3	0.999683429	0.01601924	0.04972554	Positive
Ikbbg	Elovl6	0.99968307	0.01602834	0.04972554	Positive
Prkx	Nxt2	0.99967974	0.01611233	0.04972554	Positive
Tab1	Rpl8	0.999678109	0.0161533	0.04972554	Positive
Rxra	Per3	0.999676037	0.01620521	0.04972554	Positive
Flad1	Rpsa	0.999674745	0.01623748	0.04972554	Positive
Casp8	Sgpl1	0.999666854	0.01643329	0.04972554	Positive
Rpl15	Pck1	0.999666558	0.01644058	0.04972554	Positive
Apoa5	Acads	0.999659845	0.01660526	0.04972554	Positive
Stx16	Hsd17b12	0.999656454	0.01668782	0.04972554	Positive
Cyp3a44	Kdsr	0.999653536	0.01675855	0.04972554	Positive
Rpl36	Aprt	0.999652565	0.01678203	0.04972554	Positive
Prkdc	9130409123Rik	0.999648527	0.01687929	0.04972554	Positive
Acy1	Per2	0.999644917	0.01696574	0.04972554	Positive
Flad1	Rps7	0.999642693	0.01701881	0.04972554	Positive

Moringa Oleifera leaf improves type 2 diabetes

Bcat2	Aprt	0.999638325	0.01712252	0.04972554	Positive
Acads	Uck2	0.999637896	0.01713266	0.04972554	Positive
Stx2	Cul1	0.999636152	0.01717387	0.04972554	Positive
Nmd3	Ddc	0.999631383	0.01728606	0.04972554	Positive
Nfe2l2	Kdsr	0.999630523	0.01730621	0.04972554	Positive
Siah1a	Tab3	0.999628398	0.01735591	0.04972554	Positive
Cyp2c50	Cebpb	0.99962218	0.01750052	0.04972554	Positive
Cul2	Eif2ak3	0.999620864	0.01753099	0.04972554	Positive
Stx3	Nxf1	0.999617455	0.01760964	0.04972554	Positive
Cd36	Cyp3a41b	0.999617081	0.01761824	0.04972554	Positive
Pik3r3	Acadl	0.999616455	0.01763263	0.04972554	Positive
Scd2	Stx16	0.999614102	0.01768665	0.04972554	Positive
Sar1b	Fads1	0.999609486	0.01779212	0.04972554	Positive
Arntl	Nfe2l2	0.999600787	0.01798919	0.04972554	Positive
Siah1a	Ccnb2	0.999597558	0.01806182	0.04972554	Positive
Casp8	Anapc4	0.99959716	0.01807074	0.04972554	Positive
Creb1	Casp8	0.999595651	0.01810456	0.04972554	Positive
Cyp2c37	Tnfrsf1b	0.999595642	0.01810476	0.04972554	Positive
Rpl10	Pck1	0.999587293	0.01829072	0.04972554	Positive
Ndufs7	Agpat1	0.999585565	0.01832899	0.04972554	Positive
Arntl	Cyp3a44	0.999576112	0.01853685	0.04972554	Positive
Nmd3	Herc1	0.999573558	0.01859261	0.04972554	Positive
Nmd3	Scd1	0.999569004	0.01869164	0.04972554	Positive
Ccng2	Eif2ak3	0.99956795	0.01871449	0.04972554	Positive
Foxo3	Pdxk	0.999566019	0.01875626	0.04972554	Positive
Sh2b2	Aprt	0.999564292	0.01879354	0.04972554	Positive
Arntl	Stx16	0.999552943	0.01903676	0.04972554	Positive
Gyk	Maoa	0.999551765	0.01906182	0.04972554	Positive
Gyk	Cltc	0.999551634	0.0190646	0.04972554	Positive
Amacr	Cyp4f13	0.999549443	0.01911113	0.04972554	Positive
Amacr	Pnpo	0.999548708	0.01912672	0.04972554	Positive
Gpx7	Pdxk	0.999548625	0.01912846	0.04972554	Positive
Skp1a	Cul1	0.99954752	0.01915186	0.04972554	Positive
Cul4b	Casp8	0.999546531	0.01917278	0.04972554	Positive
Clock	Elovl6	0.99954635	0.01917661	0.04972554	Positive
Cyp4f13	Mrps21	0.999544565	0.01921431	0.04972554	Positive
Pnpo	Mrps21	0.999543826	0.0192299	0.04972554	Positive
Fads1	Snap29	0.999541271	0.01928368	0.04972554	Positive
Gm5786	Per2	0.999540932	0.01929081	0.04972554	Positive
Acsf5	Fads1	0.999538621	0.01933929	0.04972554	Positive
Upp2	Pigo	0.999532645	0.01946416	0.04972554	Positive
Scd1	Ptplb	0.999525106	0.01962052	0.04972554	Positive
Cry2	Acads	0.999522554	0.01967317	0.04972554	Positive
Upp2	Per1	0.999519772	0.01973041	0.04972554	Positive
Scd2	Gyk	0.999517887	0.0197691	0.04972554	Positive
Elovl5	Acadl	0.999517113	0.01978497	0.04972554	Positive
Sh2b2	Rplp2	0.999513981	0.01984904	0.04972554	Positive
Cd36	Ptplb	0.999502426	0.02008361	0.04972554	Positive
Apoa5	Sec61a2	-0.999506223	0.02000683	0.04972554	Negative
Eif2ak3	Slc2a1	-0.99950809	0.01996897	0.04972554	Negative

Moringa Oleifera leaf improves type 2 diabetes

Upp2	Elovl5	-0.999513495	0.01985895	0.04972554	Negative
Amacr	Cul4b	-0.999513734	0.01985408	0.04972554	Negative
Acadl	Per1	-0.999516164	0.0198044	0.04972554	Negative
Cul4b	Mrps21	-0.999518774	0.0197509	0.04972554	Negative
Smc1a	Tab1	-0.999519443	0.01973717	0.04972554	Negative
Gpx7	Anapc4	-0.999522121	0.01968209	0.04972554	Negative
Creb1	Gpx7	-0.999523762	0.01964828	0.04972554	Negative
Acsf5	Pck1	-0.999527161	0.01957803	0.04972554	Negative
Pigo	Acadl	-0.999529085	0.01953815	0.04972554	Negative
Nmd3	Aqp1	-0.999529336	0.01953294	0.04972554	Negative
Pck1	Snap29	-0.999529843	0.01952242	0.04972554	Negative
Sec61a2	Uck2	-0.999531911	0.01947944	0.04972554	Negative
Foxo3	Cul4b	-0.999540272	0.01930467	0.04972554	Negative
Tnfrsf1b	Adipor2	-0.999541568	0.01927742	0.04972554	Negative
Gyk	Flad1	-0.999545642	0.01919157	0.04972554	Negative
Rpsa	Cyp3a41a	-0.999554417	0.01900534	0.04972554	Negative
Rxrb	Cdkn1a	-0.999566474	0.01874643	0.04972554	Negative
Glb1	Eif2ak3	-0.999569216	0.01868705	0.04972554	Negative
Casp8	Pdxk	-0.9995721	0.01862437	0.04972554	Negative
Ndufs7	Ikbbg	-0.999572267	0.01862075	0.04972554	Negative
Cul4b	Gpx7	-0.999574134	0.01858005	0.04972554	Negative
Cdk1	Polr2c	-0.999582123	0.01840495	0.04972554	Negative
Elovl5	Mrps16	-0.999584241	0.01835824	0.04972554	Negative
Prkdc	Rplp2	-0.999584263	0.01835776	0.04972554	Negative
Foxo3	Creb1	-0.999589739	0.01823644	0.04972554	Negative
Rps7	Cyp3a41a	-0.999590298	0.01822401	0.04972554	Negative
Foxo3	Anapc4	-0.999591259	0.01820263	0.04972554	Negative
Stx3	Gm6139	-0.999594176	0.01813756	0.04972554	Negative
Rpl10	Fads1	-0.999597996	0.01805198	0.04972554	Negative
Sar1b	Pck1	-0.999598936	0.01803085	0.04972554	Negative
Prkx	Ndufb4	-0.999599891	0.01800937	0.04972554	Negative
Stat3	9130409123Rik	-0.999602983	0.01793965	0.04972554	Negative
Acy1	Ugcg	-0.999611171	0.01775369	0.04972554	Negative
Siah1a	Sc4mol	-0.999612441	0.01772467	0.04972554	Negative
Upp2	Pik3r3	-0.99961323	0.01770662	0.04972554	Negative
Elovl6	Slc2a1	-0.999632743	0.01725414	0.04972554	Negative
Maoa	Rps7	-0.999637224	0.01714855	0.04972554	Negative
Cltc	Rps7	-0.999637341	0.01714578	0.04972554	Negative
Gne	Cul2	-0.999640591	0.0170688	0.04972554	Negative
Cul1	Rplp1	-0.999645695	0.01694715	0.04972554	Negative
Cyp2c50	Cdc27	-0.999654429	0.01673695	0.04972554	Negative
Nfe2l2	Mrpl14	-0.999662453	0.01654148	0.04972554	Negative
Cd36	Cyp4a31	-0.999662636	0.016537	0.04972554	Negative
Dnm1l	Ndufb4	-0.999664192	0.01649881	0.04972554	Negative
Lss	Stx3	-0.999667457	0.01641841	0.04972554	Negative
Cul1	Sh2b2	-0.999668675	0.01638831	0.04972554	Negative
Maoa	Rpsa	-0.999669527	0.01636723	0.04972554	Negative
Cltc	Rpsa	-0.999669639	0.01636445	0.04972554	Negative
Elovl6	Agpat1	-0.999671427	0.0163201	0.04972554	Negative
Rxrb	Ptplb	-0.999671433	0.01631995	0.04972554	Negative

Moringa Oleifera leaf improves type 2 diabetes

Foxo3	Sgpl1	-0.999672179	0.01630141	0.04972554	Negative
Pik3r3	Mrps16	-0.999676009	0.01620591	0.04972554	Negative
Rpl15	Fads1	-0.999676171	0.01620184	0.04972554	Negative
Herc1	Per1	-0.999677363	0.01617202	0.04972554	Negative
Skp1a	Aprt	-0.999683004	0.01602999	0.04972554	Negative
Cyp3a44	Mrpl14	-0.999684433	0.01599382	0.04972554	Negative
Glb1	Elovl6	-0.999685285	0.01597221	0.04972554	Negative
Herc1	Pigo	-0.999687898	0.01590577	0.04972554	Negative
Nfkbia	Stx16	-0.99968981	0.01585697	0.04972554	Negative
Siah1a	Acy1	-0.999704585	0.0154747	0.04972554	Negative
Sh2b2	9130409I23Rik	-0.999707885	0.01538801	0.04972554	Negative
Skp1a	Flad1	-0.999709702	0.01534007	0.04972554	Negative
Lss	Ccnb2	-0.999714739	0.0152064	0.04972554	Negative
Nfe2l2	Rpl8	-0.99971597	0.01517357	0.04972554	Negative
Braf	Pck1	-0.999716548	0.01515812	0.04972554	Negative
Rorc	Sec61a2	-0.99971775	0.01512593	0.04972554	Negative
Tab3	Per2	-0.999719293	0.01508453	0.04972554	Negative
Nmd3	Upp2	-0.999721163	0.01503422	0.04972554	Negative
Amacr	Smc1a	-0.999721999	0.01501165	0.04972554	Negative
Smc1a	Mrps21	-0.999725807	0.01490848	0.04972554	Negative
Cul4b	Tab1	-0.999726312	0.01489474	0.04972554	Negative
Rxrb	Acaca	-0.999726526	0.01488891	0.04972554	Negative
Ube2d2a	Rplp2	-0.999727855	0.01485269	0.04972554	Negative
Alas1	Nxt2	-0.999732816	0.01471667	0.04972554	Negative
Cyp3a44	Rpl8	-0.999736102	0.01462591	0.04972554	Negative
Maoa	Akt1	-0.999736138	0.0146249	0.04972554	Negative
Cltc	Akt1	-0.999736238	0.01462213	0.04972554	Negative
Rplp1	Cyp3a41a	-0.999741202	0.01448388	0.04972554	Negative
Cyp3a41a	Mrps16	-0.999742611	0.01444439	0.04972554	Negative
Fabp2	Per1	-0.999744012	0.01440503	0.04972554	Negative
Ndufs7	Cul2	-0.999744075	0.01440326	0.04972554	Negative
Nxf1	Sc4mol	-0.999745882	0.01435232	0.04972554	Negative
Alas1	Jak2	-0.999748471	0.01427903	0.04972554	Negative
Fabp2	Pigo	-0.999753387	0.01413878	0.04972554	Negative
Tab1	Kdsr	-0.99975749	0.01402066	0.04972554	Negative
Amacr	Clock	-0.999761266	0.01391109	0.04972554	Negative
Pnpo	Elovl6	-0.999762975	0.01386119	0.04972554	Negative
Cyp4f13	Elovl6	-0.999763508	0.0138456	0.04972554	Negative
Cyp3a44	Cebpb	-0.999764117	0.01382776	0.04972554	Negative
Creb1	Tab1	-0.99976416	0.01382652	0.04972554	Negative
Clock	Mrps21	-0.999764794	0.01380791	0.04972554	Negative
Tab1	Anapc4	-0.999765312	0.0137927	0.04972554	Negative
Ikbbg	Gpld1	-0.999767166	0.01373811	0.04972554	Negative
Smc1a	Gpx7	-0.999767182	0.01373762	0.04972554	Negative
Stx2	Rplp2	-0.999768011	0.01371315	0.04972554	Negative
Ddc	Rpl10	-0.999770518	0.01363886	0.04972554	Negative
Adipor2	Pck1	-0.999771201	0.01361853	0.04972554	Negative
Eif2ak3	Agpat1	-0.999771647	0.01360526	0.04972554	Negative
Nmd3	Mrps16	-0.999774049	0.01353351	0.04972554	Negative
Gm6139	Ccnb2	-0.999775591	0.01348724	0.04972554	Negative

Moringa Oleifera leaf improves type 2 diabetes

Nfe2l2	Cebpb	-0.999782431	0.01328011	0.04972554	Negative
Cyp2c37	Ptplb	-0.999784001	0.01323209	0.04972554	Negative
Cul1	Rps7	-0.999784819	0.01320701	0.04972554	Negative
Gm5786	Siah1a	-0.999786685	0.01314964	0.04972554	Negative
Cyp2c50	Kdsr	-0.999788751	0.01308579	0.04972554	Negative
Upp2	Cyp3a41a	-0.999793314	0.01294369	0.04972554	Negative
Nfkbia	9130409123Rik	-0.999797061	0.01282581	0.04972554	Negative
Clock	Gpx7	-0.99980299	0.01263706	0.04972554	Negative
Nmd3	Pck1	-0.999803079	0.0126342	0.04972554	Negative
Nedd4l	Polr2c	-0.999807521	0.01249091	0.04972554	Negative
Cltc	Sh2b2	-0.999808793	0.01244955	0.04972554	Negative
Maoa	Sh2b2	-0.999808879	0.01244677	0.04972554	Negative
Cul1	Rpsa	-0.999809526	0.01242569	0.04972554	Negative
Scd1	Rpl10	-0.999815378	0.01223328	0.04972554	Negative
Cyp2c37	Fads1	-0.999816167	0.01220713	0.04972554	Negative
Gyk	Aprt	-0.999817029	0.01217849	0.04972554	Negative
Mad2l1	Polr2c	-0.999818845	0.01211788	0.04972554	Negative
Casp8	Rpl8	-0.999826027	0.01187525	0.04972554	Negative
Ddc	Rpl15	-0.999828553	0.01178872	0.04972554	Negative
Scd1	Tnfrsf1b	-0.999830652	0.01171633	0.04972554	Negative
Cyp4f15	Cd36	-0.999837368	0.01148164	0.04972554	Negative
Nfkbia	Cyp3a11	-0.999839201	0.01141676	0.04972554	Negative
Ugcg	Uck2	-0.999843432	0.01126555	0.04972554	Negative
Alas1	Klhl9	-0.999844982	0.01120964	0.04972554	Negative
Pnpo	Eif2ak3	-0.999846727	0.01114636	0.04972554	Negative
Cyp4f13	Eif2ak3	-0.999847156	0.01113077	0.04972554	Negative
Flad1	Prkdc	-0.999848403	0.01108524	0.04972554	Negative
Stat3	Stx16	-0.999857616	0.01074314	0.04972554	Negative
Apoa5	Ugcg	-0.999857748	0.01073815	0.04972554	Negative
Amacr	Ccng2	-0.999857855	0.01073413	0.04972554	Negative
Cul1	Akt1	-0.999859196	0.01068336	0.04972554	Negative
Ccng2	Mrps21	-0.999860574	0.01063095	0.04972554	Negative
Casp8	Mrpl14	-0.999863797	0.01050734	0.04972554	Negative
Scd1	Rpl15	-0.999866998	0.01038314	0.04972554	Negative
Tnfrsf1b	Ddc	-0.999868846	0.01031076	0.04972554	Negative
Dnm1l	Polr2c	-0.999869658	0.01027879	0.04972554	Negative
Glb1	Anapc4	-0.999870402	0.01024943	0.04972554	Negative
Creb1	Glb1	-0.999871255	0.01021562	0.04972554	Negative
Tab3	Acads	-0.9998765	0.01000537	0.04972554	Negative
Pik3r3	Pck1	-0.999877573	0.0099618	0.04972554	Negative
Sphk2	Sec61a2	-0.999878901	0.00990762	0.04972554	Negative
Ccng2	Pdxk	-0.999884679	0.00966836	0.04972554	Negative
Cry2	Tab3	-0.999884693	0.0096678	0.04972554	Negative
Foxo3	Kdsr	-0.99988605	0.00961073	0.04972554	Negative
Scd2	Bcat2	-0.999887911	0.00953191	0.04972554	Negative
Cul2	Gpld1	-0.999888177	0.00952063	0.04972554	Negative
Stx3	Per3	-0.999888425	0.00951005	0.04972554	Negative
Gpx7	Ccng2	-0.999889594	0.0094601	0.04972554	Negative
Gpx7	Eif2ak3	-0.999894343	0.00925439	0.04972554	Negative
Ptplb	Rpl15	-0.999894731	0.00923738	0.04972554	Negative

Moringa Oleifera leaf improves type 2 diabetes

Scd2	Rpl36	-0.999895776	0.00919142	0.04972554	Negative
Cul4b	Glb1	-0.999896772	0.00914739	0.04972554	Negative
Slc2a1	Anapc4	-0.999900792	0.00896751	0.04972554	Negative
Creb1	Slc2a1	-0.999901539	0.00893369	0.04972554	Negative
Prkx	Polr2c	-0.999905152	0.00876823	0.04972554	Negative
Hsd17b12	Aprt	-0.999908981	0.00858944	0.04972554	Negative
Bcat2	Hsd17b12	-0.999910171	0.00853308	0.04972554	Negative
Stx16	Rpl36	-0.999910967	0.00849523	0.04972554	Negative
Aqp1	Cyp3a41a	-0.999912017	0.00844496	0.04972554	Negative
Cdk1	Ndufb4	-0.999913517	0.00837265	0.04972554	Negative
Hsd17b12	Rpl36	-0.999917197	0.0081926	0.04936564	Negative
Bcat2	Stx16	-0.99991796	0.00815474	0.04934842	Negative
Rxra	Nxf1	-0.999918946	0.00810562	0.04934842	Negative
Nxf1	Per3	-0.999919066	0.00809959	0.04934842	Negative
Eif2ak3	Mrps21	-0.999919387	0.00808354	0.04934842	Negative
Amacr	Eif2ak3	-0.999921431	0.00798036	0.04934842	Negative
Cul4b	Slc2a1	-0.999923677	0.00786547	0.04934842	Negative
Elovl5	Pck1	-0.99992476	0.00780947	0.04934842	Negative
Cyp2c37	Ddc	-0.999925058	0.00779401	0.04934842	Negative
Stx2	Pigo	-0.999926156	0.00773668	0.04934842	Negative
Siah1a	Cry2	-0.99992708	0.00768811	0.04934842	Negative
Scd2	Aprt	-0.999928918	0.00759061	0.04934842	Negative
Ube2d2a	Flad1	-0.999929114	0.00758018	0.04934842	Negative
Stx2	Per1	-0.999931151	0.00747043	0.04934842	Negative
Maoa	Rplp2	-0.999932402	0.00740226	0.04934842	Negative
Cltc	Rplp2	-0.999932453	0.00739949	0.04934842	Negative
Ptplb	Rpl10	-0.999932676	0.00738724	0.04934842	Negative
Cyp2c37	Acsf5	-0.999937245	0.00713216	0.04934842	Negative
Cyp3a41a	Mrpl12	-0.999937357	0.00712582	0.04934842	Negative
Cyp2c37	Snap29	-0.99993822	0.00707655	0.04934842	Negative
Nmd3	Tnfrsf1b	-0.999939975	0.00697531	0.04934842	Negative
Scd2	Stat3	-0.999940521	0.00694351	0.04934842	Negative
Fabp2	Mrps16	-0.999942516	0.00682609	0.04934842	Negative
Cyp3a41a	Per1	-0.999943177	0.00678673	0.04934842	Negative
Gyk	Sh2b2	-0.999946015	0.00661505	0.04934842	Negative
Gpx7	Elovl6	-0.99994724	0.00653956	0.04934842	Negative
Cyp3a41a	Pigo	-0.999947548	0.00652048	0.04934842	Negative
Clock	Pdxk	-0.999948014	0.0064914	0.04934842	Negative
Stx2	Akt1	-0.999948029	0.00649051	0.04934842	Negative
Cyp4f13	Cul2	-0.999949465	0.00640022	0.04934842	Negative
Cyp2c50	Sgpl1	-0.999949545	0.00639512	0.04934842	Negative
Cyp2c37	Scd1	-0.999949651	0.00638843	0.04934842	Negative
Pnpo	Cul2	-0.99994971	0.00638463	0.04934842	Negative
Stat3	Cyp3a11	-0.999950989	0.00630292	0.04934842	Negative
Cyp4f15	Cyp3a41b	-0.999953542	0.0061366	0.04934842	Negative
Scd1	Pck1	-0.999954733	0.00605744	0.04934842	Negative
Stat3	Hsd17b12	-0.999956402	0.00594469	0.04934842	Negative
Sgpl1	Mrpl14	-0.999956677	0.00592595	0.04934842	Negative
Rxra	Ccnb2	-0.999956916	0.00590955	0.04934842	Negative
Tnfrsf1b	Fads1	-0.99995709	0.00589763	0.04934842	Negative

Moringa Oleifera leaf improves type 2 diabetes

Mrpl12	Acadl	-0.999957174	0.00589185	0.04934842	Negative
Ugcg	Acads	-0.999957533	0.00586711	0.04934842	Negative
Cyp2c37	Sar1b	-0.999961519	0.00558499	0.04934842	Negative
Cyp4a31	Acaca	-0.999963869	0.00541176	0.04934842	Negative
Smc1a	Pdxk	-0.999964147	0.00539084	0.04934842	Negative
Elovl6	Mrps21	-0.999964441	0.0053687	0.04934842	Negative
Upp2	Fabp2	-0.999965013	0.00532538	0.04934842	Negative
Amacr	Elovl6	-0.999965795	0.00526552	0.04934842	Negative
Herc1	Mrps16	-0.999968424	0.0050591	0.04934842	Negative
Ube2d2a	Sh2b2	-0.999969203	0.00499634	0.04934842	Negative
Stx2	Rpsa	-0.999972186	0.00474818	0.04934842	Negative
Arntl	Cebpb	-0.999972642	0.00470909	0.04934842	Negative
Adipor2	Rpl10	-0.999973069	0.00467219	0.04934842	Negative
Ddc	Pck1	-0.999973303	0.00465186	0.04934842	Negative
Aqp1	Acadl	-0.999974204	0.00457271	0.04921773	Negative
Sgpl1	Rpl8	-0.999974369	0.00455804	0.04921773	Negative
Smc1a	Glb1	-0.999977136	0.00430496	0.04921773	Negative
Tnfrsf1b	Pik3r3	-0.999977158	0.0043029	0.04921773	Negative
Tab1	Casp8	-0.999977421	0.00427804	0.04921773	Negative
Cyp2c50	Nfe2l2	-0.999978026	0.00422042	0.04921773	Negative
Gm5786	Tab3	-0.999978173	0.00420627	0.04921773	Negative
Cyp3a11	Rpl36	-0.999979714	0.00405501	0.04921773	Negative
Stx2	Rps7	-0.999980587	0.00396685	0.04921773	Negative
Cul2	Agpat1	-0.999980987	0.00392573	0.04921773	Negative
Flad1	Cul1	-0.999982075	0.0038118	0.04921773	Negative
Rxrb	Cd36	-0.999982524	0.00376367	0.04921773	Negative
Bcat2	Cyp3a11	-0.999982978	0.00371452	0.04921773	Negative
Cyp2c50	Cyp3a44	-0.999983358	0.00367276	0.04921773	Negative
Herc1	Upp2	-0.999984379	0.0035584	0.04921773	Negative
Cyp4f15	Cdkn1a	-0.999984877	0.00350113	0.04921773	Negative
Cul1	Rplp2	-0.999985225	0.00346072	0.04921773	Negative
9130409I23Rik	Appt	-0.999985692	0.00340553	0.04921773	Negative
Clock	Glb1	-0.999987332	0.0032044	0.048066	Negative
Acsf5	Rpl15	-0.999987856	0.00313745	0.048066	Negative
Braf	Rpl10	-0.999987894	0.0031326	0.048066	Negative
Rpl15	Snap29	-0.999988283	0.00308184	0.048066	Negative
Smc1a	Slc2a1	-0.999988726	0.00302304	0.048066	Negative
Adipor2	Rpl15	-0.999990175	0.00282205	0.04626856	Negative
Skp1a	Sh2b2	-0.999990578	0.00276355	0.04584239	Negative
Cyp2c37	Braf	-0.999990925	0.00271225	0.04557041	Negative
Herc1	Mrpl12	-0.999993702	0.00225947	0.04305209	Negative
Cyp4f13	Ikbkg	-0.999994122	0.00218274	0.04274523	Negative
Pnpo	Ikbkg	-0.999994206	0.00216715	0.04274523	Negative
Tnfrsf1b	Elovl5	-0.999994294	0.00215057	0.04274523	Negative
Rpl8	Kdsr	-0.999994389	0.00213264	0.04274523	Negative
Clock	Slc2a1	-0.99999544	0.00192248	0.04045805	Negative
Nxt2	Ndufb4	-0.99999556	0.00189704	0.04045805	Negative
Tab3	Acy1	-0.999995634	0.00188121	0.04045805	Negative
Scd2	Nfkbia	-0.99999587	0.00182967	0.04045805	Negative
Sar1b	Rpl15	-0.99999688	0.00159027	0.0380048	Negative

Moringa Oleifera leaf improves type 2 diabetes

Cyp4a31	Cdkn1a	-0.99999702	0.00155424	0.03778403	Negative
Prkdc	Sh2b2	-0.999997256	0.00149128	0.03778403	Negative
Acadl	Mrps16	-0.999997489	0.00142672	0.03778403	Negative
Acsf5	Rpl10	-0.999997956	0.00128731	0.03778403	Negative
Braf	Rpl15	-0.999997971	0.00128246	0.03778403	Negative
Ccng2	Slc2a1	-0.999998058	0.00125449	0.03778403	Negative
Rpl10	Snap29	-0.999998128	0.0012317	0.03778403	Negative
Lss	Nxf1	-0.999998249	0.00119123	0.03778403	Negative
Cyp2c37	Adipor2	-0.999998303	0.00117266	0.03778403	Negative
Cyp4a31	Cyp3a41b	-0.999998558	0.00108124	0.03778403	Negative
Herc1	Aqp1	-0.999998909	0.00094	0.03778403	Negative
Nfkbia	Hsd17b12	-0.999999148	0.000831	0.03660932	Negative
Aqp1	Fabp2	-0.999999157	0.000827	0.03660932	Negative
Ugcg	Per2	-0.999999234	0.000788	0.03660932	Negative
Kdsr	Mrpl14	-0.999999279	0.000765	0.03660932	Negative
Cdc27	Cebpb	-0.999999281	0.000764	0.03660932	Negative
Anapc4	Pdxk	-0.999999622	0.000554	0.0300238	Negative
Cul4b	Pdxk	-0.999999629	0.000548	0.0300238	Negative
Nxf1	Gm6139	-0.999999656	0.000528	0.0300238	Negative
Creb1	Pdxk	-0.999999667	0.00052	0.0300238	Negative
Fabp2	Mrpl12	-0.999999701	0.000492	0.0300238	Negative
Cyp4f15	Acaca	-0.999999843	0.000356	0.02768292	Negative
Sc4mol	Ccnb2	-0.99999986	0.000337	0.02768292	Negative
lkbkg	Agpat1	-0.999999895	0.000292	0.02742536	Negative
Sar1b	Rpl10	-0.999999917	0.00026	0.02681515	Negative
Pck1	Fads1	-0.99999993	0.000239	0.02681515	Negative
Stx2	Rplp1	-0.999999937	0.000227	0.02681515	Negative
Foxo3	Casp8	-0.999999979	0.000132	0.01859548	Negative
Flad1	Maoa	-0.999999979	0.00013	0.01859548	Negative
Cltc	Flad1	-0.99999998	0.000127	0.01859548	Negative
Upp2	Acadl	-0.999999993	0.000074	0.01738663	Negative
Glb1	Ccng2	-0.999999999	0.0000274	0.01192015	Negative