Faculty of Home Economics

Journal of Home Economics
Menoufia University, Shibin El Kom, Egypt
https://mkas.journals.ekb.eg

Menoufia University

Nutrition and Food Sciences

Tofu Mixed with Plums, Guava and Mango Juices for Amelioration of Diabetes Miletus in Male Albino Rats

Fatma El- Zahraa A. El-Sherif, Adel Abd El-Moaty Ahmed, Waheed Ahmed Ragab, and Naelaa Abd El-Kader Mostfa Kassem

Dept. of Nutrition and Food Sciences, Faculty of Home Economics , Menoufia University, Shibin El Kom, Egypt.

Abstract:

The present study was conducted to investigate the alleviation of diabetes mellitus in albino rats by using Tofu with plums, guava, mango and mix juices as 5%. This study was used (30) male albino rat, Sprague Dawley strain, their weighing (150 ±10g). They were divided into 6 groups including five rats each fed on basal diet one as a negative control, five groups injected with alloxan 150mg/kg body weight to induce diabetes, one group of them fed just on basal diet as a positive control, the other groups (5 rats each) on experimental diets containing 5% Tofu with plum, guava, mango and its mixture. At the end of the experiment (28 days) blood samples were taken, organs separated and weighted to calculate relative organs weight. Serum separated and biochemical analysis carried out. The results indicated that treating rats with a mixture of plum tofu , guava and mango increased relative body weight gain (%), decreased the relative weight of organs, and decreased serum glucose, liver enzymes, and improved kidney function and lipid profile.

Key words: Liver functions, kidney functions, lipid profile, fruit juices.

Introduction:

Tofu, also called doufu (often in Chinese recipes) or bean curd , is a food of Chinese origin, made by coagulating soy milk, and then pressing the resulting curds into blocks. The making of tofu from soy milk is similar to the technique of making cheese from milk. Wheat gluten, or seitan, in its steamed and fried forms, is often mistakenly called "tofu" in Asian or vegetarian dishes. Soybeans (Glycine max) are rich in protein (30-40%) and oil (20%) Due to shortage of meat and dairy products in many Asian countries, food uses of soybeans contribute significant protein and fat requirements to people of Asia .With the recent attention on the protective effects of soy isoflavones in cancer prevention, the benefits of eating soy are rising which may increase the popularity of soy foods. Soybeans are one of the highest sources of plant protein, containing around 40% protein, in addition to being rich inessential amino acids . They also contain35% carbohydrates, including soluble di-and oligosaccharides, 18% to 22% fat, including polyunsaturated fatty acids, tocopherols, phytosterols, phospholipids, minerals, B vitamins, and fiber .Soy foods are classified as functional foods because they contained polyphenol components, including isoflavones, glycosides and malonate conjugates, which contribute to their antioxidant activity The amount of isoflavones in soy products varies with the type of soybean, the condition and area of cultivation, and processing. Green soybeans and tempeh are good sources of isoflavones with more than 48.95 mg isoflavones per 100 g product. Tofu and soy milk contain approximately 30 to 40mg isoflavones per gram of protein . (Sipos, 1988), (Wilson,1995), (Liu,1997), (USDA, 2008), (Xiao, 2008 & Mackinnon and Rao, 2011).

Mango (Mangifera Indica L.) is the most popular fruit consumed world-wide, with over 1000 known varieties and commercial production in 87 countries .Mango contained high concentrations of phytochemicals, including gallic acid, mono galloyl glucosides, gallotannins, flavonol glycosides and benzophenone derivatives , some of which are unique to the plant and have been proposed for use in creating phytochemical rich dietary supplements .Gallic acid esters of glucose have been reported to range from one to twelve degrees of polymerization. In addition, penta-galloylglucose, a gallotanin with galloyl moieties esterified to each of the five available hydroxyls of glucose, is considered the standard for gallotannins. Since glucose has a maximum of five aliphatic hydroxyl groups, larger gallotannins are only created by gallic acid linking via a para (p)or meta (m)-depside bonds on a phenolic hydroxyl of gallic acid (Schieber et al., 2003; Tharanathan et al., 2006; and Barreto et al., 2008).

Plums are important source of compounds influencing human health and preventing the occurrence of many diseases .These are mostly consumed fresh all over the world. The processing of plums is generally relying on drying of fresh plum, canning and beverage preparation. Although sun drying was very common earlier, today plums are mostly dehydrated (Bhutani and Joshi ,1995; and Stacewicz et al., 2000).

Plums have high sugar content, to maintain the nutritional and sensory quality, dehydration to desired moisture content, sub atmospheric conditions are desirable .Plums have low calorie content and relatively high nutritive value. They contain carbohydrates, first of all sucrose, glucose and fructose, organic acids, e.g., citric and malic acids, fiber (pectin), tannins, aromatic substances and enzymes. Contents of minerals in plums

increase as fruits ripen. These substances determine nutritive value and taste of plums (Ertekina et al., 2006; and Heredia et al., 2007).
Guavas are rich in dietary fiber and vitamin C, with moderate levels of folic acid . Low in calories per typical serving, and with few essential nutrients, a single common guava (P. guajava) fruit contains 257% of the Daily Value (DV) for vitamin C. Nutrient content varies across guava cultivars. Although the strawberry guava (P. littorale var. cattleianum) has only 39% of the vitamin C in common varieties, its content in a 100-gram serving (90 mg) still provides 100% of the DV . Because of its high level of pectin, guavas are extensively used to make candies, preserves, jellies, jams, and marmalades (such as Brazilian goiabada and Colombian and Venezuelan bocadillo),and as a marmalade jam served on toast (Morton, 1987).
Diabetes mellitus is a metabolic disorder characterized by the presence of hyperglycemia due to defective insulin secretion , defective insulin action both. The chronic hyperglycemia of diabetes is associated with relatively specific long-term micro vascular complications affecting the eyes, kidneys and nerves, as well as an increased risk for cardiovascular disease (CVD). The diagnostic criteria for diabetes are based on thresholds of glycemia that are associated with micro vascular disease, especially retinopathy.“ Prediabetes ” is a practical and convenient term referring to impaired fasting glucose (IFG), impaired glucose tolerance (IGT) or a glycated hemoglobin (A1C) of 6.0% to 6.4%, each of which places individuals at high risk of developing diabetes and its complications(American Diabetes Association, 2012).

Materials and Methods

Materials

Fruits and used products: Tofu obtained from Food Technology Research Institute, Agricultural Research Centre , Giza, Egypt. Plums, guava and mango were obtained from local market in Shebin El-Kom, Menoufia, Egypt.
Rats: Thirty adult male albino rats, their weighting (150 ±10g) were obtained from Medical Insects Research Institute, Dokki, Giza, Egypt.
Chemicals: Alloxan pure chemical fine (BDH, purchased from Sigma) used for inducing diabetes in this study. Casein, all vitamins, all minerals, cellulose and starch were obtained from Technogene Co., Dokki, Giza, Egypt.

Methods

Preparation of Tofu: The fruits of plum, mango and guava were sliced separately using an electric mixer to give the juice. 5% of each juice added to the tofu and then the mixture is kept in the freezer until use.

Induction of diabetes: Diabetes was induced in normal male albino rats by intraperitoneal injection of alloxan 150mg/kg body weight, according to the method described by Desia and Bhide (1985).

One week after the injection of alloxan, fasting blood samples obtained to estimate fasting serum glucose, which should be ≥ 200mg/dl to consider diabetic rats (NDDG, 1994).

Experimental design: Rats were housed in individual stainless-steel cages under controlled environmental conditions, in the Animal House of Home Economics Faculty, Menoufia University and were fed on basal diet for a week as an adaptation period. Diet was offered to rats in special food cups to avoid loser conditions of feed, water was provided to the rats by glass tubes supported to one side of the cage, feed and water provided ad-labium and checked daily.

The rats were divided into (6) groups (5 rats each group) according to the following groups

Group (1): Negative control group fed on basal diet .

Group (2): Positive control group diabetic rats fed on basal diet.

Group (3): Diabetic group treated with 5% plums juice with tofu.

Group (4): Diabetic group treated with 5% guava juice with tofu.

Group (5): Diabetic group treated with 5% mango juice with tofu.

Group (6): Diabetic group treated with 5% mixture of plum, guava and mango juices with tofu.

Biological evaluation: During the experimental period, the diet consumed was recorded every day and body weight was recorded every week. The body weight gain (BWG), feed efficiency ratio (FER), and relative organs weight were determined according to Chapman et al.(1959).

Blood sampling and organs: Blood samples were collected after 12 hours fasting at the end of the experiment using the abdominal aorta in which the rats were scarified under ether anesthetized. Blood samples were received into clean dry centrifuge tubes and left to clot at room temperature, then centrifuged for 10 minutes at 3000 rpm to separate the serum. Serum was carefully, transferred into clean cuvette tubes, and stored frozen at-20oCfor analysis (Malhotra, 2003). serum samples were analyzed for determination.

Serum glutamate oxaloacetate transaminase S.GOT was determined as Unit/L according to Yound (1975), S.GPT was determined as Unit/L according to Yound (1975), serum alkaline phosphatase (ALP) was determined U/L according to (IFCC, 1983),total cholesterol was determined according to Allain (1974), enzymatic colorimetric determination of triglycerides was carried out according to Fossati and Prencipe (1982),determination of HDL was carried out according to the method of Lopez (1977), determination of LDL and VLDL was carried out according to the method of Lee and Nieman (1996), urea determination was according to the enzymatic method of Malhotra

(2003),uric acid determination was according to the enzymatic colorimetric test of Barham and Trinder (1972), creatinine was measured using the modified kinetic method according to Henry (1974).At the same time, the organs: Heart, kidney, liver, lungs and spleen were removed, washed in saline solution, wiped by filter paper and weighted according to Drury and Wallington,(1980).

Calculation of atherogenic index (A.I): This index was calculated as the VLDL+ LDL cholesterol / HDL ratio according to the formula of Kikuchi et al .(1998).

Statical analysis: The data were statistically analyzed using a computerized COSTAT program by one-way ANOVA. The results are presented as mean ± SD. Differences between treatments at ($P \leq 0.05$) were considered significant (SAS, 1985).

Results and Discussion

The effect of 5% tofu with different juices on body weight gain, feed intake and feed efficiency ratio presented in table 1. Table (1) showed the mean values of body weight gain (g/day) of diabetic rats fed on various diets. It could be noticed that the mean value of BWG (g/day) of negative control (-) group was higher than positive control (+) group, which being 2.35±0.01 and 1.13±0.02g respectively, with significant difference at percent of increase +107.96 % of control (-) group when compared to control (+) group. The values were 1.87±0.14, 1.76±0.07, 2.2±0.1 and 2.38±0.02g for groups Tofu plums juice, guava juice, mango juice and mix juice fruit respectively. The percent of increases were from (+55.75% to +110.61%) for all groups. All treatments fed on various diet revealed significant differences as compared to control (+) group. Rats fed on groups (3 and 4) showed nonsignificant differences in mean values . There are nonsignificant differences between group (1 and 6). The best treatment was recorded for group 6 (rats fed on 5% Tofu +% 5 mix juice fruit).

Table (1) indicated the mean values of feed intake (g/28day) of diabetic rats fed on variable diets. The results showed that the mean value of FI of control (-) group was higher than control (+) group, which were 31.2±0.2 and 21.5±0.5 (g / 28 rat) respectively with a percent of increase + 45.12 % for control (-) group when compared to control (+) group. All treatments fed on various diet revealed significant increases as compared to control (+) group. The percent of increases from (+6.09% to + 47.54%) for all groups. The best FI was recorded for group 6 (Tofu 5% with mix fruits juices at the level 5%) when compared to control (+) group.

Table (1) illustrated the mean values of FER for diabetic rats fed on different diets. The mean value of FER of control (-) group was higher than control (+) group, being 0.075±0.001 and 0.053±0.001 respectively, showing significant difference with percent of increase +45.1 % of control (-) group when compared to control (+) group. All treatments fed on various diet revealed significant increases as compared to control (+)

group. The percent of increases were from + 7.55% to + 41.51% for all groups. Group (3) (5 % Tofu with Plum juice) showed the nearest value to control (+) and recorded the worst treatment followed by G (4) (5 %Tofu with guava juice) group. Rats fed on group (6) and healthy rats showed nonsignificant differences in mean values and recorded the best FER (5% Tofu with mix fruits). The obtained results of table (1) are in the same line with Bhathena and Velasquez (2002) .
Manuel and Bhathena (2007) concluded that an increasing body of evidence from nutritional intervention studies in animals and humans indicates that dietary soy protein has beneficial effects on obesity. Consumption of soy protein can favorably affect satiety and reduce excess body fat in obese animals and humans. Soy protein ingestion also improves insulin resistance, the hallmark of obesity. Dietary soy protein and some of its constituents also reduce plasma lipids and fat accumulation in liver and adipose tissue, which may reduce the risks of atherosclerosis and lipotoxicity and possibly other obesity-related complications. Several potential mechanisms whereby soy protein or its constituents may improve insulin resistance lower body fat and blood lipids .

Table (1): Effect of 5%Tofu with plums, guava, mango and mix juices on BWG, FI and FER of diabetic rats(mean ± L.S.D)

Groups	BWG (g/day)	FI (g/ 28 day)	FER
G (1) Negative control group	2.35a±0.01	31. 2ab±0.20	0.075a±0.001
G (2) Positive control group	1.13d±0.02	21.5e±0. 50	0.053e±0.001
G(3) Rats fed on 5% tofu with5% Plums	1.87c±0.14	22.81d±0.10	0.057d±0.001
G (4) Rats fed on 5% tofu with 5% guava	1.76c±0.07	29.33c±0.77	0.061c±0.001
G(5) Rats fed on 5% tofu with 5%mango	2.2b±0.1	30.36b±0.74	0.072b±0.001
G(6) Rats fed on 5% tofu with 5%fruits mixture	2.38a±0.02	31.72 a±0.28	0.075a±0.001
L.S.D	0.15	0.92	0.001

Means in the same row with different letters are significantly different and vice versa. Significance at P≤0.05.

Table (2) showed the mean value of relative weight of liver (%) of diabetic rats fed on various diets. It could be noticed that the mean value of liver (%) of control (-) group was lower than control (+) group, being 4.1±0.10 and 4.6±0.02 respectively, showing significant difference with percent of decreasing -10.87% of control (-) group as compared to control (+) group. All treatments fed on various diet indicated significant decreasing as compared to control (+) group. The percent of decreasing were from -2.17 to -13.25% for all groups. Rats fed on diet groups (5 and 6) showed nonsignificant differences between them. Numerically group 6 revealed better treatment for relative weight of liver (%) than the other groups.

Table (2) indicated the mean value relative heart weight of diabetic rats fed on various diets. It could be noticed that the mean value of relative heart (%) of control (-) group was lower than control (+) group, which being 0.46±0.02 and 0.73±0.01% respectively, showing significant difference with percent of decreased -36. 98 %of control (-) group as compared to control (+) group. All diabetic rats fed on different diets showed significant differences in mean values as compared to control (+) group. The percent of decreases were from -19.18% to -54.80 % for all groups. Group (4) similar to healthy rats and revealed nonsignificant difference between them. The best heart relative weight was recorded for group 6 (5% Tofu with mix fruits 5%) when compared to control (+) group.

Data in the same table showed the mean value relative lungs weight of diabetic rats fed on various diets. It could be noticed that the mean value of relative lungs (%) of control (-) group was lower than control (+) group, which being 0.56±0.01 and 0.95±0.02 respectively, showing significant difference with percent of decreased -40.05 % of control (-) as compared to control (+) group. All diabetic rats fed on different diets showed significant differences in mean values as compared to control (+) group. The values of the treated groups being from 0.80±0.02 to 0.56±0.005. Rats fed on groups (1, 5) showed nonsignificant differences between them. Group (6) recorded the superior group for relative lungs weight.

The mean value of relative spleen weight for diabetic rats fed on various diets. It could be noticed that the mean value of spleen (%) of control (-) group was lower than control (+) group, which being 0.44 ±0.01 and 0.67±0.02 respectively, showing significant difference with percent of decrease -34.33 % of control (-) as compared to control (+) group. All diabetic rats fed on different treatment revealed significant differences in mean values as compared to control (+) group. The percent of decreases were from -47.76% to -37.31% for all groups. Groups 3 and 4 indicated nonsignificant differences between them. Rats fed on basal diet with Tofu and 5% mix juices revealed the best group and resemble healthy rats.

The mean value of relative kidneys weight for diabetic rats fed on various diets. It could be noticed that the mean value of kidneys (%) of control (-) group was lower than control (+) group, which being 1.1±0.1 and 1.6±0.03 respectively, showing significant difference with percent of increase 31.25 % of control (-) as compared to control (+) group. All diabetes rats fed on different diets revealed significant decreases in mean values as compared to control (+) group. The values of the treated groups from 1.4±0.01 to 1.18±0.01%. Rats fed on groups (5 and 6) showed nonsignificant differences between them. Numerically group (6) recorded the best treatment followed by group 5 and Tofu with guava juice.

Table (2): Effect of 5% Tofu with plums, guava, mango and mix fruits juice on relative liver, heart, lungs, spleen and kidneys weight of diabetic rats.

Groups	Liver (%)	Heart (%)	Lungs (%)	Spleen (%)	kidneys(%)
G(1)Negative control group	4.1a±0.10	0.46c±0.02	0.56d±0.01	0.44b±0.01	1.1e±0.1
G (2) Positive control group	4.6b±0.02	0.73a±0.01	0.95a±0.02	0.67a±0.02	1.6a±0.03
G(3) Rats fed on 5% tofu with 5% Plums	4.5c±0.02	0.59b±0.01	0.80b±0.02	0.36d±0.01	1.4b±0.01
G (4) Rats fed on 5% tofu with 5% guava	4.3d±0.03	0.46c±0.01	0.64c±0.01	0.35d±0.01	1.3c±0.02
G(5) Rats fed on 5% tofu with 5%mango	4.1e±0.02	0.40d±0.02	0.56d±0.005	0.35d±0.01	1.2d±0.01
G(6) Rats fed on 5% tofu with 5%fruits mixture	3.99e±0.09	0.33e±0.019	0.54e±0.019	0.42b±0.008	1.18d±0.01
L.S.D	0.069	0.009	0.011	0.028	0.069

Means in the same row with different letters are significantly different and vice versa. Significance at ($p \leq 0.05$).

Table (3) revealed the mean value of serum glucose (mg/dl) of diabetes rats fed on different diets. It could be noticed that the mean value of control (-) group was lower than control (+) group, being 115.33±1.04 and 229.00±1.00 respectively, which showing significant difference and percent of increase +178.64% of control (-) as compared to control (+) group. All diabetic rats fed on different diets indicate significant decreases in mean values as compared to control (+) group. The values were 200.00±1.00, 195.68±0.40, 184.48± 0.50, and 181.60±0.35 mg/dl for groups 3, 4, 5 and 6 respectively. The best serum glucose was observed for group 6 (5%Tofu with mix juices) when compared to control (-) group.

The obtained results of table (3) are in the same line with that published by Bhathena and Velasquez (2002) who reported legumes, especially soybeans, have a very low glycemic index and are valuable foods to include in a diabetic diet. Regular consumption of soy protein may help to reduce symptoms associated with Type 2 Diabetes. Soy has been shown to decrease postprandial hyperglycemia, improve glucose tolerance and decrease amounts of glycosylated hemoglobin.

Nagasawa et al. (2002) found that glucose levels were also decreased by tofu diet and reported that plasma glucose levels in mice on a soy protein isolate diet were still lower than those treated with an isocaloric casein-protein-diet. Orsolya et al.(2003) stated that soy isoflavones improve and produce an antidiabetic effect and activate peroxisome-proliferator activated receptors PPAR receptors in rats. Dae et al.(2010) suggested that the ingestion of soy protein with isoflavones improves glucose control and reduces insulin resistance. Korean fermented soybean products such as doenjang, kochujang, and chungkookjang contain alterations in the structures and content of isoflavonoids and small bioactive peptides, which are produced during fermentation. Several studies revealed improvements in insulin resistance and insulin secretion with the consumption of these fermented products. Therefore, fermented soybean products may help prevent or attenuate the progression of type 2 diabetes. Mona et al. (2014) reported that soy isoflavone-containing diets have been reported to be beneficial in diabetes rats. Mohamed et al. (2020) concluded that administration of FSM to HFFD-rats inhibited intestinal and pancreas α-amylase activity by 26 and 31% as compared to untreated HFFD-rats, and consequently decrease of blood glucose by 36%.

Cheng and Yang (1983) suggested that guava may be employed to improve and/or prevent the disease of diabetes mellitus in alloxan-treated diabetic mice. Kumari et al.(2016) reported that guava fruit without peel is more effective in lowering blood sugar in human subjects.

Hiroshi et al.(2005) found that plum treatment for 2 weeks in obese Wistar fatty rats reduced areas under the curve (AUCs) for glucose and insulin during a glucose tolerance test. In db/db mice, plum decreased these AUCs, and also blood glucose during an insulin tolerance test.

Perpétuo and Salgado (2003) stated that the diabetic animals eating diets containing 5, 10 and 15% mango flour during the 30-day study showed a significant decrease ($p < 0.05$) in blood glucose level in comparison to the diabetic controls eating a diet containing 0% mango. In the second study, diets with 0 and 5% mango flour were fed to diabetic rats to see if the 5% mango diet would still reduce blood glucose over a longer period. The blood glucose level of the rats consuming mango at the end of ninety days was 66% lower than that in the controls.

The effect of 5%Tofu with plums, guava, mango and mix fruits juices on total cholesterol (T.C), triglyceride (T.G), high density lipoprotein cholesterol (HDL-c), low density lipoprotein cholesterol (LDL-c) and very low-density lipoprotein cholesterol (VLDL-c).

Data of table (4) illustrated the mean value of serum (TC) (mg/dl) of diabetic rats fed on different diets. It could be observed that the mean value of (TC) of control (-) group was lower than control (+) group, being 130.00±1.00& 160.00±2.00 mg/dl respectively, which showing significant difference with percent of decrease - 18.75 % when compared to control (+) group. All diabetic rats fed on different diets revealed significant decreases in mean values as compared to control (+) group. The highest value was 151.28±0.28 mg/dl recorded for group (3) followed by groups (4 and 5) 144.99±0.41 and 144.38±0.25mg/dl which showed nonsignificant differences between them. Group 6 (5% Tofu with mix fruits) revealed the lower mean value, which being 142.00±1.00mg/dl and showed better level of serum (TC) when compared to control (+) group.

Table (3): Effect of 5% Tofu with plums, guava, mango and mix fruits juice on serum glucose (mg/dl) of diabetic rats

Variables	G (1) Negative control group	G (2) Positive control group	G(3) Rats fed on 5% tofu with 5% Plums	G (4) Rats fed on 5% tofu with 5% guava	G(5) Rats fed on 5% tofu with 5% mango	G(6) Rats fed on 5% tofu with 5% fruits mixture	LSD
Glucose (mg/dL)	115.3f±1.04	229.0a±1.00	200.0b±1.0	195.7c±0.40	184.5d±0.5	181.6e±0.35	1.36

Means in the same row with different letters are significantly different and vice versa. Significance at(p≤0.05).

Table (4) showed the mean value of serum (TG) (mg/dl) of diabetic rats fed on different diets. It could be observed that the mean value of (TG) of control (-) group was higher than control (+) group, being 45.53±0.25 and 156.00±1.00 mg/dl respectively ,which indicating significant difference with percent of decrease -70.81 % of control (-)group when compared to control (+) group. All diabetic rats fed on different diets revealed significant decreases in mean values as compared to control (+) group. The percent of decreases were from -48.55% to - 67.57% for all groups. The best serum (TG) was recorded for group 6 (5%Tofu with Mix fruits) compared to control (+) group.

It could be observed that the mean value of (VLDL.c) of control (-) group was recorded 9.11± 0.20 and lower than control (+) group, being 32.20±1.00 (Table 4), showing significant difference with percent of decrease -70.80 % of control (-) when compared to control (+) group. All diabetic rats fed on different diets revealed significant decreases in mean values as compared to control (+) group. The values were from 16.05±0.10 to 10.12±0.03 mg/dl for all groups. The superior treatment was recorded for group 6(5% Tofu with mix fruits) considering serum (VLDL-c).

Table (4): Effect of 5% Tofu with plums, guava, mango and mix fruits juice on TC, TG and VLDL (mg/dl) of diabetic rats

Group	TC (mg/dl)	TG (mg/dl)	VLDL(mg/dl)
G (1) Negative control group	130.00e±1.00	45.53f±0.25	9.11f±0.20
G (2) Positive control group	160.00a±2.00	156.00a±1.00	31.20a±1.00
G(3)Rats fed on 5% tofu with 5% Plums	151.28b±0.28	80.26b±0. 25	16.05b±0.10
G (4)Rats fed on 5% tofu with 5% guava	144.99c±0.41	59.40c±0.69	11.88c±0.19
G(5)Rats fed on 5% tofu with 5%mango	144.38c±0.25	54.5d±0. 5	10.90d±0.11
G(6)Rats fed on 5% tofu with 5%fruits mixture	142.00d±1.00	50.59e±0.19	10.12e±0.03
L.S.D	1.88	0.83	0.72

Means in the same row with different letters are significantly different and vice versa. Significance at($p \leq 0.05$).

Data of table (5) indicated the mean value of serum (HDL-c) (mg/dl) of diabetic rats fed on different diets. It could be observed that the mean value of (HDL- c) of control (-) group was higher than control (+) group, being 65.50±0.50 and 31.01±0.21 (mg/dl) respectively, showing significant difference with percent of increase +111.22% for control (-) when compared to control (+) group. All diabetic rat fed on various treatment indicated significant differences when compared to control (+) group. The mean values of rats fed on groups (3and4) 52.60±0.40 and 55.02±0.31 mg/dl showed nonsignificant differences between them .Also rats fed on groups (4 and 6) indicating values 59.83±0.21 and 57.30±0.39 (mg/dl) showed nonsignificant differences between them . Numerically the superior treatment was recorded for groups 5(5%Tofu with mango) as compared to control (+) group.

Data in the same table (5) illustrated the mean value of serum (LDL -c) (mg/dl) of diabetic rats fed on different diets. It could be observed that the mean value of (LDL -c) of control (-) group was lower than control (+) group, being 55.39± 0.39 and 97.79±0.50 respectively, which showing significant difference with percent of decrease -42.90% when compared to control (+) group. All diabetic rats fed on different diets revealed significant decreases in mean values as compared to control (+) group. The percent of decreases were from -15.50 % to -24.69% for all groups. Rats fed on group 5 (5%Tofu with mango fruits) recorded the best serum LDL -c.

The mean value of AI of control (-) group was lower than control (+) group, which being 0.99± 0.015 and 4.16±0.02 respectively and showing significant difference with percent of decrease -76.55% when compared to control (+) group (Table 5). All diabetic rats fed on different diets showed significant decreases in mean values as compared to control (+) group. The highest values were recorded to Tofu with plums followed by tofu with guava and tofu with mango as compared to group control (+) .Rats fed on groups (5 and 6) & (4 and 5) showed nonsignificant differences between them. The nearest treatment to the healthy rats revealed to group 5 and indicated the best group.

The results of tables (4 and 5) are in parallel with that obtained by Nilavsen and Meinertz(1998); Potter et al. (1998); Merritt (2004); Zhuo et al., (2004); Harlanda & Haffnerb (2008); Taku et al. (2008). for diabetic rats. Also, many authors confirmed data of present work. It is well established that soy protein consumption reduces serum total cholesterol, LDL cholesterol, and triglycerides as well as hepatic cholesterol and triglycerides. Studies in animals indicate that soy protein ingestion exerted its lipid-lowering effect by reducing intestinal cholesterol absorption and increasing fecal bile acid excretion, thereby reducing hepatic cholesterol content and enhancing removal of LDL (Greaves et al. 2000) ; Wright and Salter(1998)

Additional support for an effect of soy protein on LDL receptor activity was provided by Kikuchi et al. (1998) in their studies using the LDL-receptor deficient (LDLr-null) mouse. In the study, significant reduction in plasma concentrations of total cholesterol, LDL-c, and VLDL-c were observed in C57BL/6J (wild type) mice fed soy protein isolate. By contrast, no significant effect of the soy protein isolate on plasma lipids was observed in LDLr-null mice, suggesting that soy isoflavones might reduce lipid levels by increasing LDL receptor activity. Earlier work in humans with normal and elevated serum cholesterol has also shown that dietary soy protein reduces insulin/glucagon ratio, which may contribute to the hypocholesterolemic effect of soy protein Oddrun et al. (2006) have shown that feeding obese Zucker rats with soy protein concentrate enriched with isoflavones (HDI) for 6 weeks reduced fatty liver and decreased the plasma levels of alanine transaminase and aspartate transaminase.

Bruckert and Rosenbaum (2011) reported that LDL-cholesterol reduction ranging from 3 to 10% for soy protein and have indicated that dietary recommendations may have important impacts on cardiovascular events as they can be implemented early in life and because the sum of the effect on LDL-cholesterol is far from being negligible.

Orsolya et al.(2003) suggested that soy isoflavones improve lipid metabolism, produce an antidiabetic effect, and activate Peroxisome-proliferator activated receptors (PPAR).

Preeti et al.(2017) reported that consumption of plums prevents macular degeneration, heart diseases and also damage to neurons and fats that form a part of cell membranes.

Kumari et al. (2016) found that serum total cholesterol, triglycerides and low-density lipoprotein cholesterol (LDL-c) levels decreased significantly ($p<0.05$) indicating that guava pulp without peel may have a favorable effect on lipid levels.

Subhasis et al. (2019) reported that mango possessed hypolipidemic effect in diabetic rats. Formula suggested in present work were not found in previous study.

Table (5): Effect of 5%Tofu with plums, guava, mango and mix fruits juice on HDL-c, LDL-c and AI (mg/dl) of diabetic rats

Group	HDL(mg/dl)	LDL (mg/dl)	AI (mg/dl)
G (1) Negative control group	65.5a±0. 50	55.39f±0.39	0.99e±0.015
G (2) Positive control group	31.01d±0.21	97.79a±0.50	4.16a±0.02
G(3)Rats fed on 5% tofu with 5% Plums	52.6c±0. 40	82.63b±0.19	1.88b±0.16
G (4)Rats fed on 5% tofu with 5% guava	55.0bc±0.31	78.09c±0.30	1.64c±0.02
G(5)Rats fed on 5% tofu with 5%mango	59.83b±0.21	73.65e±0.17	1.41cd±0.01
G(6)Rats fed on 5% tofu with 5%fruits mixture	57.3bc±0.39	74.58d±0.09	1.48c±0.02
L.S.D	4.54	0.54	0.13

Means in the same row with different letters are significantly different and vice versa. Significance at($p \leq 0.05$).

Data of table (6) showed the mean value of serum (GOT) (U/L)of diabetes rats fed on different diets . It could be observed that the mean value of (GOT) of control (-) group was lower than control (+) group , being 64.00±0.29 and 78.01±0.39U/L respectively ,which showing significant difference with percent of decrease - 17.95 % of control(-) when compared to control (+) group .All treatments indicated significant differences when compared to control (+) group. The values were from 73.00±0.20 to 66.00±0.33 for all groups the best treatment was observed for group 6 (5%Tofu with mix fruits) when compared to control (+) group considering (GOT) activity.

The mean value of (GPT) of control (-) group was 26.22±0.11and lower than control (+) group, being 39.51±0.19 U/L (Table 6), showing significant difference with percent of decrease -33.63 % of control (-) group when compared to control (+) group. All the groups showed significant differences as compared to control (+) group. The percent of decreases were from -8.09% to -34.19% for all groups. Rats fed on groups (1 and 6) showed nonsignificant differences between each other. The best treatment was observed for group 6(5% Tofu with mix fruits) when compared to control (+) group considering (GPT) activity and similar to healthy rats.

It could be noticed that the mean value of (ALP) of control (-) group was lower than control (+) group, being 20.05±0.05 and 24.89±0.11 U/L respectively (Table 6) showing significant difference with percent of decrease -55.66 % when compared to control (+) group. All diabetic rats fed on different diets revealed significant decreases in mean values as compared to control (+) group. The values were from 21.41±0.49 to 23.35±0.05 for all groups. The better group was recorded for treatment 3 (5% Tofu by 5% with plums) when compared to control (+) group.

The obtained results of table (6) are in parallel with that obtained by Ndatsu et al. (2013) who evaluated the antioxidant and hepatoprotective properties of tofu using acetaminophen to induce liver damage in albino rats. Rats fed with various tofu and acetaminophen had their serum ALP, ALT, AST levels significantly ($P \leq 0.05$) reduced, and total protein and albumin concentrations increased when compared with basal diet and acetaminophen administered group. Therefore, all tofu curdled with various coagulants could be used to prevent liver damage caused by oxidative stress. Duong et al.(2016) reported that Silk tofu made from germinated soybeans expressed higher hepatoprotective activity as compared to silk tofu made from nongeminated soybeans in mice.

Table (6): Effect of 5%Tofu with plums, guava, mango and mix fruits juice on GOT, GPT and ALP (U/L) of diabetic rats

Group	GOT (U/L)	GPT(U/L)	ALP(U/L)
G (1) Negative control group	64.00f±0.29	26.22e±0.11	20.05f±0.05
G (2) Positive control group	78.01a±0.39	39.51a±0.19	24.89a±0.11
G(3)Rats fed on 5% tofu with 5% Plums	73.00b±0.20	36.31b±0.20	21.41e±0.49
G (4)Rats fed on 5% tofu with 5% guava	70.26c±0.25	34.11c±0.11	23.35b±0.05
G(5)Rats fed on 5% tofu with 5%mango	69.61d±0.20	28.50d±0.20	22.83c±0.17
G(6)Rats fed on 5% tofu with 5%fruits mixture	66.00e±0.33	26.00e±0.22	21.90d±0.11
L.S.D	0.14	0.35	0.39

Means in the same row with different letters are significantly different and vice versa. Significance at($p \leq 0.05$).

Álvaro Fernández et al.(2019) suggested that a mango-supplemented diet exerted a significant antioxidant effect in the liver of diabetic rats, likely due to its phenolic compounds, like mangiferin and its metabolites. Subhasis et al. (2019) reported that mango possesses hepatoprotective effect studied for diabetic rats.
Data of table (7) illustrate the mean value of serum urea (mg/dl) of diabetic rats fed on various diets .It could be noticed that the mean value of urea of control (-) group was lower than control (+) group ,being 49.50±0.50 and 88.50±0.29 mg/dl respectively, indicating significant difference with percent of decrease -44.07% when compared to control (+) group .All diabetic rats fed on different diets revealed significant decreases in mean values as compared to control (+) group . The percent of decreases were from -7.79 % to -45.41% for all above mentioned groups. The best treatment was recorded for group 6 (5%Tofu with mix fruits juice) when compared to control (+) group .

The mean value of creatinine of control (-) group was 0.89±0.02 and lower than control (+) group , being 1.08±0.01 mg\dl, showing significant difference with percent of decrease -17.59% of control(-)group when compared to control (+) group(Table 7) . All diabetes rats fed on different diets revealed significant decreases in mean values as compared to control (+) group .The values were from 0.97±0.06 to 0.80±0.01 mg/dl for all groups. Rats fed on groups (4 and 5)showed nonsignificant differences between them . The superior treatment was recorded for group 6 (5%Tofu with mix fruits juice) when compared to control (+) group.

The mean value of uric acid of control (-) group was 2.95±0.02 and lower than control (+) group , being 4.65±0.05 mg/dl, which showing significant difference with percent of decrease -36.56% of control(-)group when compared to control (+) group(Table 7). All diabetes rats fed on different diets revealed significant decreases in mean values as compared to control (+) group . The percent of decreases were from -11.39% to -38.49% for all groups . Rats fed on groups 6 (5% Tofu with mix fruits) similar to healthy rats and showed nonsignificant differences between them and recorded the better group when compared to control (+) group.

The data of Table (7) are in agreement with that obtained by Nakamura et al.(1989) for diabetic rats. Also Kopple (1989) reported that protein intake produced a smaller increase in the GFR than did red meat intake Zeller(1991).

Kontessis et al. (1990) showed that soy-protein intake over 3 week was associated with lower renal plasma flow, GFR, and fractional clearance of albumin. Meat intake produced a vasodilatory response that increased renal plasma flow and GFR while decreasing renal vascular resistance; soy-protein intake, however, did not significantly alter these variables. The plasma concentration of amino acids did not differ, suggesting that other mechanisms mediated these differences. Soy isoflavones may contribute to this difference. Glucagon and prostaglandin concentrations increased after ingestion of meat but not soy.

Marion et al. (2010) suggested that soy protein can slow renal disease progression by decreasing plasma cholesterol and proteinuria in patients with nephropathies.

Nancy et al. (2016) and Mahmoud et al. (2017) reported that soybeans supply high-quality plant protein and exclusive isoflavones (genistein and daidzein). Soy protein contains a unique amino acid profile that is different from animal and soy peptides including 4 to 20 amino acids which may have been very worthy effects on high BP (blood pressure) and hyperlipidemia; therefore, soy peptides may affect renal function. In the animal, it seems to be well established the ability of soy protein to reduce proteinuria and consequently, to lower the progression of renal disease. Soy protein consumption has been shown to slow the decline in estimated glomerular filtration rate and significantly improve proteinuria in diabetic and non-diabetic patients with nephropathy. Soy's beneficial effects on renal function may also result from its impact on certain physiological risk factors for CKD such as dyslipidemia, hypertension and hyperglycemia. Soy intake is also associated with improvements in antioxidant status and systemic inflammation in early and late-stage CKD patients.

Table (7): Effect of 5% Tofu with plums, guava, mango and mix fruits juice on serum urea, creatinine and uric acid (mg/dl) of diabetic rats

Group	Urea (mg/dl)	Creatinine (mg/dl)	Uric Acid (mg/dl)
G (1) Negative control group	49.50e±0.50	0.89c±0.02	2.95 e±0.02
G (2) Positive control group	88.50a±0.29	1.08a±0.01	4.65a±0.05
G(3)Rats fed on 5% tofu with 5% Plums	81.60b±0.20	0.97b±0.06	4.12b±0.26
G (4)Rats fed on 5% tofu with 5% guava	74.99c±0.32	0.86cd±0.01	3.60 d±0.19
G(5)Rats fed on 5% tofu with 5%mango	71.51d±0.38	0.86cd±0.01	3.89c±0.11
G(6)Rats fed on 5% tofu with 5%fruits mixture	48.31f±0.19	0.80d±0.01	2.86 e±0.01
L.S.D	0.55	0.058	0.022

Means in the same row with different letters are significantly different and vice versa. Significance at($p \leq 0.05$).

References:

Allain, C.C. (1974): Determination of serum total cholesterol: Clin. Chem, (20): 470.

Álvaro Fernández, O.;Rosario Cazares, C.;IsabelBorrás, L.J. and Abraham D. A. (2019): "Evaluation of metabolic changes in liver and serum of streptozotocin-induced diabetic rats after Mango diet supplementation." Journal of Functional Foods, Volume 64, 103695.

American Diabetes Association. (2012) : Diagnosis and classification of Diabetes mellitus. Diabetes Care;35(suppl 1):S64e71.

Barham, D. and Trinder, P. (1972): Determination of uric acid. Analyst, 97:142.

Barreto ,J.C.; Trevisan ,M.T.; Hull W.E., Erben ,G.; de Brito, E.S.; Pfundstein, B.; Würtele, G.; Spiegelhalder ,B. and Owen, R.W.(2008): Characterization and quantitation of polyphenolic compounds in bark, kernel, leaves, and peel of mango (Mangifera indica L.). Journal of agricultural and Food Chemistry, 56(14):5599-5610.

Bhathena, S. J. and Velasquez, M. T. (2002):Beneficial role of dietary phytoestrogens in obesity and diabetes." Am J Clin Nutr.;76(6):1191-201.

Bhutani, V. P. and Joshi, V. K. (1995): Plum, In Fruit Science and Technology, Production, Composition, Storage and processing. Marcel Dekker, Inc, New York, pp: 203-241.

Bruckert, E. and Rosenbaum, D. (2011): Lowering LDL-cholesterol through diet: Potential role in the statin era. Current Opinion in Lipidology, 22(1); 48-64.

Chapman, D.G.; Castilla , R. and Champbell, J.A . (1959):Evaluation of protein in food I.A. Method for the determination of protein efficiency ratio. Can . J., Biochemistry Physiology , 37 :679-686.

Cheng J. T. and Yang R. S.(1983): Hypoglycemic effect of guava juice in mice and human subjects. Am J. Chin Med ;11(1-4):74-6.

Dae ,Y. K.;James, W. D. ;Hyun J. K. and Sunmin P.(2010): Antidiabetic effects of fermented soybean products on type 2 diabetes. Nutrition Research ,30(1):1-13 .

Desai, A. and Bhide , M . (1985) : Hypoglycemic effect of Hanitonia suavecolens. Indian. J .Med ., 81:86-91 .

Drury, R.A . and Wallington , E.A.(1980) : Carltons Histological Technique . 5th Ed ., Oxford University.

Duong, T. P. L. ;Cao, T. K. H.; Nguyen, T. H.;Duong, X. C.; Phan ,T. B. T. and Ha, T. T.(2016):" Hepatoprotective Effect Of Tofu Processed From Germinated Soybean On Carbon Tetrachloride Induced Chronic Liver Injury In Mice. Journal of food and Health science .3(1):1-11.

Ertekina, C.; Gozlekcib, S.; Kabasa, O.; Sonmezc, S. and Akinci I. (2006): Some physical, pomological and nutritional properties of two plum (Prunus domestica L.) cultivars. Journal of Food Engineering ,75: 508-514.

Fossati, P. and Prencipe, L. (1982): Determination of serum triglycerides: Clin. Chem, 28:2077-2080.

Greaves , K . A. ; Wilson , M. D. ; Rudel , L .L . ; Williams , J. K. and Wagner , J. D. (2000): Consumption of soy protein reduces cholesterol absorption compared to casein protein alone or supplemented with an isoflavone extract or conjugated equine estrogen in ovariectomized cynomolgus monkeys. J. Nutr. 130(4):820-6.

Harlanda, J. I. and Haffnerb, T.A. (2008): Systematic review, meta-analysis and regression of randomised controlled trials reporting an association between an intake of circa 25g soy protein per day and blood cholesterol. Atherosclerosis,: 13-27.

Henry, R. J. (1974): Clinical Chemistry Principles and Techniques. 2nd Ed., Harper and Publishers, New York. Philadelphia.

Heredia, A.; Barrera, C. and Andrés A. (2007): Drying of cherry tomato by combination of different dehydration techniques. Comparison of kinetics and other related properties. Journal of Food Engineering, 80: 111-118.

Hiroshi,U.; Tadashi ,Y.;Junzo,K. and Kazuaki ,K.(2005): Anti-hyperglycemic effects of plum in a rat model of obesity and type 2 diabetes Wistar fatty rat. Biomedical Research, 26(5):193-200.

IFCC. (1983): Methods for measurement of catalytic concentration of enzymes, parts 5: IFCC methods for alkaline hosphatase. J. Clin. Chem. Clin Biochem., 21:731-748.

Kikuchi , H.;Onodera, N.; Matubara, S.;Yasudo ,E.;Chanon,O.; Takahashi,R. and Ishikawa, F . (1998): Effect of soy milk on lipid metabolism in aged ovariectomized rats. Bioscience Biotechnology and biochemistry,62(9):1688.

Kontessis, P.; Jones ,S.L. and Dodds R. (1990):" Renal, metabolic and hormonal responses to ingestion of animal and vegetable proteins. KidneyInt.,38:136–44.

Kopple, J.D.(1989): Nutrition and metabolism in renal disease. Fifth International Congress on Renal Nutrition and Metabolism. New York: Spainger International.

Kumari ,S.;Rakavi ,R. and Mangaraj, M.(2016): Effect of guava in blood glucose and lipid profile in healthy human subjects: A Randomized Controlled Study. Journal of Clinical and Diagnostic Research :JCDR, 10(9):BC04- BC07.

Lee, R. and Nieman, D. (1996): Nutritional Assessment. 2nd Ed., Mosby, Missouri, USA.

Liu, K.S. (1997):Chemistry and nutritional value of soybean components. In: Soybeans: Chemistry, Technology and Utilization.Gaithersburg: Aspen Publication, Inc. P. 25-113.

Lopez, M.F. (1977): Determination of serum high density lipoprotein cholesterol. Clin. Chem., (23): 882.

Mackinnon , E.S. and Rao, L.G.(2011):"Traditional chinese functional foods". In: Shi J, Ho CT and Shahidi F. Functional Foods of the East. Boca Raton: CRC Press. p 277-96.

Mahmoud,R.;Sara, B.; Hamid ,N. and Marzieh K. (2017):Soy Protein and Chronic Kidney Disease .Int J . Prev Med. 8: 105.

Malhotra ,V.K.(2003):Practical Biochemistry for Students. Fourth Edition ,Jaypee Brothers Medical publishers (p) LTD , New Delhi .

Manuel ,T. V. and Bhathena ,J. B.(2007):" Role of dietary soy protein in obesity." Int J. Med Sci ., 4(2): 72–82.

Marion, S. A.; Alessandra, C. and Gianna M.(2010): Short-term effects of soy prote diet in patients with proteinuric glomerulopathies. Jornal Brasileiro de Nefrologia : 'orgao Oficial de Sociedades Brasileira e Latino-americana de Nefrologia , 33(2):150-159

Merritt, J. C.(2004):Metabolic syndrome: Soybean foods and serum lipids. Jouranl of the National Medical Association, 96: 1032–1041.

Mohamed, T.;Zoubeida, S.;Nouha, b.A.;cManel, N.;cLotfi, A. and Khaled, H. (2020):Fermented soy milk prepared using kefir grains prevents and ameliorates obesity,type 2 diabetes, hyperlipidemia and liver-kidney toxicities in HFFD-rats. Journal of Functional Foods, Volume 67, 103869.

Mona, A. ; Naglaa , H. M.; Nahed , L. Z.; Mohamed, S. A. and Hassan M. S. (2014): Effects of Soybean Isoflavone on Lipid Profiles and Antioxidant Enzyme Activity in Streptozotocin Induced Diabetic Rats. Global Journal of Pharmacology , 8 (3): 378 -384.

Morton J.F. (1987):Guava . Fruits of Warm Climates. Purdue University. PP.356–363.

Nagasawa , A.; Fukui ,K.; Funahashi, T. ; Maeda ,N.; Shimomura, I.; Kihara, S.; Waki , M. ; Takamatsu, K. and Matsuzawa, Y.(2002):Effects of soy protein diet on the expression of adipose genes and plasma adiponectin. Horm Metab Res , 34(11-12):635-9.

Nakamura, H.; Takasawa, M. and Kasahara, S. (1989):Effects of acute protein loads of different sources on renal function of patients with diabetic nephropathy.Tohoku J. Exp Med.,159:153–62.

Nancy, J. M.; Elaine, S K.; Elizabeth,G.B. and Alan, R. P.(2016):" Soy-based renoprotection. World J. Nephrol. 6; 5(3): 233–257.

Ndatsu, Y.; Aliyu, O. A. and Ganiyu, O.(2013):Antioxidant and Hepatoprotective Properties of Tofu (Curdle Soymilk) against Acetaminophen-Induced Liver Damage in Rats. International Journal of Tropical Medicine 8(3):62-67

Nation Diabetes Data Group, N.D.D.G. (1994) :"Densificcation and diagnosis of diabetes mellitus and other categories of glucose intolerance" . J .of Diabetes,28 :1039-1057.

Nilavsen,K. and Meinertz, H. (1998):Variable response to dietary soy protein in healthy normolipidemic men. American Journal of Clinical Nutrition, 68:1380S-1384S.

Oddrun, A. G.; Hege,W.;Sverre , M.; Bjørn , L.; Marit , E. and Rolf, K .B.(2006):" Dietary soya protein concentrate enriched with isoflavones reduced fatty liver, increased hepatic fatty acid oxidation and decreased the hepatic mRNA level of VLDL receptor in obese Zucker rats." Br J. Nutr., 96(2):249-257.

Orsolya, M. ;William, J. B. ; Richard, W. S. ; Michael, R. P. ; Todd , A. W. and Neil S.(2003): Soy isoflavones exert antidiabetic and hypolipidemic effects through the PPAR pathways in obese zucker rats and murine RAW 264.7 Cells .The Journal of Nutrition, 133 (5): 1238–1243

Perpétuo, G. and Salgado, J. (2003): "Effect of mango (Mangifera indica, L.) ingestion on blood glucose levels of normal and diabetic rats. "Plant Foods Hum Nutr., 58: 1–12 .

Potter, S. M., Baum, J.A.,Teng, H., Stillman, R.J., Shay, N.F& Erdman ,J.W. (1998):Soy protein and isoflavones. American Journal of Clinical Nutrition, 68 : 1375S-1379S.

Preeti ,B. ; Deshmukh, G.; Saurabh, S.P.& Pragati ,S. (2017): Plums: A Brief Introduction 1Dairy Engineering, SRS of ICAR-National Dairy Research Institute (NDRI), Bangalore, Karnataka, India 2Indian Agricultural Research Institute (IARI), New Delhi, India.

SAS (1985): User , s Guide :Statistics . Cary , NC:SAS Institute .

Schieber A., Berardini N. and Carle R. (2003):Identification of flavonol and Xanthone glycosides from mango (Mangifera indica L. cv. Tommy Atkins) peels by high-performance liquid chromatography–electrospray ionization mass spectrometry. J. Agric. Food Chem. 51, 5006–5011. 10.1021/jf030218f .

Sipos, E.F.(1988): Edible uses of soybean protein. In Soybean Utilization Alternatives, McCann, L. (Ed.), p. 57-93. Center for Alternative Crops and Products, University of Minnesota, St. Paul.

Stacewicz,S.M.; Bowen, P.E.; Hussain, E.A.; Damayanti, W.B. and Farnsworth, N.R. (2000):Chemical composition and potential health effects of prunes: A functional food. Critical reviews in food science and nutrition, 41: 251-286.

Subhasis,S.; Ranabir, C.; Subarna ,G.; Alugubelli, G.R. and Janmajoy B.(2019):Anti-diabetic activity of mango (Mangifera indica): review. Ranabir Chanda, Sana College of Pharmacy, Kodad, Telengana, India, Volume 6 .

Taku, K.; Umegaki, K.; Ishimi, Y.and Watanabe, S.(2008):Effects of extracted soy isoflavones alone on blood total and LDL cholesterol: Meta-analysis of randomized controlled trials. Journal of Therapeutics and Clinical Risk Management, 5: 1097-1103.

Tharanathan,R.;Yashoda, H. and Prabha, T.(2006): Mango (Mangifera indica L.) The king of fruits—An overview. Food Reviews International, 22(2):95-123.

USDA database for the isoflavone content of selected foods (2008):Nutrient Data Laboratory.Beltsville Human Nutrition Research Center, Agricultural Research Service. P. 17.

Wilson, L.A. (1995):Soy foods. Ch. 22 in Practical Handbook of Soybean Processing and Utilization. Erickson, D.V. (Ed.), p. 428459. AOCS Press, Champaign, IL, and United Soybean Board, St. Loius, MO.

Wright, S. M. and Salter, A. M. (1998): Effects of soy protein on plasma cholesterol and bile acid excretion in hamsters. Comp Biochem Physiol B Biochem Mol Biol., 119(2):247-54.

Xiao,C.W.(2008): Health effects of soy protein and isoflavones in humans". J. Nutr.,138(6):1244s-9s.

Yound, D. S. (1975): Determination of GOT. Clin. Chem., 21.

Zeller K.R. (1991):Low-protein diets in renal disease. Diabetes Care,14:856–66.

Zhuo, X. G, Melby, M. K. and Watanabe, S. (2004):Soy isoflavone intake lowers serum LDL cholesterol: A meta-analysis of 8 randomized controlled trials in humans. Journal of Nutrition, 134: 2395-2400.

التوفو المخلوط مع عصائر البرقوق والجوافه والمانجو لتخفيف ارتفاع البول السكرى لدى ذكور الفئران البيضاء

فاطمة الزهراء أمين الشريف، عادل عبد المعطى أحمد، وحيد أحمد رجب، نائلة عبد القادر مصطفى قاسم
قسم التغذية وعلوم الأطعمة، كلية الاقتصاد المنزلي، جامعة المنوفية، شبين الكوم، مصر

الملخص العربى

أجريت هذه الدراسة للتخفيف من مرض البول السكري في الفئران البيضاء باستخدام التوفو المخلوط مع عصائر البرقوق والجوافة والمانجو بنسبة 5٪. أجريت هذه الدراسة بأستخدام (30) من ذكور الفئران البيضاء، أوزانهم (150 ± 10 جم). تم تقسيمهم إلى سته مجموعات كل مجموعه تشمل خمس فئران تغذت احدى هذه المجموعات على حمية قاعدية واحدة كعنصر تحكم سلبي ، والخمس مجموعات الاخرى تم حقنهم بألوكسان 150 ملجم / كجم من وزن الجسم وذلك لاصابتهم بمرض السكري ، مجموعة واحدة منهم تغذت فقط على النظام الغذائي الأساسي كعنصر تحكم إيجابي ، و،أربعه مجموعات (5 فئران لكل منهما) تغذت على علائق تجريبية تحتوي على 5٪ من التوفو المخلوط مع البرقوق والجوافة والمانجو ومزيجهم. في نهاية التجربة (28 يومًا) تم أخذ عينات الدم وفصل الأعضاء ووزنها لحساب الوزن النسبي للأعضاء. تم فصل المصل وإجراء التحليل البيوكيميائي. أشارت النتائج إلى أن علاج الفئران بمزيج من التوفو والجوافة والمانجوو البرقوق أدى إلى زيادة الوزن النسبي للجسم (٪) ، وانخفاض الوزن النسبي للأعضاء ، وانخفاض مستوى الجلوكوز في الدم ، وإنزيمات الكبد ، وتحسن وظائف الكلى والدهون.

الكلمات المفتاحية: وظائف الكبد، وظائف الكلى، الدهون، عصائر الفاكهة.