Biological and Biochemical Studies on Turmeric and Cocoa on Streptozotocin-Induced Diabetic Rats

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Abstract

The effect of different concentrations (2.5 and 5%) of turmeric (*Curcuma longa*) and cocoa (*Theobroma cacao*) on diabetic rats were evaluated. Forty rats were used in this study and divided into 8 groups, each group contain 5 rats. Rats was treated by streptozotocin (STZ) to induced diabetic. Results showed that rats fed on 5 % mixture powder recorded the lowest glucose level with significant differences being, 106.10 mg/dl. The lower Alkaline phosphatase (ALP), Aspartate Transaminase (GOT) and Alanine Transaminase (GPT) liver enzyme of treated group recorded for group fed on 5% mixture powder but, the highest value recorded for group fed on 2.5 % cacao powder with significant difference. Lowest value of triglyceride and cholesterol recorded for group fed on 5% mixture powder. The highest High Density Lipoprotein cholesterol (HDL-c) of treated group recorded for group fed on 5% mixture powder. While, the highest Low Density Lipoprotein cholesterol (LDL-c) and Very low Density Lipoprotein cholesterol (VLDL-c) of treated group recorded for rats fed on 2.5 % cacao powder. The lowest urea, uric acid and creatinine levels of treated group recorded for group fed on 5 % mixture powder.

Key words: Turmeric, Cocoa, Rats, Diabetic and Biochemical analysis.

INTRODUCTION

Diabetes mellitus (DM) is a chronic disease caused by inherited and/or acquired deficiency in production of insulin by the pancreas, or by the ineffectiveness of the insulin produced. Such a deficiency results in increased concentrations of glucose in the blood, which in turn damage many of the body's systems, in particular the blood vessels and nerves **(Nagappa *et al.,* 2003)**.

Diabetes is one of the most common chronic diseases affecting more than 100 million people worldwide. The two major types of diabetes mellitus are characterized by hyperglycemia, abnormal metabolism of lipid and protein with specific long term complications affecting the retina, kidney and nervous system **(Mathur *et al.,* 2011)**.

Turmeric (*Curcuma longa*) is a rhizomatous herbaceous perennial plant of the ginger family, *Zingiberaceae* which is native to tropical South Asia. It needs temperatures between 20 and 30 deg.C and a considerable amount of annual rainfall to thrive. Plants are gathered annually for their rhizomes, and reseeded from some of those rhizomes in the following seasons. Its rhizomes are boiled for several hours and then dried in hot ovens, after which they are ground into a deep orange-yellow powder commonly used as a spice in curries and other South Asian cuisine, for dyeing, and to impart color to mustard condiments. Its active ingredient is curcumin and it has an earthy, bitter, peppery flavor **(Iqbal *et al.,* 2003)**.

Curcumin an orange-yellow crystalline powder, is the active component in turmeric rhizomes at a content of 3 to 5%, it's a lipophilic polyphenol that is nearly insoluble in water. Curcumin containing 95% pure curcuminoids (curcumin 80 % desmethoxycurcumin 10% and bisdesmethoxycurcumin 5%) **(Anand *et al.,* 2007)**.

The active constituents of turmeric are the flavonoid curcumin (diferuloyl methane) and various volatile oils, including tumerone, atlantone, and zingiberone. Other constituents include sugars, proteins, and resins. The best-researched active constituent is curcumin, which comprises 0.3-5.4 percent of raw turmeric **(Niranjan and prakash, 2008)**.

Turmeric's active constituents are yellowish orange volatile oils called curcumninoids known as curcumin, which has demonstrated antioxidant, antineoplastic; antiviral, anti-inflammatory, antibacterial, antifungal, antidiabetic, anticoagulant and cardiovascular protective **(Kumar *et al.,* 2012)**.

The effect of curcumin to lower blood glucose was one of the first effects to be seen with curcumin. In a STZ-induced diabetic mouse model, curcumin (at 60 mg/kg body weight) was shown to act as an anti-diabetic agent, which in turn to maintain the normal structure of the kidney **(Sawatpanich *et al*., 2010)**.

Supplementation of curcumin to aprediabetic population over the course of nine months appears to preserve pancreatic function and improve both insulin sensitivity and adiponection relative to control,

and curcumin was able to prevent any occurrence of diabetes during this time frame (whereas 16.4% of control developed it) **(Chuengsamarm *et al.*, 2012)**.

Cocoa (*Theobroma cacao,* L.) is grown mainly in West Africa although significant quantities also come from Asia and South America, cocoa consider an important crop, it is the raw material which chocolate is manufactured. Raw cocoa beans are one of the most nutritious foods in the world **(Copetti *et al.*, 2014)**.

Cocoa (*Theobroma cacao,* L.) is a cash crop of huge economic significance in the world and the key raw material for chocolate manufacturing **(Krähmer *et al.*, 2015)**.

Cocoa is a rich source of polyphenolic compounds with a high amount of flavonoids, specifically flavanols, also known as flavan-3-ols **(Manach *et al.*, 2004)**.

Cocoa is considered a good source of fiber (26-40%), proteins (15-20%), carbohydrates (about 15%) and lipids (10-24%); generally, (10-12%). Cocoa contains flavanols such as epicatechin and catechin as monomers, and dimers or larger polymers derived from both of these, known as procyanidin **(Castell *et al.*, 2015)**.

Raw cocoa beans are one of the most nutritious foods in the world, and protects the body from the impact of free radicals, reduces stress and depression, protect against heart disease and blood vessels, protects against many types of cancer, is an excellent source of iron, regulates blood sugar and cholesterol levels, promotes better memory and concentration, reduces the risk of heart attack, and helps regulate blood pressure **(Latif, 2013)**.

Our previous study on oral glucose tolerance test (OGTT) of diabetic rats showed that cocoa powder extract could reduce blood glucose levels **(Amin *et al.*, 2004)**.

phenolic and flavonoid contents and total antioxidant capacities of cocoa are higher than that of other phytochemical-rich foods. The antioxidant effects of the cocoa components may influence insulin resistance, reduce the risk for diabetes or stimulate redox-sensitive signaling pathways involved in the gene expression of endogenous antioxidant defenses **(Katz *et al.*, 2011)**.

Material & Methods

Materials

Turmeric (*Curcuma longa*) and cocoa (*Theobroma cacao*) were obtained from local market, Menoufia Governorate, Egypt.

Cholesterol powder

Pure white crystalline cholesterol powder and saline solutions were purchased from SIGMA Chemical Co., (USA).

Casein, cellulose, choline chloride, and DL Methionine

Casein, cellulose, choline chloride powder, and DL methionine powder, were obtained from Morgan Co. Cairo, Egypt.

Experimental animals

A total of 40 adult normal male albino rats Sprague Dawley strain weighing 140±10 g were obtained from Vaccine and Immunity Organization, Ministry of Health, Helwan Farm, Cairo, Egypt.

The chemical kits

Chemical kits used for determination the (TC, TG, HDL-c, ALT, AST, ALP, bilirubin, urea, creatinin, albumin) were obtained from AlGomhoria Company, Cairo, Egypt.

Methods

Experimental design

Forty adult male white albino rats, Sprague Dawley Strain, 10 weeks age, weighing (140±10g) were used in this experiment. All rats were fed on basal diet (casein diet) prepared according to **American Institute of Nutrition (AIN) (1993)** for 7 consecutive days. After this adaptation period, rats are divided into 8 groups, each group which consists of 5 rats as follows: group (1): rats fed on basal diet as negative control. group (2): injected by streptozotocin a dose of 40 mg per kg of weight of the rat and used as a positive control group. group (3): a group infected diabetic fed on the turmeric as powder by 2.5% of the weight of the rat. Group (4): a group infected diabetic fed on the turmeric as powder by 5% of the weight of the rat. Group (5): agroup infected diabetic fed on the cocoa as powder by 2.5% of the weight of the rat. Group (6): a group infected diabetic fed on the cocoa as powder by 5% of the weight of the rat. Group (7): a group infected diabetic fed on the mixture turmeric and cocoa as powder by 2.5% of the weight of the rat. Group (8): a group infected diabetic fed on the mixture turmeric and cocoa as powder by 5% of the weight of the rat. During the experimental period, the body weight and food intake were estimated weekly and the general behavior of rats was observed. The experiment will take 28 days, at the end of the experimental period each rat weight separately then, rats are slaughtered and collect blood samples. Blood samples were centrifuged at (4000 rpm) for ten minute to separate blood serum, then kept in deep freezer till using.

Blood sampling

After fasting for 12 hours, blood samples in initial times were obtained from

hepatic portal vein at the end of each experiment. Blood samples were collected into a dry clean centrifuge glass tubes and left to clot in water bath (37°C) for 28 minutes, then centrifuged for 10 minutes at 4000 rpm to separate the serum, which were carefully aspirated and transferred into clean cuvette tube and stored frozen at -20°C till analysis according to the method described by **Schermer (1967)**.

Biochemical Analysis

Lipids profile

Determination of serum total cholesterol

Serum total cholesterol was determined according to the colorimetric method described by **Thomas (1992)**.

Determination of serum triglycerides

Serum triglycerides was determined by enzymatic method using kits according to the **Young, (1975) and Fossati, (1982)**.

Determination of high density lipoprotein (HDLc)

HDLc was determined according to the method described by **Fredewaid (1972) and Grodon and Amer (1977)**.

Calculation of very low density lipoprotein cholesterol (VLDLc)

VLDLc was calculated in mg/dl according to **Lee and Nieman (1996)** using the following formula:

VLDLc (mg/dl) = Triglycerides / 5

Calculation of low density lipoprotein cholesterol (LDLc)

LDLc was calculated in mg/dl according to **Lee and Nieman (1996)** as follows:

LDLc (mg/dl) = Total cholesterol – HDL-c – VLDL-c

Liver functions

Determination of serum alanine aminotransferase (ALT), serum asparatate aminotransferase (AST), serum alkaline phosphatase (ALP) were carried out according to the method of **(Clinica Chimica Acta 1980**, **Hafkenscheid 1979 and Moss 1982**), respectively.

Kidney functions

Determination of serum urea, serum creatinin and serum uric acid

Serum urea and serum creatinin were determinated by enzymatic method according to **(Patton and Crouch 1977** and **Henry 1974)**.While, serum uric acid was determined calorimetrically according to the method of **Barham and Trinder (1972)**.

Determination of blood glucose

Enzymatic determination of plasma glucose was carried out calorimetrically according to the method of **Tinder (1969)**.

Statistical analysis

The data were analyzed using a completely randomized factorial design **(SAS, 1988)** when a significant main effect was detected; the means were separated with the Student-Newman-Keuls Test. Differences between treatments of ($P \leq 0.05$) were considered significant using Costat Program. Biological results were analyzed by One Way ANOVA.

RESULTS AND DISCUSSION

Data given in Table (1) show the effect of turmeric, cocoa and its mixtures on glucose of hyperglycemic rats. It could be observed that the highest glucose recorded for positive control group, while the lowest glucose recorded for negative control group with significant differences. The mean values were 237.50 and 95.60 mg/dl, respectively.

On the other hand, the highest glucose of treated groups (diabetes groups) was recorded for 2.5% cacao powder group, while the lowest glucose recorded for 5% mixture powder group with significant differences. The mean values were 140.10 and 106.10 mg/dl, respectively. The best treatment was recorded for group 8 (5% mixture

powder) as compared to negative control group. These results are in agreement with **Ruzaidi *et al.*, (2005)** they showed that a diet containing cocoa polyphenol rich extract reduced the glucose levels and lipid profiles in STZ-induced diabetic rats. Moreover, **Gupta *et al*., (2012)** they showed that curcumin revealed an anti-hyperglycemic effect and improved insulin sensitivity.

Table (1) Effect of turmeric, cocoa and its mixtures on glucose of hyperglycemic rats

Groups	Glucose mg/dl
	M±SD
G_1 C (-)	95.60 ± 0.40^{g}
G_2 C (+)	237.50 ± 1.10^{a}
G_3 (2.5% turmeric powder)	121.50 ± 0.10^{d}
G_4 (5% turmeric powder)	119.70 ± 0.30^{e}
G_5 (2.5% cacao powder)	140.10 ± 0.30^{b}
G_6 (5% cacao powder)	129.00 ± 0.20^{c}
G_7 (2.5% mixture powder)	116.50 ± 0.10^{d}
G_8 (5% mixture powder)	106.10 ± 0.20^{f}
LSD	1.37

Each value is represented as mean ± standard deviation (n = 3).
Mean under the same column bearing different superscript letters are different significantly ($p < 0.05$).

Data given in Table (2) show the effect of turmeric, cocoa and its mixtures on ALP, GOT and GPT of hyperglycemic rats. It is clear to notice that the highest ALP recorded for positive control group, while the lowest ALP recorded for negative control group with significant differences. The mean values were 195.0 and 93.0 u/l, respectively. On the other hand, the highest ALP of treated groups (diabetes groups) was recorded for 2.5% cacao powder group, while the lowest ALP recorded for 5% mixture powder group with significant differences. The mean values were 133.0 and 97.0 u/l, respectively. The best treatment was recorded for group 8 (5% mixture powder) as compared to negative control group.

The same Table illustrated that the mean value of GOT of negative control group which was lower than positive control group with significant differences between them. The mean values were 8.62 and

55.22 u/l, respectively. On the other hand, the highest GOT of treated groups (diabetes groups) was recorded for 2.5% cacao powder group, while the lowest GOT recorded for 5% mixture powder group with significant differences. The mean values were 38.8 and 10.50 u/l, respectively. The best treatment was recorded for group 8 (5% mixture powder) as compared to negative control group.

As for as, the mean value of GPT of negative control group, while, was lower than positive control group with significant differences between them. The mean values were 6.20 and 20.40 u/l, respectively. On the other hand, the highest GPT of treated groups (diabetes groups) was recorded for 2.5% cacao powder group, while the lowest GPT recorded for 5% mixture powder group with significant differences between them. The mean values were 14.90 and 6.50 u/l, respectively. The best treatment was recorded for group 8 (5% mixture powder) as compared to negative control group. These results are in agreement with **Allam (2009)** who found that infected mice treated with curcumin

Groups	ALP U/L	GOT U/L	GPT U/L
	M±SD	M±SD	M±SD
G_1 C (-)	93.0^{e} ± 1.20	8.62^{f} ± 1.10	6.20^{d} ± 0.40
G_2 C (+)	195.0^{a} ± 0.20	55.22^{a} ± 1.35	20.40^{a} ± 0.10
G_3 (2.5% turmeric powder)	121.0^{c} ± 0.10	26.55^{d} ± 1.25	13.50^{c} ± 1.00
G_4 (5% turmeric powder)	111.0^{f} ± 0.40	16.61^{e} ± 0.90	10.65^{d} ± 0.30
G_5 (2.5% cacao powder)	133.0^{b} ± 1.10	38.8^{b} ± 2.05	14.90^{c} ± 0.20
G_6 (5% cacao powder)	123.0^{d} ± 1.30	30.4^{c} ± 0.60	13.63^{b} ± 0.10
G_7 (2.5% mixture powder)	107.0^{f} ± 0.30	14.61^{e} ± 0.90	6.80^{d} ± 0.20
G_8 (5% mixture powder)	97.0^{f} ± 0.10	10.50^{e} ± 0.90	6.50^{d} ± 0.10
LSD	**2.32**	**2.29**	**1.39**

Each value is represented as mean ± standard deviation (n = 3).

restore the hepatic ALT and AST activities that were decreased. Also, **Oliveira and Genovese (2013)** they showed that antioxidant capacity were improved in lipid peroxidation was reduced in liver.

Table (2): Effect of turmeric, cocoa and its mixtures on ALP, GOT and GPT of hyperglycemic rats

Mean under the same column bearing different superscript letters are different significantly ($p < 0.05$)

Data given in Table (3) show the effect of turmeric, cocoa and its mixtures on serum urea, serum uric acid and serum creatinine of hyperglycemic rats. It is clear to mention that the highest urea recorded for positive control group, while the lowest urea recorded for negative control group with significant differences. The mean values were 73.65 and 42.20 mg/dl, respectively. On the other hand, the highest urea of treated groups (diabetes groups) was recorded for 2.5 % cacao powder group, while the lowest urea recorded for 5% mixture powder group with significant differences. The mean values were 60.13 and 44.20 mg/dl, respectively. The best treatment was recorded for group 8 (5% mixture powder) as compared to negative control group.

The same Table illustrated that the mean value of uric acid of negative control group which was lower than positive control group with significant differences between them. The mean values were 2.10 and 4.00 mg/dl, respectively. On the other hand, the highest uric acid of treated groups (diabetes groups) was recorded for 2.5% cacao powder group, while the lowest uric acid recorded for 5% mixture powder group with significant differences. The mean values were 3.31 and 1.95 mg/dl, respectively. The best treatment was recorded for group 8 (5% mixture powder) as compared to negative control group.

As for as, the mean value of creatinine of negative control group, while, was lower than positive control group with significant differences between them being 0.85 and 1.25 mg/dl, respectively. On the other hand, the highest creatinine of treated groups (diabetes groups) was recorded for 2.5% cacao powder group, while the lowest creatinine recorded for 5% mixture powder group with significant differences. The mean values were 1.18 and 0.88 mg/dl, respectively. The best treatment was recorded for group 8 (5% mixture powder) as compared to negative control group. These results are in agreement with **Ghosh (2009) and Zhong (2011)** they indicated that curcumin at 5mg\kg bodyweight (rats) is able to prevent histological changes in kidney structure and in delaying the inevitable progression of renal failure. Moreover, **Oliveira and Genovese (2013)** they stated that antioxidant capacity were improved in kidneys, and lipid peroxidation was reduced in kidneys.

Table (3): Effect of turmeric, cocoa and its mixtures on serum urea serum uric acid and serum creatinine of hyperglycemic rats

Groups	Parameters		
	Urea mg/dl	Uric acid mg/dl	Creatinine mg/dl
	M±SD	M±SD	M±SD
G1 C (-)	42.20g ± 2.10	2.10b± 0.20	0.85c+ 0.21
G2 C (+)	73.65a ±3.20	4.00a ± 0.90	1.25a+ 0.13
G3 (2.5% turmeric powder)	53.96d± 1.60	2.67b± 0.60	1.18a+ 0.01
G4 (5% turmeric powder)	50.27e ± 0.90	2.30b± 0.30	1.10b+ 0.14
G5 (2.5% cacao powder)	60.13b± 1.30	3.31a ± 0.70	1.21a+ 0.01
G6 (5% cacao powder)	55.40c± 0.50	2.95b± 1.20	1.14a+ 0.03
G7 (2.5% mixture powder)	46.25f± 0.50	2.20b± 1.10	1.01b+ 0.02
G8 (5% mixture powder)	44.20f± 0.50	1.95b± 1.30	0.88c+ 0.03
LSD	3.24	1.26	0.12

Each value is represented as mean ± standard deviation (n = 3).

Mean under the same column bearing different superscript letters are different significantly ($p < 0.05$).

Data given in Table (4) show the effect of turmeric, cocoa and its mixtures on serum triglycerides and serum total cholesterol of hyperglycemic rats. It is clear to notice that the highest triglycerides (T.G) recorded for positive control group, while the lowest T.G recorded for negative control group with significant differences. The mean values were 136.65 and 57.31 mg/dl, respectively. On the other hand, the highest T.G of treated groups (diabetes groups) was recorded for 2.5% cacao powder group, while the lowest T.G recorded for 5% mixture powder group with significant differences. The mean values were 91.64 and 61.90 mg/dl, respectively. The best serum T.G level was showed for group 8 (5% mixture powder) when compared with negative control group.

The same Table illustrated that the mean value of total cholesterol (T.C) of negative control group which was lower than positive control group with significant differences between them. The mean values were 95.00 and 130.00 mg/dl, respectively. On the other hand, the highest

T.C of treated groups (diabetes groups) was recorded for 2.5% cacao powder group, while the lowest T.C recorded for 5% mixture powder group with significant differences. The mean values were 122.00 and 93.00 mg/dl, respectively. The best serum T.C level was showed for group 8 (5% mixture powder) when compared with negative control group. These results are in agreement with **Osakebe *et al.*, (2001)** they indicated that the significant decrease in the total cholesterol levels of the experimental rats may have resulted from the antioxidant properties of the polyphenols in cocoa. Moreover, **Kim and Kim (2010)** they showed that rats fed the curcumin diet showed a significantly decreased serum TG level by 27% and lowered serum TC and LDL-c by 34% and 68%, respectively, in comparison with control group.

Table (4): Effect of turmeric, cocoa and its mixtures on serum triglycerides and serum total cholesterol of hyperglycemic rats

Groups	Triglycerides mg/dl	Total cholesterol mg/dl
	M±SD	M±SD
G1 C (-)	57.31e ± 0.22	95.00fg ± 0.30
G2 C (+)	136.65a ±1.31	130.00a ± 1.10
G3 (2.5% turmeric powder)	79.83c ± 1.10	117.00c ± 0.20
G4 (5% turmeric powder)	66.92d ± 0.30	108.00e ± 0.10
G5 (2.5% cacao powder)	91.64b ± 2.10	122.00b ± 0.30
G6 (5% cacao powder)	77.13c± 1.25	113.00d ± 0.40
G7 (2.5% mixture powder)	64.95d ± 0.20	100.00f ± 0.40
G8 (5% mixture powder)	61.90d ± 0.10	93.00g ± 0.40
LSD	3.67	1.27

Each value is represented as mean ± standard deviation (n = 3).

Mean under the same column bearing different superscript letters are different significantly ($p < 0.05$).

Data presented in Table (5) show the effect of turmeric, cocoa and its mixtures on HDL-c, LDL-c and VLDL-c of hyperglycemic rats. It is clear to mention that the highest HDL-c recorded for negative control group, while the lowest HDL-c recorded for positive control group with significant differences. The mean values were 43.50 and 27.25 mg/dl, respectively. On the other hand, the highest HDL-c of treated groups (diabetes groups) was recorded for 5% mixture powder group, while the lowest HDL-c recorded for 2.5% cacao powder group with significant differences. The mean values were 40.37 and 30.65 mg/dl, respectively. The best serum HDL-c was observed for group 8 (5% mixture powder) when compared with negative control group.

The same table illustrated that the mean value of LDL-c of negative control group which was lower than positive control group with significant differences between them. The mean values were 40.04 and 75.42 mg/dl, respectively. On the other hand, the highest LDL-c of treated groups (diabetes groups) was recorded for 2.5% cacao powder group, while the lowest LDL-c recorded for 5% mixture powder group with significant differences. The mean values were 73.02 and 40.25 mg/dl, respectively. The best serum LDL-c was observed for group 8 (5% mixture powder) when compared with negative control group.

As for as, the mean value of VLDL-c of negative control group, while, was lower than positive control group with significant differences between them being 11.46 and 27.33 mg/dl, respectively. On the other hand, the highest VLDL-c of treated groups (diabetes groups) was recorded for 2.5% cacao powder group, while the lowest VLDL-c recorded for 5% mixture powder group with significant differences. The mean values were 18.33 and 12.38 mg/dl, respectively. The best serum VLDL-c was observed for group 8 (5% mixture powder) when compared with negative control group. These results are in agreement with **Nishiyama *et al.,* (2005)** they mentioned that turmeric may lower blood levels of low-density lipoprotein (LDL or "bad" cholesterol) and increase high- density lipoprotein (HDL or "good" cholesterol). Also, **Kurosawa *et al.,* (2005)** they reviewed that anti-oxidative activity of poly phenols rich in cocoa may be a key factor for improving the lipids profile.

Table (5): Effect of turmeric, cocoa and its mixtures on HDL-c, LDL-c and VLDL-c of hyperglycemic rats

Groups	Parameters		
	HDL-C mg/dl	LDL-c mg/dl	VLDL-c mg/dl
	M±SD	M±SD	M±SD
G1 C (-)	43.50a ± 2.10	40.04e± 0.21	11.46c± 0.69
G2 C (+)	27.25e ± 1.41	75.42a± 1.20	27.33a± 1.20
G3 (2.5% turmeric powder)	35.17c ±1.13	65.86b ± 1.72	15.97b ± 1.41
G4 (5% turmeric powder)	37.30c±0.20	57.32c ± 0.90	13.38c ± 0.30
G5 (2.5% cacao powder)	30.65d± 0.30	73.02a± 1.60	18.33b± 1.10
G6 (5% cacao powder)	33.50d ±1.50	64.07b±2.20	15.43b±1.20
G7 (2.5% mixture powder)	38.44b±0.10	48.61d±2.20	12.95c±2.10
G8 (5% mixture powder)	40.37b±0.21	40.25e±2.20	12.38c±1.30
LSD	3.02	3.67	3.67

Each value is represented as mean ± standard deviation (n = 3).
Mean under the same column bearing different superscript letters are different significantly ($p < 0.05$).

Recommendations

According to the present work was conducted to study the following could be recommended:

1. Data reported that use of 5% mixture powder (turmeric and cocoa) for reducing glucose levels.
2. Data indicated that the use of 5% mixture powder (turmeric and cocoa) has improvement of liver and kidney functions.
3. Also, The obtained data found that the use of 5% mixture powder (turmeric and cocoa) has agood effect on serum lipids and decreasing total cholesterol, triglyceride.
4. Data suggested that use of 5% mixture powder (turmeric and cocoa) improvement healthy status of albino rats.
5. Finally, Make programs of nutritive edification to explain the danger of kidney disease and the dietary supplements as a complementary and alternative medicine.

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دراسات بيولوجية وبيوكيميائية على الكركم والكاكاو فى الفئران المصابة بالسكر بتأثير الإستربتوزوتوسين

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الملخص العربى

تم تقييم تأثير تركيزات مختلفة (٢.٥، ٥٪) من مسحوق الكركم والكاكاو في الفئران المصابة بمرض السكر. واستخدم فى هذه الدراسة ٤٠ فأر في هذه الدراسة وتم تقسيمها إلى٨ مجموعات، كل مجموعة تحتوي على ٥ فئران. وتم اصابة الفئران بمرض السكر بواسطة الإستربتوزوتوسين. وأظهرت النتائج أن الفئران التي تغذت على مخلوط من مسحوق الكركم والكاكاو بتركيز ٥% أقل مستوى لسكر الجلوكوز مع وجود فرق معنوى ،حيث كانت القيمة ١٠٦.١٠ ملجم / ديسيلتر. أعلى انخفاض لإنزيمات الكبدGPT,GOT,ALP سجلت مع مجموعة الفئران التي تغذت على مخلوط من مسحوق الكركم والكاكاو بتركيز ٥٪ ، ولكن أعلى قيم كانت مع مجموعة الفئران التى تغذت على مسحوق الكاكاو بتركيز٢.٥% مع وجود فرق معنوى. أقل قيمة من الدهون الثلاثية والكوليسترول مع مجموعة الفئران التي تغذت على مخلوط من مسحوق الكركم والكاكاو بتركيز ٥٪. أعلى قيم للكوليستيرول عالى الكثافة سجلت مع مجموعة الفئران التي تغذت على مخلوط من مسحوق الكركم والكاكاو بتركيز ٥٪. في حين أعلى قيم من الكولسيتيرول منخفض الكثافة والكولسيتيرول منخفض الكثافة جدا سجلت مع مجموعة الفئران التي تغذت على مسحوق الكاكاو بتركيز ٢.٥%. أقل قيم لليوريا وحمض اليوريك وللكرياتينين سجلت مع مجموعة الفئران التي تغذت على مخلوط من مسحوق الكركم والكاكاو بتركيز٥٪.

الكلمات الافتتاحية: الكركم ـ الكاكاو ـ الفئران ـ السكر ـ التحاليل الكيميائية الحيوية