Middle East Journal of Applied Sciences
ISSN 2077-4613

Volume : 05 | Issue : 01 | Jan-Mar. | 2015
Pages: 10-18

Nutrition with Pumpkin (*Cucrbita pepo*) Cake as Lowering Cholesterol in Rats

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ABSTRACT

This investigation was carried out to evaluate cake made from pumpkin meal substituted with wheat flour 72% extraction at level 5, 10 and 10%, respectively to give three blends and control was prepared from wheat flour 72% extraction. Chemical analysis, total carotenoides, fiber fraction and minerals were determined in raw materials and their blends. The results observed that the pumpkin meal had contained the highest crude fiber and ash (8.03 and 6.45%, respectively) and when increased amounts the pumpkin meal in the blends the chemical constituents were increased. Moreover, the total carotenoides was the highest in pumpkin meal 41.04mg/100g than wheat flour 0.37 mg/100g. Meanwhile, the total carotenoides in blends were increased by increasing pumpkin meal. Total dietary fiber (20.65%), soluble dietary fiber (7.20%) and insoluble dietary fiber (13.45%) were found the highest in pumpkin meal and followed by all blends. The pumpkin meal is reach source of mineral elements and the blends were increased in minerals content by increasing addition of pumpkin meal.

Organoleptic characteristics were determined in sponge cake and their blends and peroxide value was determined in the shortening extracted from sponge cake and their blends every week to four weeks. The results showed that the sensory characteristics could be no variation by various concentrations of the ingredients in dough during production of sponge cake at level 5, 10and 15% pumpkin meal were acceptable to most members regarding to taste, odor, texture, crust color, crumb color, general appearance and overall acceptability. The results observed that the blends made from pumpkin meal 10 and 15% were effectively inhibited to increase in peroxide value for four weeks.

At the end of biological experimental period the total lipid, triglyceride blood sugar, total cholesterol, low density lipoprotein and high density lipoprotein were determined in all groups fed on basal diet substitute with 20% from sponge cake made from 5, 10 and 15% pumpkin meal and the results are reported that the hypercholesterolemic rats fed on sponge cake made from 15% pumpkin meal; the total lipid and triglyceride were the lowest 0.68 g/dl and 115.1 mg/dl followed by hypercholesterolemic rats fed on 10% sponge cake was amounted 0.78 g/dl and 141.0 mg/dl. Moreover, the results illustrated that the hypercholesterolemic rats fed on sponge cake made from 15% pumpkin meal, the total cholesterol had the lowest (200.0 mg/dl) contained and nearly the negative healthy control 186.3 mg/dl fed on basal diet and the best group from the results of low and high lipoprotein were the rats fed on sponge cake made from 15% pumpkin meal. Whilst, the blood sugar in the groups fed on basal diet substitute with 20% from sponge cake made from10 and 15% pumpkin meal were decreased 125.3 and 110.7 mg/dl, respectively, than control positive and nearly to control negative 115.3 mg/dl.

From the obviously results it can may be recommended the sponge cake made from 10 and 15% pumpkin meal was observed that general appearance and overall acceptability, effectively inhibited to increase in peroxide value for four weeks period and effects on lowering lipid patterns and blood glucose level.

Key words: Cake , pumpkin ,meal substituted Cholesterol, wheat flour

Introduction

Diabetes mellitus is a metabolic disorder characterized by chronic hyperglycemia resulting from defects in insulin secretion, insulin action, or both. It is associated with reduced life expectancy, significant morbidity due to specific diabetes related micro vascular complications (retinopathy, nephropathy and neuropathy), increased risk of macro vascular complications (ischemic heart disease, stroke and peripheral vasculardisease) and diminished quality of life WHO and IDF (2006). The major mode of controlling diabetes can be achieved by diet, exercise, and insulin replacement therapy and/or by different oral hypoglycemic drugs. In modern medical system, managing diabetes without side effects is still a challenge.

Diabetes mellitus is a chronic disorder of carbohydrate, lipid and protein metabolism manifested by elevated blood glucose level. This disease is caused by a defect in cellular uptake of glucose due to either reduced insulin secretion or cellular resistance to insulin (DeFronzo, 1997). Clinically, diabetes is an important risk factor for a range of diseases including nephropathy, retinopathy and neuropathy, and it is increasing in prevalence according to some estimates (Tripathi and Srivastava, 2006). In addition, lipid disorders and lipid per-oxidation together with diabetes play a crucial role in the development of cardiovascular disease (Roland *et al.,* 2004 and David *et al.,* 2005). Although, insulin and hypoglycaemic drugs constitute the main treatment in

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diabetes, the use of nutritional methods and medicinal plants are increasing in some countries (Grover *et al.,* 2002 and Khan and Anderson, 2003).

Pumpkin (*Cucurbita maxima*) of the Cucurbitaceous family (Argentina) is grown in subtropical Florida and tropical countries and it is a good source of carotene, pectin, mineral salts, vitamins and other constituents which are beneficial to health. Thus, it was leading to the processing of pumpkin into a myriad of food products (Argentina). Adding pumpkin flour at different levels (5 %-15%) in composite flour showed an increase in ash and crude fiber with a decrease in fat and protein (See *et al.* 2007). Previous studies substituting pumpkin powder into the noodles demonstrated an increase in beta carotene and also improvements in color and sensory characteristic (Chi-Ho Lee *et al.* 2002). Substitution of pumpkin seed flour in cookies at different levels (0 %-25 %) indicated increased protein, calcium, sodium and phosphorus contents Giami and Achinewhu (2005).

Pumpkins (genus; Cucurbita) belong to the family of Cucurbitaceae. They are classified as Cucurbita pepo, Cucurbita moschata, Cucurbita maxima and Cucurbita mixta according to the texture and shape of their stems. This family contains chemicals, including tetra cyclic triterpens, saponins, proteins, fibers, polysaccharides and minerals (iron, zinc, manganese, copper, etc) (Bombardelli and Morazzoni, 1997). Pectin, a major component of plant cell walls, it is a water-soluble fiber found abundantly in pumpkin plants (Fissore *et al.,* 2009). The seeds of this plant, which have been implicated in providing many health benefits, are rich natural source of fatty acids (including linoleic acid, oleic acid, palmitic acid and stearic acid), phenolic compounds (Applequist *et al.,* 2006 and Xanthopoulou *et al.,* 2009) and also, antioxidant vitamins, such as carotenoids and tocopherol (Stevenson *et al.,* 2007). So far, several pharmacological properties have been reported for different species of pumpkin including anti-oxidant, lipid-lowering, hepatoprotective (Makni *et al.,* 2008), anti-carcinogenic (Hong, 2005), anti-microbial (Park *et al.,* 2010) and anti-diabetic properties (Caili *et al.,* 2006 and Xia and Wang, 2006).

Pumpkin can be processed into flour which has a longer shelf-life. Pumpkin flour is used because of its highly-desirable flavor, sweetness and deep yellow-orange color. It has been reported to be used to supplement cereal flours in bakery products, for soups, sauces, instant noodle and spice as well as a natural coloring agent in pasta and flour mixes. Pumpkin is rich in carotene, vitamins, minerals, pectin and dietary fiber (Djutin, 1991). Hence, supplementation of pumpkin flour would improve the nutritional quality of bread (Ptitchkina *et al.,* 1998).

Therefore, the aim of this study was to evaluate the effects of cake made from various doses of pumpkin on elevated blood glucose and lipid levels in hypercholesterolemic male rats.

Materials and Methods

Materials:

Pumpkin fresh (Cucrbita pepo) was obtained from farmer of Aga, El - Mansoura, Egypt. Pumpkin was washed, removed the peel and cut to 1 -2 mm slices (sliced thinly). The slices were frozen immediately in a frozen at - 6ºC for 6 h and perfection frozen at - 25ºC for 18 h. After this treatment the slices were dried promptly in a convection oven air circulation at 50 ±2ºC for 24h as described by Park (1987).

Wheat flour 72% extraction (Triticum aestivum L.) was obtained from the North Flour Mills Company, Egypt. Shortening (Rawaby consider refined palm oil, 100% pure vegetables oil and its cholesterol free) was obtained from Safola Egypt Company 10th Ramadan City, Cairo. Skim milk, vanilla, sugar, eggs and baking power were purchased from local market.Kits for determination of serum glucose and lipid parameters were purchased from Alkan-Medical Division Biocon, Germany.

Methods:

Chemical constituents of raw materials and its blends:

Protein, total fat, ash and crude fiber were determined in raw materials (wheat flour 72% extraction and pumpkin meal) and their blends according to the method outlined in AOAC (2005). The total amount of carotenoids in wheat flour 72% extraction, pumpkin meal and their blends were determined using a spectrophotometer at 450 nm according to the method described with Britton *et al.* (1996). Moreover, total dietary fiber was determined of the raw materials and their blends according to the methods described by Prosky (1988). Also, soluble and insoluble dietary fibers were determined in the raw materials and their blends according to Lee and Prosky (1995).

Minerals content cupper (Cu), potassium (K), calcium (Ca), magnesium (Mg), iron (Fe), zinc (Zn), sodium (Na) and manganese (Mn) were determined in the diluted solution of ash raw materials and their blends using the atomic absorption spectrophotometer (3300 Perkin-Elme) as described in by AOAC (2005) method.

Preparation of sponge cake:

The ingredients of raw materials (wheat flour 72% extraction and pumpkin meal) were used in the preparation of sponge cake according to Chaiya and Pongsawatmanit (2011). Wheat flour 72% extraction (100gm.) mixed with 40gm shortening; 100gm. sugar, 2.0gm baking powder, 150.0 gm. egg, 3.0gm vanilla, 8 gm emulsifier and 10.0 gm skim milk were added to give control cale. Pumpkin meal was added separately to control and substituted wheat flour at levels 5.0, 10.0 and 15.0% to give three blends, respectively.

Organoleptically evaluation and extraction for different blends of sponge cake:

The sponge cake blends were baked at 175° C for 20 minutes in an electric oven. Sponge cake was allowed to cool on racks for about one hour before evaluation. The organoleptically evaluation for different blends of sponge cake was estimated by ten experienced panelists according to AACC (2002). Also, shortening were extracted from sponge cakes every week for four weeks by soaking in n-hexan at room temperature for 48 hr. The extract was filtrated and evaporated from the solvent. Shortening was kept in deep freezer for further investigation.Peroxide value as phesico-chemical characteristics was determined in shortening which extracts from sponge cake made from pumpkin at different levels 5, 10 and 15%, respectively as mill equivalent / kg shortening according to AOAC (2005).

Nutritional experiments:

Male albino adult rats (30 rats) weight ranging 170-180g were brought from Helwan Experimental Animal, Station Ministry of Health, Egypt. Animals were housed in individual cages with screen bottoms and fed on basal diet for eight days. The basal diet consisted of corn starch 70%, casein 10% corn oil 10%, salt mixture 4%, vitamin mixture 1% and cellulose 5% according AOAC (2005).

After feeding on basal diet for eight days, rats were divided into two groups. The first group (6 rats) was fed on the basal diet for another four weeks and considered as negative control. The second group (24 rats) was fasted overnight and injected by alloxan solution (150 mg active alloxan/1Kg rat weight) according to Buko *et al.* (1996) to induce hyperglycemia and hypercholesterolemia (Arbeeny and Bergquist, 1991) then the whole rats injection were fed on basal diet for 48 hr. where hypercholesterolemia and hyperglycemia were developed. After that, the rats were divided into four sub groups. The first one (6 rats) was continued to be fed on basal diet and considered as positive control. The second , third and fourth sub group (6 rats for each) were fed on the basal diet after native the 20% sponge cake made from pumpkin at different levels 5, 10 and 15%, respectively.

The body weight and food consumption recorded every three days for four weeks. At the end of experimental period (four weeks), the blood samples were taken with drawn from the orbital plexus and centrifuged at 3000 rpm to obtain the sera. After that, the sera were kept on a deep freezer at -20°C until their analyses. Serum glucose, total lipids, total cholesterol and triglycerides were determined according to knight et al. (1972), Allain *et al.* (1974), Fossati and Prencipe (1982) and Tietz (1986), respectively. High and low density lipoprotein- cholesterol in serum was determined according to Burstein (1970) and Fruchart (1982).

Statistical analysis:

Statistical analysis for each of the collected data was done following the procedure outline by Gomez and Gomez (1984). The treatment means were compared using the least significant difference test (LSD) at 5% level of probability as outline by Waller and Duncan (1969).

Results and Discussion

Chemical compositions of raw materials and their blends:

Pumpkin and wheat flour 72% extraction and its blends were analyzed for their constituents of crude protein, lipid, fiber, ash and total carbohydrates and the results are reported in Table (1). The obtains data are given in Table (1) indicated that the pumpkin meal had contained the highest crude fiber and ash (8.03 and 6.45%, respectively).The results illustrated that the blends made from wheat flour 72% extraction substituted with 5, 10 and 15% pumpkin, when increased amount the pumpkin meal in the blends the chemical constituents were increased. Wheat flour 72% extraction was the highest in total protein 14.12% followed by the blends made from 5, 10 and 15% pumpkin meal were 13.90, 13.41 and 12.95%, respectively caused the pumpkin had contained lower amounts from protein 8.86% than wheat flour. Total carbohydrates were the highest amounted in wheat flour 72% extract (81.59%). Whilst, the blends were decreased in total carbohydrates by increasing pumpkin meal due to the pumpkin meal had contained lower total carbohydrates (75.84%) than wheat flour 72%

extraction (81.59%). Moreover, the total carotenoides was the highest in pumpkin meal 41.04mg/100g than wheat flour 0.37 mg/100g. Meanwhile, the total carotenoides in blends were increased by increasing pumpkin meal at levels 5, 10 and 15% were 2.09, 4.48 and 6.53 mg/100g, respectively.

High contents of total carotenoids (2120 µg.100 g–1) and β-carotene (1180 µg.100 g–1) have been found in *C. maxima*. However, the highest amounted of total carotenoids (47 µg. g–1 of *E*-α-carotene and 235 µg.g–1 of *E*- β-carotene) were found in peeled *C. moschata* (Baianinha cultivar) Kandlakunta *et al.* (2008).

The fiber fractions in pumpkin meal and wheat flour 72% extraction and their blends as total dietary fiber, soluble and insoluble dietary fiber are shown in the same table. The results illustrated that the total dietary fiber was increased in the blends (3.92, 5.21 and 6.86%, respectively) by the amounts of pumpkin meal increased at levels 5, 10 and 15%, respectively, than wheat flour which had low value (3.17%) in the total dietary fiber. Also, soluble dietary fiber had indicated increasing in the blends (1.60, 2.49 and 2.88%, respectively), than wheat flour (1.03%). This means that the increased in total, soluble and insoluble dietary fiber, could may be the highest total dietary fiber (20.65%), soluble dietary fiber (7.20%) and insoluble dietary fiber (13.45%) were found in pumpkin meal to be of great important. These insoluble dietary fibers include cellulose, hemicelluloses and lignin. These fibers are capable of buffering the pH of stomach by binding to the excess acids produced by the digestive system, aid in fecal bulking, and also intestinal emptying (Vergara-Valencia *et al.* 2006).

Pumpkin have high composition of carbohydrates, salts and minerals, dietary fiber, vitamins, fatty acids and amino acid gives a unique value in human nutrition. Moreover, pumpkin is playing a significant role in neutralization of free radical and finally suppress the various types of diseases development and progression Jun *et al.* (2006).

Table 1. Chemical compositions of raw materials and their blends (on dry weight basis).

Chemical analysis	Wheat flour 72% extraction	Pumpkin meal	Blends cake made from pumpkin		
			5 %	10 %	15 %
Protein	14.12	8.86	13.90	13.41	12.95
Lipid	2.03	0.82	1.80	1.93	2.03
Ash	1.05	6.45	1.97	2.17	2.37
Crude fibers	1.21	8.03	2.17	3.57	4.41
Total carbohydrates	81.59	75.84	80.16	78.92	78.24
T.Caro.	0.37	41.04	2.09	4.48	6.53
TDF	3.17	20.65	3.92	5. 21	6.86
ISDF	2.14	13.45	2.32	2.72	3.98
SDF	1.03	7.20	1.60	2.49	2.88

TDF: Total dietary fiber ISDF: Insoluble dietary fiber SDF : Soluble dietary fiber Total carotenoides mg/100g

Minerals composition of pumpkin meal and wheat flour 72% extraction and their blends are shown in Table (2). The obtained results revealed that the pumpkin meal constitute a reach source of mineral elements. The predominant minerals in pumpkin meal was potassium 3623 mg/100g followed by magnesium, sodium and calcium were 302.63, 226.29 and 166.4 mg/100g, respectively. Wheat flour 72% extraction also contains useful amounted of potassium, magnesium and calcium (146.07, 102.25 and 15.74 mg/100g, respectively). Moreover, the blends had contained the highest amount of potassium followed by magnesium, sodium and calcium. Therefore, the blends were increased in minerals content by increasing addition of pumpkin meal. The values obtained for K, Ca, Fe, Mg, Mn, Na, Zn and Cu are reasonably high in different bends with different levels of pumpkin meal that may satisfy the nutritional needs of the consumers.

Table 2. Minerals content of raw materials and its blends (mg/100g).

Minerals content	Wheat flour 72% extraction	Pumpkin meal	Blends cake made from pumpkin		
			5 %	10 %	15 %
Magnesium	102.25	302.63	152.8	170.1	195.9
Sodium	4.844	226.29	66.9	74.1	81.8
Zinc	3.83	4.57	3.21	3.43	3.60
Manganese	0.70	0.54	0.60	0.70	0.95
Iron	1.82	7.56	1.05	1.30	1.60
Calcium	15.74	166.4	13.5	27.1	30.8
Potassium	146.07	3623.6	230.2	252.0	272.6
Cupper	0.27	1.82	0.28	0.29	0.30

Organoleptic evaluation of the sponge cake made from pumpkin meal:

Data obtained in Table (3) for sensory properties showed that the control sample of sponge cake made from wheat flour 72% extraction had the highest degree (98.78%) of sensory acceptance. The same sensory acceptability resultant showed that in the sponge cake made from wheat flour 72% extract and added the pumpkin meal at 5, 10 and 15% (97.45, 95.44 and 92.35%, respectively). From the results it could be concluded

that the sensory characteristics can be no variation by various concentrations of the ingredients in dough during production of sponge cake prepared wheat flour 72% extract and it was added separately 5, 10and 15% pumpkin meal were acceptable to most members regarding to taste, odor, texture, crust color, crumb color, general appearance and overall acceptability.

Pongjanta *et al.* (2006) reported that more than 15% of pumpkin powder substitution in sandwich bread; sweet bread and cookie formulations had too strong an effect on the physical and sensory properties of the products, while 20% pumpkin powder was optimum for butter cake, and chiffon cake. The substituted products had high energy content. A composite of pumpkin powder and wheat flour increased vitamin A from 1.88 to 12.92% per 20 to 40 g of the baked products consumed. Chiffon cake, sandwiches bread, sweet bread, butter cake, and pumpkin cookies were accepted by the consumers at the level of "like moderately" to "like very much". Most of the respondents (90-100 %) would accept and buy the products.

Dreher (1987) reported that fiber components can give texture, gelling, thickening, stabilizing, and emulsifying effects on certain foods Ability of flour to retain water and oil improves the mouthfeel of a food product and helps to reduce fat and moisture losses. Syneresis in food products is controlled by adding food ingredients with high water holding capacity (WHC) (Grigelmo-Miguel *et al.,* 1999). Thus, pumpkin could be processed into flour to be incorporated in baked products as wheat–pumpkin composite flour blend for fiber enrichment and other functional purposes

Table 3. Effect of pumpkin meal on the sensory evaluation of sponge cake:

Types of additions	Taste 20	Odor 20	Texture 15	Crust color 15	Crumb color 15	General Appearance 15	Overall acceptability 100
Control	19.75[a] ±0.56	19.50[a] ±0.13	14.82[a] ±0.66	14.90a ±0.11	14.91[a] ±0.80	14.90[a] ±0.65	98.78
5 % pumpkin	19.30[a] ±1.06	19.20[a] ±0.93	14.35[a] ±0.97	14.80[a] ±0.74	14.89[a] ±0.78	14.91[a] ±0.99	97.45
10 % pumpkin	19.10[a] ±1.06	19.10[a] ±0.12	14.25[a] ±0.28	14.70[a] ±0.47	14.42[a] ±0.09	14.67[a] ±0.67	95.44
15 % pumpkin	19.15[a] ±0.71	18.87[b] ±0.44	14.11[a] ±0.06	13.12[b] ±0.85	13.45[b] ±0.62	14.35[a] ±0.16	92.35

Effect of storage period on peroxide value in sponge cake blends:

The peroxide value is a good index for the quality of a fat. A refine fats should have peroxide value less than 1 millequivalent fat that have been stored for some period of time after refining may be found to have peroxide value of up to 10 millequivalent / kg oil (Rossell, 1983).

From the results in Table (4) it could be observed that the blends made from pumpkin meal 10 and 15% effectively inhibited to increase in peroxide value for four weeks period. Moreover, very close effects were observed for these blends. This means that pumpkin meal contained antioxidants to which lipid peroxidation during storage.

Table 4. Effect of storage period on peroxide value (millequivalent / kg oil) of sponge cake blends.

Storage period/week	Control	Blends cake made from pumpkin		
		5%	10%	15%
Zero	2.12	2.12	2.12	2.12
One week	4.79	3.45	2.64	2.42
Two weeks	7.82	4.67	3.71	3.15
Three weeks	10.35	7.23	4.95	3.98
Four weeks	14.47	11.52	8.74	5.27

Carotenoids have antioxidant activity, but few of them are converted into retinol, the active form of vitamin A (Quirós and Costa, 2006 and Dini *et al.,* 2013). Of the 600+ carotenoids with pro-vitamin A activity, the most common are α- and β-carotene. These carotenoids are susceptible to degradation (isomerization and oxidation) during cooking.

Antioxidants are chemicals/materials that interact and deactivate the free radicals, therefore preventing them from causing harm. The prevention of actions of free radical is important step in the management of disease. Medicinal plants and their constituents play a vital and significant action to neutralize or inhibit the free radical by the use of antioxidant activity. Experimental studies support the role of reactive oxygen species in cancer and dietary antioxidants as well as endogenous antioxidants shows a vital role as cancer preventive agents via neutralization of reactive oxygen species Borek *et al* (1986). Another study also showed that plant phenolic compounds including flavonoids are effective antioxidants with reported anti-mutagenic and anti-carcinogenic effects Rice-Evans *et al.* (1997).

Biological investigation:

Effect of feeding sponge cake on the initial body weight, gain body weight, total food intake and feed efficiency ratio in the experimental hypercholesterolemic rats:

Initial body weight, gain body weight, total food intake and feed efficiency ratio in the experimental hypercholesterolemic rats which were fed separately on 20% sponge cake made from5, 10 and 15% pumpkin meal and the results are reported in Table (5). The mean values of initial body weight of all groups after adaptation feeding on basal diet were ranged from 173.2 to 177.4 g.

At the end of experimental period (4 weeks), the final body weight of negative control hypercholesterolemic rats was higher than the positive control. The hypercholesterolemic rats were fed on sponge cake had lower in final body weight than those of the hypercholesterolemic rats positive control.

The obtained results illustrated that the gain in body weight at the end of experimental period for the negative control fed on basal diet was increased 146.6 g, while the hypercholesterolemic positive control fed on hypercholesterolemic diet was increased 56.0 g. Feeding on basal diet supplemented with sponge cake made from 5% 10% and 15 % pumpkin meal had lowered in body weight gain 90.3, 81.8 and 70.5 g respectively than negative control (146.6 g) and increased than positive control 56.0 g.

Concerning food intake, the results indicated that rats fed on basal diet and sponge cake are reported in the same table. The values of food intake for negative control were 560 g and 530g for hypercholesterolemic rats as positive control. Whereas, the rats group 1, 2 and 3 fed on sponge cake, the food intake were nearly values 490, 470and 420 g , respectively for four weeks

The calculate data of feed efficiency ratio (FER) for rats fed on basal diet and sponge cake summarized in the same table. From the results, it can be observed that the value of feed efficiency ratio of basal diet was 26.1%, which was depressed to 10.6% for hypercholesterolemic control positive. The FER values of rats group 1, 2 and 3 were 18.4, 17.4 and 16.7%, respectively fed on sponge cake made from 5, 10 and 15% pumpkin meal.

The gain body weight, food intake and feed efficiency ratio were decreased in rats group 1, 2 and 3 respectively, may be due to the groups fed on sponge cake made from pumpkin at different levels had contained rich amounts from dietary fiber which are consists of soluble and insoluble dietary fiber, the results are significantly greater reduction of weigh, food intake and feed efficiency ratio.

Table 5. Initial body weight, gain body weight, gain body weight and feed efficiency ratio in experimental hypercholesterolemic rats.

Groups	Initial body weight (g)	Gain body weight (g)	Total food intake (g)	Feed efficiency ratio
Control -ve	175.0 ± 2.70^{a}	146.6 ± 2.70^{a}	560 ±6.24^{a}	26.1 ±0.05^{a}
Control +ve	173.2 ± 2.58^{a}	56.0 ± 2.44^{a}	530 ±6.25^{a}	10.6 ±0.04^{c}
Group 1	176.2 ±2.34^{a}	90.3 ±1.95^{ab}	490 ±5.43^{b}	18.4 ±0.04^{ab}
Group 2	173.8 ± 3.49^{a}	81.8 ± 5.10^{b}	470 ± 5.36^{b}	17.4 ±0.08^{ab}
Group 3	177.4 ±3.95^{a}	70.5 ±4.54^{c}	420 ±5.17^{b}	16.7 ±0.05^{b}

Effect of sponge cake from pumpkin meal on total lipid and triglycerides on feeding hypercholesterolemic rats.

At the end of biological experimental period the total lipid and triglyceride were determined in all groups fed on basal diet substitute with 20% from sponge cake made from 5, 10 and 15% pumpkin meal and the results are reported in Table (6). From the results in Table (6), it could be noticed that the total lipid and triglyceride were increased in control positive (1.42g/dl and 245.7 mg/dl) than control negative was 0.65g/dl and 112.3 mg/ dl, respectively. Moreover, the results illustrated that the hypercholesterolemic rats fed on sponge cake made from 15% pumpkin meal; the total lipid and triglyceride were the lowest 0.68 g/dl and 115.1 mg/dl followed by hypercholesterolemic rats fed on 10% sponge cake was amounted 0.78 g/dl and 141.0 mg/dl. The hypercholesterolemic rats fed on sponge cake made from 5% pumpkin meal was increased in total lipid and triglyceride 0.97g/dl and 170.5 mg/dl than other group fed on sponge cake. These results showed that all groups were fed on sponge cake during experimental period; the total lipid and triglyceride were decreased at the end of experimental due to the pumpkin meal had contained high fiber amount that increases degradation of cholesterol to fecal bile acids.

The obtained results are in agreement with Parsaeyan (2012) found that the mechanism of the observed hypotriglyceridemic effect may be due to decreased fatty acid synthesis, increased lipolytic activity by inhibition of hormone-sensitive tissue lipases or suppression of lipogenic enzymes, Activation of LCAT and tissues lipases.

Table 6. Serum triglycerides and total lipids (after 4 weeks) of the experimental hypercholesterolemic rats.

Groups	Total lipids		Triglycerides	
	g/dl	% at control	mg/dl	% at control
Control -ve	0.65 ±0.03^{c}	100	112.3 ±6.1^{c}	100
Control +ve	1.42 ±0.17^{a}	218	245.7 ±27.9^{a}	219
Group 1	0.97 ±1.02^{ab}	149	170.5 ±10.5^{ab}	151
Group 2	0.78 ±0.13^{b}	120	141.0 ±30.0^{b}	125
Group 3	0.68 ±0.19^{c}	105	115.1 ±7.5^{c}	102

Effect of feeding pumpkin cake on blood sugar, total cholesterol, HDL and LDL in hypercholesterolemia rats.

At the end of biological experimental the present data in Table (7) showed that the determination of blood sugar, total cholesterol, high density lipoprotein (HDL) and low density lipoprotein (LDL) in rats fed on hypercholesterolemic diet substitute separately with 20% from sponge cake made from 5% ,10% and 15% pumpkin meal. From the results in Table (7), it could be observed that the total cholesterol in control positive was the highest amounted (296.3 mg/dl) than other group due to the positive control fed on basal diet during the experimental period. Moreover, the results illustrated that the hypercholesterolemic rats fed on sponge cake made from 15% pumpkin meal, the total cholesterol had the lowest (200.0 mg/dl) contained and nearly the negative healthy control 186.3 mg/dl fed on basal diet. These lowering results may be caused the sponge cake made from 15% pumpkin meal which highly amounts from total dietary fiber, soluble and insoluble fibers. The hypercholesterolemic rats fed on sponge cake contained of 10% pumpkin meal had lowered cholesterol 227.0 mg/dl followed by hypercholesterolemic rats fed on sponge cake prepared from 5% pumpkin meal was 240.6 mg/dl.

Table 7. Serum cholesterol profile and blood sugar (after 4 weeks) of the experimental hypercholesterolemic rats:

Groups	Total cholesterol (mg/dl)	HDL (mg/dl)	LDL (mg/dl)	Blood sugar (mg/dl)
Control -ve	186.3 ±1.1^{c}	83.7 ±4.0^{a}	25.0 ±5.56^{c}	115.3 ±5.7^{c}
Control +ve	296.3 ±6.5^{a}	47.3 ±7.2^{d}	131.7 ±20.2^{a}	169.3 ±3.8^{a}
Group 1	240.6 ±4.1^{b}	67.5 ±3.1^{b}	44.3 ±9.8^{b}	130.1 ±2.3^{b}
Group 2	227.0 ±7.0^{ab}	74.0 ±5.3^{ab}	40.6 ±10.0^{ab}	125.3 ±1.2^{ab}
Group 3	200.0 ±6.3^{c}	80.0 ±4.2^{a}	30.7 ±6.34^{c}	110.7 2.8^{c}±

Low density lipoprotein (LDL) was opposite results to low density lipoprotein (LDL) and the results are reported in the same Table. The results illustrated that the LDL in positive control was the highest amounted 131.7 mg/dl and the control negative was the lowest amounted 25.0mg/dl as well as the rats group fed on 15% sponge cake was 30.7 mg/dl followed by 10% was 40.6 mg/dl and 5% was 44.3 mg/dl, respectively.

High density lipoprotein (HDL) was determined in all groups and the best group from the results was the rats fed on sponge cake made from 15% pumpkin meal was 80.0 mg/dl followed by 10% was 74.0 mg/dl and 5% was 67.5 mg/dl, respectively.

Moreover, the blood glucose from the obviously results, It could be noticed that the positive control was the highest amounted 169.3 mg/dl followed by rats fed on basal diet substitute with 20% from sponge cake made from 5% pumpkin meal was 130.1mg/dl. Whilst, the groups fed on basal diet substitute with 20% from sponge cake made from10 and 15% pumpkin meal were decreased 125.3 and 110.7 mg/dl, respectively, than control positive and nearly to control negative 115.3 mg/dl. These results are in agree with Brown *et al.* (1999) who reported that the soluble fibers have the most beneficial effects on cholesterol metabolism. In a meta-analysis, soluble fibers, pectin and guar gum were all proven to be equally effective in reducing plasma total and LDL cholesterol levels. When included within a low saturated fat and cholesterol diet, soluble fibers lowered LDL cholesterol concentrations by 5–10% in hypercholesterolemic and diabetic patients Brown *et al.* (1999) and Sierra *et al.* (2002).

From the obviously results it can may be concluded that the pumpkin meal is a reach source of fiber, total dietary fiber, total cartenoids and mineral elements. Therefore, the sponge cake made from 10 and 15%

pumpkin reported that general appearance and overall acceptability, effectively inhibited to increase in peroxide value for four weeks period and effects on lowering lipid patterns and blood glucose level

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