Production of Biscuits Lowering Cholesterol from Soybean Treated with Microwave Apparatus

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Abstract: This study was carried out to effect of microwave heating on protein solubility and on the functional properties such as the water holding, oil binding, emulsifying, and foaming capacities for soybean meal and wheat flour 72% extraction. The results found that the microwave treated (MWT) soybean meal and wheat flour 72% extraction produced significantly enhanced values and the time for MWT as 60 sec., 120 sec. and 300 sec. was found to alter the functionality of the soybean meal and wheat flour 72% extraction. Protein solubility in general was increased during microwave treatment (MWT) for a short period of time. The results have indicated that microwave treatment (MWT) of the raw materials for a limited time period will be helpful in designing the processing system and determining the quality of processed foods. Organoleptic characteristics were determined in biscuit and their blends made from microwave soybean meal at level 10, 20 and 30% plus microwave wheat flour 72% extraction. The results showed that the sensory characteristics could be no variation by various concentrations of the ingredients in dough during production of biscuits at level 10, 20 and 30% soybean meal were acceptable to most members regarding to taste, odor, texture, crust color, crumb color, general appearance and overall acceptability. 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 biscuits made from 10, 20 and 30% microwave soybean meal and the results are reported that the hypercholesterolemic rats fed on biscuits made from 30% microwave soybean meal; the total lipid and triglyceride were the lowest 0.68 g/dl and 115.1 mg/dl followed by hypercholesterolemic rats fed on 20% biscuits was amounted 0.78 g/dl and 141.0 mg/dl. Moreover, the results illustrated that the hypercholesterolemic rats fed on biscuits made from 30% soybean 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 biscuits made from 30% soybean meal. Moreover, the blood sugar in the groups was occurred the above results. From the obviously results it can may be recommended the biscuits made from 10, 20 and 30% microwave soybean meal was observed that general appearance and overall acceptability and effects on lowering lipid parameters and blood glucose level.
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1. Introduction

Legumes, the seeds of the pod-bearing plants belonging to the order *Leguminosae* are the major source of diet consisting complex carbohydrates, dietary fibers, proteins, vitamins, minerals and variety of photochemical. In Africa, per capita consumption of proteins and essential amino acids is generally very low and legumes represent the major source of proteins in the diet **(Araujo et al., 2002).** Although the production of legumes is relatively less as compared to cereals however, they play key role in protein enrichment all over the world **(FAO, 1980).** In spite of the high nutritive values, some of the legumes are still underutilized; on the other hand protein deficiency in diet is widespread in many of the underdeveloped countries **(Adebowale and Lawal, 2004).**

Soybean has distinct nutritional values because of its high protein, vitamin, and mineral compositions that offer healthy advantages **(Obatolu et al. 2006).** Health and medicinal benefits associated with soy protein include reduced blood cholesterol level **(Anderson et al. 1995),** protection against cardiovascular disease, and reduced risk of certain cancers (prostate and breast) in humans **(Peterson and Barnes, 1993).**

Wheat (*Triticum satvium*), a major cereal crop is used commonly as the diet source for half of the world population and contribute more than 60% to the total proteins requirement in developing countries. Wheat proteins have lysine as the main limiting amino acid, following tryptophan, thereonine and methionine. The consumption of gliadins, a kind of prolamins causes celiac disease in gluten intolerant individuals **(Thompson, 2001).** However, the importance of wheat proteins is attributed to their unique viscoelastic properties where gas is occluded and retained in the liquid phase during dough development from the flour, water and other ingredients. The gluten-starch matrixes form the cell membranes that surround the expanding gas cells during fermentation and mixing **(Lagrain et al., 2005 and Baninder et al., 2009).** The mixing process facilitates the different flour proteins interactions within themselves and with the starch, which manipulates the gelatinization temperatures, rate of water evaporation and retrogradation etc. The intermolecular movements and the formation of their complexes govern the end quality of the baked products **(Mohamed et al., 2003 and Ying et al., 2006).**

Microwave baking is a rapid method as compared to the convectional heating and the effect of the MW heating on the grains to limit the moisture without changing the other properties has been investigated for facilitating the product development **(Macarthur and Dappolonia, 1982 and Campana et al., 1986).** It has been reported that the physical and chemical properties such as the viscosity, elasticity, hydrophobicity, damage starch, total starch, water absorption capacity etc., were not significantly changed during MW heating as revealed by the graphic characteristics **(Kaasova et al., 2003)** however, the initial moisture and the extent of input of the MW energy are critical parameters in maintaining the native properties of the ingredients. The baking quality was further improved by using the sprouted wheat and it was found that falling number and gluten index increased by increasing the MW energy, in view of the fact that amylase gets inactivated and the number of the disulphide bridges increased however, the wet gluten content decreases as a consequence of higher energy consumption **(Kaasova et al., 2002).** The MW treatment has illustrated that grassy, bean and gum flavor of pulses may be desirably reduced in various types of the processed foods **(Yun et al., 2005).** The spread ratio (width/height) values were suggested for rapid evaluation of the end quality of baked products **(Dogan et al., 2002).**

The aim of this investigation was carried out to evaluate the microwave treatment on protein solubility and on the functional properties for soybean meal and it was prepared biscuits fortified with soybean meat treated with microwave. The sensory characteristics and biological experiential were evaluated using biscuits at level 10, 20 and 30% microwave soybean meal.

2. Materials and Methods

Materials:

Soybean meal (*Glycine max*) and wheat flour (*Triticum satvium*), 72% extraction were purchased from local market west zone in Saudi Arabia. The other ingredients used to prepare biscuit were obtained in local market from Saudi Arabia.

Kits for determination of serum glucose and lipid parameters were purchased from Alkan-Medical Division Biocon, Germany.

Methods:

Microwave treatment of soybean meal and wheat flour 72% extraction:

Microwave treatment (MW) oven whirlpool l243/ukm347 (Norrkopping, Sweden) with frequency 2450 MHz and inner volume 25.41 L, was preheated to achieve a standard uniform temperature, by first heating 200 mL of water for 50 sec. The soybean flour and wheat flour 72% extraction (100 g each) were heated in a polyethylene container for 60 sec., 120 sec. and 300 sec. and were left for 1 min. in the oven for cooling. The samples were manually mixed with the spoon to achieve the homogeneous heating.

Determination of functional properties of microwave soybean meal and wheat flour 72% extraction:

Water holding capacities (WHCs) of each of the microwave soybean meal and wheat flour 72% extraction was determined using the method of **Beuchat (1977).** Oil binding capacities (OBCs) were determined of microwave soybean meal and wheat flour 72% extraction using the method of **Chakraborty (1986).** Foaming capacity (FC) and foaming stability (FS) of microwave soybean meal and wheat flour 72% extraction were determined in triplicate using the method described by **Makri et al. (2005).** Protein solubility (PS) of the microwave soybean meal and wheat flour 72% extraction were mixed with water separately in a ratio of 1/20 (w/v), the pH of each of the mixtures was adjusted separately from pH 2.0–10.0 in different test tubes using 0.1 N NaOH and 0.1 N HCl. The soybean flour and wheat flour 72% extraction suspensions were stirred at room temperature for 1 h, and then centrifuged at 3000 g for 15 min. The soluble protein concentration in each supernatant was determined at 595 nm **(Bradford, 1976).**

Emulsifying capacity (EC) (emulsion stabilities) were determined in triplicate of microwave soybean meal and wheat flour 72% extraction according to the method described by **Sath and Salunkhe (1981).** The samples (2 g) of each of the flours were mixed with 40, 50, 60, 70 and 100 mL of distilled water for 2 min. using a blender and 200 mL of vegetable oil was added slowly with continuous blending. The final end point was determined by Ohm meter measuring the electrical conductivity as described by **Webb et al. (1970).**

Preparation of different blends biscuits fortified with microwave soybean:

The ingredients of biscuits as microwave wheat flour 72% extrusion 100g, microwave soybean meal at levels 10, 20 and 30 % separately added, vegetable oil 16 g, milk powder 2.6 g, salt 0.36 g, vanillin 0.54 g and water 18g were mixed in mixer for 10 min. The control biscuit was prepared microwave wheat flour 82% extraction and other ingredients without microwave soybean meal. The different dough was rolled in a cookie sheet using a guide roll and backed at 280^{o}C for 12 min in an electric oven according **Wade (1988)**.

The biscuit blends were allowed to cool on racks for about one hour before evaluation. The organoleptically evaluation for different blends of biscuit blends were estimated by ten experienced panelists according to **AACC (2002).**

Nutritional experiments:

Male albino adult rats (30 rats) weight ranging 170-180g were brought from House Experimental Animal, Center of King Fahd for Researches, University King Abdul-Aziz, Jada City, Saudi Arabia 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 alternative 20% biscuits made from microwave soybean at different levels 10, 20 and 30%, respectively for four weeks.

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^{o}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:

The obtained data were exposed to analysis of variance. Duncan's multiple range tests at ($P \leq 0.05$) level was used to compare between means. The analysis was carried out using the PRO ANOVA procedure of Statistical Analysis System **(SAS, 2004).**

3. Results and Discussion

Functional properties of microwave soybean meal and wheat flour 72% extraction:

The data presented in Table (I) has shown, that water holding capacity (WHC) of the microwave soybean meal and wheat flour 72% extraction has increased the WHC. The increase in WHC of soybean meal was recorded as the highest as from 4.42 to 6.12 mL per 100 g of flour. Microwave treatment (MWT) at 300 sec. has the highest WHC, which may be due to uncoiling and more exposure of the hydrophilic domains of the various proteins, responsible for increase in water absorption. Therefore, the quality and quantity of various types of proteins, starches and dietary fibers in any raw material will predict the texture at the end of baking. Microwave treatment (MWT) of soybean meal and wheat flour is able to increase the WHC, which often is required in baked products to make the texture harder and crispy.

The Oil binding capacity (OBC) as in Table (I) showed that the microwave (MW) heating for 60 sec. has increased OBC in all the treatment samples, while it decreased with further heating. This behavior may be attributed to the extent of the insolubility of proteins. The wheat proteins (gluten) are almost insoluble in water and have shown maximum capacity of oil absorption in wheat flour after 300 sec. while the soybean is more protein and the maximum capacity of oil absorption in soybean meal after 60 sec. may be caused during MWT proteins were denatured when heated for 60 sec., 120 sec. or 300 sec. exposing hydrophobic sites that increased lipid interaction leading to decrease oil binding capacity (OBC).

The formation of foaming capacity and stability foams where water molecules surround air droplets represents the non-polar phase and is related to soft texture of food products. Some proteins and peptides in dispersion are capable of reducing the surface tension at the water-air interface that leads to foaming. The proteins are good foaming agents as they easily diffuse into the air-water interface forming cohesive, adhesive and elastic films by partial unfolding themselves. The foaming capacity of proteins is strongly related to number and matrix of the hydrophobic amino acids which are exposed at the surface of the protein molecules **(Kong, 2007).** The maximum foaming capacity was achieved at 300 sec. in MWT in the soybean meal and wheat flour as shown in Table (I). From the results it could be noticed that the soybean meal has the high FC as compared to the wheat flour at treatment for 300 sec. its means that greater exposure of hydrophobic amino acids. It also proves that MWT stimulate protein unfolding and protein–protein interactions, which elevates the viscosity and facilitates the formation of multilayer the viscosity and facilitates the formation of multilayer cohesive protein film at the interface of bubbles, offering resistance to coalescence **(Surowka and Fik, 1992).**

Increase protein solubility (PS) in Table (1) is not only due to the size reduction of the protein molecules but it involves also the reduction of the secondary structure of the parent protein molecules. Microwave treatment (MWT) induces both desirable and undesirable effects on the soybean meal and wheat flour. It inactivates the anti-nutrients such as the trypsin and amylase inhibitors in legumes, thus improving the bioavailability and digestibility of the proteins and starches **(Snyder and Kwon, 1987).** Decrease in the PS value after MWT are showed in Table (1) and can be explained by the effect of heating, which increased surface hydrophobicity of protein due to unfolding of the helical secondary structure, exposure of the hydrophobic amino acids their interactions and formation of the disulfide bonds **(Kong et al., 2007).**

Table (1): Effect different microwave treatment on physicochemical properties of soybean meal and wheat flour 72% extraction.

Variety	Microwave treatment(sec.)	WHC (ml)	OBC (ml)	FC (ml)	FS (min)	P S pH 7
Soybean meal	0	4.42 ±0.25[a]	4.55 ±0.14[b]	4.42 ±0.24[c]	9	1.61 ±0.11[d]
	60	4.74 ±0.31[a]	4.96 ±0.21[b]	4.71 ±0.31[c]	20	1.64 ±0.09[d]
	120	5.31 ±0.16[a]	4.86 ±0.25[b]	5.31 ±0.13[c]	10	0.92 ±0.03[d]
	300	6.12 ±0.39[a]	3.89 ±0.33[b]	6.12 ±0.19[c]	15	0.65 ±0.08[d]
Wheat flour 72% extraction	0	4.45 ±0.16[a]	4.49 ±0.17[b]	4.45 ±0.24[c]	6	1.29 ±0.09[d]
	60	4.43 ±0.27[a]	4.57 ±0.21[b]	4.43 ±0.13[c]	14	1.28 ±0.05[d]
	120	4.59 ±0.10[a]	4.47 ±0.31[b]	4.59 ±0.24[c]	11	0.97 ±0.12[d]
	300	4.92 ±0.27[a]	4.78 ±0.20[b]	4.92 ±0.32[c]	12	1.20 ±0.14[d]

WHC: Water holding capacity OBC: Oil binding capacity FC: Foaming capacity FS: Foaming stability PS: Protein solubility

Emulsifying capacity (EC) different microwave treated samples:

The microwave treatment (MWT) of soybean meal and wheat flours for 50 s in various flours improved emulsifying capacity (EC) due to an increase in balanced surface availability of hydrophobic and hydrophilic amino acids. The data in Table (2) indicates that the MWT need only small quantity of oil for excellent emulsion formation with strong stability. The EC at 50 sec has shown that soybean meal > wheat flour, which may be attributed to increased protein content of soybean meal. More globulin proteins get solubilized in salt solutions thus increasing the exposure of more hydrophobic groups at the water and oil interface, resulting in increased EC and stability of the emulsion. Moreover, the EC is ability of proteins to diffuse at the oil-water interface and to develop interlink ages with water and hydrophilic amino acids and oil with hydrophobic amino acids simultaneously. The role of proteins as emulsifiers in food processing is well recognized as a result of the binding of water and oil with proteins simultaneously. Formations of such complexes help in food systems because of their effects on the flavor and texture of the final products. The hydrophilic and hydrophobic properties facilitate both water and oil to be mixed in food systems **(Agyare et al., 2009)**.

Table(2): Emulsion capacities of different microwave treated samples:

Variety	Microwave treatment(sec.)	Water and oil ratio (ml) in formation of stable emulsion				
		Water 40 mL	**Water 50 mL**	**Water 60 mL**	**Water 70 mL**	**Water 100 mL**
Soybean meal	0	20	39	35	40	60
	60	37	50	56	63	72
	120	20	39	30	49	48
	300	41	40	31	29	74
Wheat flour 72% extraction	0	24	22	40	38	76
	60	15	19	28	45	40
	120	9	13	8	13	15
	300	9	19	18	10	12

Organoleptic evaluation of the biscuits made from soybean meal:

Data obtained in Table (3) for sensory properties showed that the control sample of biscuits made from wheat flour 72% extraction had the highest degree (98.78%) of sensory acceptance. The same sensory acceptability resultant showed that in the biscuits made from wheat flour 72% extract and added the soybean meal at 10, 20 and 30% (96.45, 89.44 and 81.35%, 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 biscuits prepared wheat flour 72% extract and it was added separately 10, 20 and 30% soybean meal were acceptable to most members regarding to taste, odor, texture, crust color, crumb color, general appearance and overall acceptability.

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, microwave soybean meal could be processed into flour to be incorporated in baked products as wheat–soybean composite flour blend for fiber enrichment and other functional purposes.

Table (3) Effect of microwave soybean meal on the sensory evaluation of biscuit:

Types of additions	Taste 20	Odor 20	Texture 15	Crust color 15	Crumb color 15	General Appearance 15	Overall acceptability 100
Control	19.75 ±0.56[a]	19.50 ±0.13[a]	14.82 ±0.66[a]	14.90 ±0.11[a]	14.91 ±0.80[a]	14.90 ±0.65[a]	98.78
10 % Soybean	19.30 ±1.06[a]	18.20 ±0.93[a]	14.35 ±0.97[a]	14.80 ±0.74[a]	14.89 ±0.78[a]	14.91 ±0.99[a]	96.45
20 % Soybean	18.10 ±1.06[ab]	17.10 ±0.12[ab]	14.25 ±0.28[a]	13.70 ±0.47[a]	13.42 ±0.09[a]	13.67 ±0.6 7[a]	89.44
30 % Soybean	16.15 ±0.71[b]	15.87 ±0.44[b]	14.11 ±0.06[a]	11.12 ±0.85[b]	12.45 ±0.62[b]	12.35 ±0.16[b]	81.35

Biological investigation:

Effect of feeding biscuits 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% biscuits made from 10, 20 and 30% soybean meal and the results are reported in Table (4). 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 to 146.6 g, while the hypercholesterolemic positive control fed on hypercholesterolemic diet was increased to 56.0 g. Feeding on basal diet supplemented with biscuits made from 5%, 10% and 15 % soybean 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 biscuits 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 biscuits, 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 biscuits 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 biscuits made from 10, 20 and 30% soybean 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 biscuits made from soybean meal 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.

Legumes, such as soybeans, kidney beans, lentils and chickpeas, contain many important nutrients and photochemical; and are present in most Chinese daily diets as good sources of protein, generous amounts of dietary fiber, starch, lipids and minerals. Many researchers have shown the relationship between legume consumption and health benefits, such as, protection from cardiovascular disease, breast cancer, colon cancer, other cancers and diabetes **(Mathers, 2002).**

Table (4): 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 negative	175.0 ± 2.70^{a}	146.6 ± 2.70^{a}	560 ±6.24^{a}	26.1 ±0.05^{a}
Control positive	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 biscuits from soybean 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 biscuits made from 10, 20 and 30% soybean meal and the results are reported in Table (5). From the results in Table (5), 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 biscuits made from 30% soybean meal; the total lipid and triglyceride were the lowest 0.68 g/dl and 115.1 mg/dl followed by hypercholesterolemic rats fed on 20% biscuits was amounted 0.78 g/dl and 141.0 mg/dl. The hypercholesterolemic rats fed on sponge cake made from 5% soybean meal was increased in total lipid and triglyceride 0.97g/dl and 170.5 mg/dl than other group fed on biscuits. These results showed that all groups were fed on biscuits 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 (5): 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 negative	0.65 ±0.03[c]	100	112.3 ±6.1[c]	100
Control positive	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 biscuits on blood sugar, total cholesterol, HDL and LDL in hypercholesterolemia rats.

At the end of biological experimental the present data in Table (6) 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 biscuits made from 10% ,20% and 30% soybean meal. From the results in Table (6), it could be observed that the total cholesterol in control positive was the highest amounted (297.3 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 biscuits made from 30% soybean meal, the total cholesterol had the lowest (200.0 mg/dl) contained and nearly the negative healthy control 187.3 mg/dl fed on basal diet. These lowering results may be caused the biscuits made from 30% soybean meal which highly amounts from total dietary fiber, soluble and insoluble fibers. The hypercholesterolemic rats fed on sponge cake contained of 20% soybean meal had lowered cholesterol 227.0 mg/dl followed by hypercholesterolemic rats fed on biscuits prepared from 10% soybean meal was 240.6 mg/dl.

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 25.0 mg/dl as well as the rats group fed on 30% biscuits was 30.7 mg/dl followed by 20% was 40.6 mg/dl and 10% 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 biscuits made from 30% soybean meal was 80.0 mg/dl followed by 20% was 74.0 mg/dl and 10% was 67.5 mg/dl, respectively.

Table (6): 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 negative	187.3 ±1.1[c]	83.7 ±4.0[a]	25.0 ±5.56[c]	115.3 ±5.7[c]
Control positive	297.3 ±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]±

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 biscuits made from 10% soybean meal was 130.1mg/dl. Whilst, the groups fed on basal diet substitute with 20% from biscuits made from 20% and 30% soybean 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.

From the obviously results it can may be concluded that the microwave soybean meal is a reach source of fiber, total dietary fiber, total protein, natural antioxidant and mineral elements. Therefore, the biscuits made from 10, 20 and 30% microwave soybean meal plus wheat flour 72% extraction are reported that general appearance, and overall acceptability and effects on lowering lipid parameters and blood glucose level.

References

1. AACC (2002). American Association of Cereal Chemist. Approved Method, Published by American Association of Cereal Chemists, Ins. St. Poul, Minesota, USA.
2. Adebowale, K.O. and O.S. Lawal, (2004). A Comparative study of the functional characteristics of some underutilized African Legume flours: Bambarra groundnut (*Voandzeia subterranean*), Jack bean (*Canavalia ensiformis*) and Mucuna bean (*Mucuna pruriens*). *Food Res. Int.*, 37: 335–365.
3. Agyare, K.K., K. Addo and Y.L. Xiong, (2009). Emulsifying and foaming properties of transglutaminase-treated wheat gluten hydrolysate as influenced by pH, temperature and salt. *Food Hydrocolloids*, 23: 72–81
4. Allain, C. C., Poon, L., Chan C. S. and Richmond, W. (1974). Enzymatic determination of total cholesterol. Clin. Chem., 20 (4): 470 – 475
5. Anderson, J. W., Johnstone, B. M. and Cook-Newell, M. E. (1995). Meta-analysis of the effects of soy protein intake on serum lipids. The New England Journal of Medicine 333 (5), 276–282.
6. AOAC (2005). Official Methods of Analysis of the Association of Official Analytical Chemists, 18th ed., Washington, D.C.
7. Araujo, A.H., P.C.B. Cardoso, A.R. Pereira, M.L. Lima, A.S. Oliveira and M.R.A. Miranda, (2002). *In vitro* digestibility of globulins from cowpea (*Vigna unguiculata*) and xerophitic algarroba (*Prosopis julifora*) seeds by mammalian digestive proteinases:a comparativestudy. *Food Chem.*, 78: 143–147.
8. Arbeeny, C. M. and Bergquist, K. E. (1991). The effect of pravastatin on serum cholesterol levela in hypercholesterolemic diabetic rabbits. Biovhem. Biophys. Acta., 1096 (3): 238-244.
9. Baninder, S.S., R.S. Bean and F. MacRitchie,(2009). Mechanism of gas stabilization in bread making. I. The primary gluten-starch matrix, *J. Cer. Sci.,* 49: 32–40
10. Beuchat, L.R. (1977). Functional and electrophoresis characteristics of succinylated peanut flour protein. *J. Agric. Food Chem.*, 25: 258–261
11. Bradford, M.M., (1976). Method for quantitation of microgram quantities of protein utilizing the principle of protein-dye-binding. *Biochemistry,* 72: 248–254.
12. Brown, L., Rosner, B., Willett, W.W. and Sacks, F. M. (1999). Cholesterol-lowering effects of dietary fiber: a meta-analysis. American Journal of Clinical Nutrition; 69(1):30–42. 69.
13. Buko, V., Lukivskaya, O., Nikitin, V., Tarasov, Y., Zavodink, L., Borodassky, A., Goren Shatein, B., Janz, B., and Gundermann, K. J. (1996). Hepatic and pancreatic effects of polyenoylphatidyl choline in rats with alloxan – induced diabetes. Cell Biochem. Funct., 14 (2): 131 – 137.
14. Burstein, M. (1970). HDL Cholesterol determination after separation of high density lipoprotein. Lipids Res., 11:583-589.
15. Campana, L.E., M.E. Sempe and R.R. Filgueira, (1986). Effect of microwave energy on drying wheat. *Cer. Chem.,* 63: 271–273
16. Chakraborty, P., M. Lemeguer and P. Jelen, (1986). Coconut proteins isolate by ultra filtration. *Food Eng. Proc. Appl.*, 2: 308–315
17. Dogan, I.S., 2002. Effect of α-amylases on dough properties during Turkish heart bread production. *Int. J. Food Sci. Technol*., 38: 1–8.
18. Dreher, M. L. (1987). Handbook of dietary fiber: an applied approach. New York : Marcel Dekker.
19. FAO, (1980). Food and Agriculture Organisation of the UN. Food Balance Sheets 1975–1977.
20. Fossati, P. and Prencipe, L. (1982). The determination of triglyceride using enzymatic methods. Clin. Chem., 28: 2077-2081.
21. Fruchart, J. C. (1982). LDL cholesterol determination after separation of low density lipoprotein. Rev. Fr. Des. Lab., 103:7-17.
22. Grigelmo-Miguel N., Gorinstein S., Martin-Belloso O. (1999). Characterization of peach dietary fiber concentrate as a food ingredient. Food Chem 65:175–81.
23. Kaasova, J., P. Kadlec, Z. Bubnik, B. Hubackova and J. Prihoda, (2003). Changes of starch during microwave treatment of rice. *Czech J. Food Sci.*, 21: 176–184
24. Kaasova, J., P. Kadlec, Z. Bubnik, B. Hubackova and J. Prihoda, (2002). Chemical and biochemical changes during microwave treatment of wheat. *Czech J. Food Sci*., 20: 74–78.
25. Kinght, J. A., Anderson, J. W. and Rowle, A. L. (1972). Chemical bases of the sulfo-phosphor vanillin reaction for estimating total serum lipids. J. Clin., 18: 199 –204.
26. Kong, X., H. Zhoua and H. Qiana, 2007. Enzymatic preparation and functional properties of wheat gluten hydrolysates. *Food Chem.*, 101: 615–620

27. Lagrain, B., T.G.K. Brijs and A. Delcour, 2005. Mechanism of gliadin– glutenin cross-linking during hydrothermal treatment. *Food Chem.*, 107: 753–760
28. Mathers, J. C. (2002). Pulses and carcinogenesis: potential for the prevention of colon, breast and other cancers. Br. J. Nutr., 88: 273-279.
29. Macarthur, L.A. and Dappolonia, B.L. (1982). Microwave and gamma radiation of wheat. *Cereal Foods World,* 27: 58–60
30. Makri, E., Papalamprou, E. and Doxastakis, G. (2005). Study of functional properties of seed storage proteins from indigenous European legume crops (lupin, pea & broad bean) in admixture with polysaccharides. *Food Hydrocolloids*, 19: 583–594
31. Mohamed, A.,. Gordon, S.H., Rayas-Duarte, P. and Xu, J. (2003). Estamation of heat damage in hard red winter wheat cultivars. *J. Food Chem.*, 87: 195–203
32. Obatolu, V.A., Olusola, O.O. and Adebowale, A.A. (2006). Qualities of extruded puffed snacks from maize/soybean mixture. Journal of Food Process Engineering 29, 149–161.
33. Parsaeyan, N. (2012).The effect of coriander seed powder Consumption on atherosclerotic and cardio protective Indices of Type 2 Diabetic Patients Iran Journal of Department an obesty,4(2): 127-132.
34. Peterson, T.G. and Barnes, S. (1993). Genistein and biochanin-a inhibit the growth of human prostate cancer cells but not epidermal growth-factor receptor tyrosine autophosphorylation. Prostate 22 (4), 335–345.
35. SAS (2004). Statistical Analysis System. SAS User's Statistics SAS Institute Inc. Editors, Cary, NC.
36. Sath, S.K. and Salunkhe, D. K. (1981). Solubilization and electrophoretic characterization of great northern bean *(Phaseolus vulgarisL)* proteins. *J. Food Sci.,* 46: 82–87
37. Surowka, K. and Fik, M. (1992). Studies on the recovery of proteinaceous substances from chicken heads: II-Application of pepsin to the production of protein hydrolysate. *Int. J. Food Sci. Tech.,* 27: 9–20
38. Snyder, H.E. and Kwon, T.W. (1987). Nutritional Attributes of Soyabeans and Soybean Products, pp: 187–217. In soybean utilization. New York: Van Nor strand Reinhold Company Inc
39. Tietz, N. W. (1986). Text Book of Clinical Chemistry. P.796.Saunders, W. B. Co., London-Pheladelphia.
40. Thompson, T. (2001). Wheat starch, gliadin, and the gluten-free diet. *J. American Diet Assoc*., 102: 637
41. Wade, P. (1988). Biscuits, cookies and crackers, vol., 1. Applied Sci., Publishers LTD, London, UK. Recipe of Marie biscuit used during investigation.
42. Webb, N.B., Ivey, F.J., Craig, H.B. and Jones, V.A. (1970). The measurement of emulsion capacity by electrical resistance. J. Food Sci., 35: 501
43. Ying, Hu Zhiqiang, I. Larry, Heller, B. Sturat, K.P. Glahn and R.M. Welch, (2006). Kaempferol in red and pinto bean seed (*Phaselous vulgaris* L.) coats inhibits iron bioavailability using as in vitro digestion/human caco-2 cell model. *Agric. Food Chem.,* 54: 9254–9261
44. Yun, H., Rema, G. and Quail, G. (2005). Physicochemical properties of processed pulse flour. 55th Australian Cereal Chemistry Conference and Pacific Rim Symposium.

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