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Effect of Soya Beans Bread Fortified with Turmeric or Ginger on Diabesity

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ABSTRACT

Diabesity indicates the coexistence of obesity and diabetes. In the 21st century, Diabesity is considered a leading cause of serious fatal chronic diseases. The objective of this study was to demonstrate the effect of bread formed of soya bean flour and turmeric or ginger in junction with a balanced hypocaloric regimen in reducing body weight and controlling diabetes in a sample of Egyptian females complaining of diabesity. This study was conducted on seventy two obese women suffering from type II diabetes. They followed a dietary therapy for 8 weeks. During the first 4 weeks, they followed a hypocaloric diet, supplemented with soya bean bread. While in the last 4 weeks, they followed only the hypocaloric regimen. Different anthropometric measurements, fasting blood glucose, serum lipid profile, C-peptide and Apolipoprotein J were determined. Data of the current study revealed that, bread formed of soya beans flour and fortified with curcumin or ginger helped in weight loss, decreased in % body fat with preservation of lean muscle mass, increased basal metabolic rate, reduced blood lipids levels, improved insulin sensitivity and reduced atherosclerosis risk. So both supplements can be used to prevent or delay the onset of diabesity- related co-morbidities by controlling the metabolic disorders.

Key words: Diabesity, Soya bean, Turmeric, Ginger.

INTRODUCTION

The increase in the prevalence of type II diabetes in line with the global rise in the scale of obesity and overweight persons with central obesity “accumulation of fat around the waist” led Ethan Sims, on 1973, to describea type of diabetes resulted in these obese patients which is nicknamed diabesity (diabetes+ obesity)[1], resulted from insulin resistance in spite of absence of family history of diabetes[2, 3,4].These patients with diabesity, have high level of plasma glucose, triglycerides, and impaired glucose tolerance[5]. Patients with diabesity are at high risk of serious medical problems such as heart disease, dementia, depression, hypertension, cancer, renal failure and blindness [6, 7].

Insulin resistance is a term used in case of inability of insulin to transport glucose into cells for metabolism, as a result of failure of insulin receptors on the cells to recognize the insulin [2, 8]. Muscles become resistant or insensitive to the insulin secreted from the pancreas and unable to take up the glucose circulating in the blood [9]. As a sequence, the pancreas produces more insulin for compensation, to the level that it becomes exhausted to secrete insulin hormone with the increased demand for insulin. This viscous deadly cycle where both insulin and glucose accumulate in the blood while organ cells is complaining of insulin starvation, end by the elevation of blood glucose levels and development of type II diabetes [10].

In 1857, Soya beans arrived first in Africa via Egypt [11]. Soya bean flour is an excellent source of different nutrients; it is rich in protein, essential fatty acids, minerals, isoflavones, and fibers. It contains more riboflavin, thiamine, lecithin, calcium, phosphorus, magnesium, folic acid and iron than wheat flour. Soy flour has a benefit of absence of gluten in its constituents [12]. Concerning Soya beans flour beneficial values; it prevents blood clotting, protects against cardiac infarction, protects against oxidation, minimizes risk of certain cancers development, lower cholesterol level, and prevents plague formation [13, 14].

Turmeric is derived from *Curcuma longa* plant. Turmeric has a naturalanti-inflammatory, antioxidant, and antitumor effects that make it one of the medicinal remedy, which has healthful effect on prevention and treatment of inflammatory diseases [15]. Its accepted yellow color, flavor make it used as spice, and in preservation of foods [16].

Ginger is derived from *Zingiberofficinale* plant family that includes cardamom and turmeric, which is the most widely used dietary condiment due to its high pharmacological benefits. Gingerols, the oily resin from the root, acts as a highly potent anti-inflammatory and antioxidant agent. Other pharmacological properties of ginger include antiemetic, antihyperglycemic, antiarthritic, and neuroprotective actions [17].

Several researches demonstrated that obesity is considered as a chronic inflammatory disease that promotes other comorbidities as atherosclerosis, type 2 diabetes, osteoarthritis, inflammatory cardiomyopathy, and certain types of cancers. The adipose tissue, mainly in the abdominal region, is the main secretor of the inflammatory cells. It secretes a proinflammatory cytokine (leptin) and an anti-inflammatory cytokine (adiponectin) [3, 18]. The increase in fat cell mass results in the infiltration of the adipose tissue by the macrophages, which secrete other proinflammatory cytokines (IL-6, IL-1, TNF- alpha); the liver produces CRP and begins an inflammatory pathway [19, 20].

As obesity is a factor for oxidative damage. Obesity leads to excess production of free radicals and results in a state of oxidative stress. This in sequence damage cell membrane, lipoproteins polyunsaturated fats, and alters RNA and DNA. The oxidative damage impairs cell functions and end by cell aging, damage and diseases [21, 22].

The objective of this study was to demonstrate the effect of bread formed of soya beans flour and turmeric or ginger in junction with a balanced hypocaloric regimen in reducing body weight and controlling diabetes to evaluate its effects on the metabolic profile of an Egyptian females complaining of diabesity.

MATERIALS AND METHODS

Analytical Methods

Table (1): Formula composition of Syrian bread (g/100g dry weight)

Raw materials	Formula (1)	Formula (2)
Soy bean flour	60	60
Wheat germ	10	10
Turmeric	5	-
Ginger	-	5
Skim milk	10	10
Sauce	5	5
Corn oil	5	5
Black seed	1.5	1.5
Baking powder	2	2
Salt	1.5	1.5

Basic and modified formulae were prepared by mixing the soy bean flour with 5% turmeric powder (formula 1), or soy bean flour with 5% ginger powder(Formula 2), then with other ingredients according to table (1). 14.7 ml of dextrose solution (5.93%) and the suitable amount of water were added according to [23], to be formed as Syrian bread. These formulae were baked in a special oven at 200 °C for about 15 minutes. Weight, volume, diameter, thickness and spread ratio of the bread were recorded.

Chemical Composition of the Bread
Moisture, protein, fat, crude fiber and ash of Syrian bread were determined according to [23]. Carbohydrates were calculated by differences. Amino acids, fatty acids, polyphenols, elements (Ca, P, K, Fe, Zn and Mg) in all samples were determined [24, 25].

Subjects
Seventy two women suffering from obesity and type II diabetes participated as volunteers in this study which lasted for 8 weeks, the participants were informed about the purpose of the study and their permission in the form of written consentwas obtained. The protocol was approved by the "Ethical Committee" of the "National Research Centre".

We excluded patients on insulin injection, statin or lipid lowering medications, patients with hypercoagulable state, thyroid dysfunction, allergy to soya, family history of cancer breast, pregnant or breast feeding females, and those on weight loss program in the last three months.

The study was divided into two phases; each phase lasted for 4 weeks. The patients were divided into two groups, group (A), with mean age 46.53±1.70 years and had a mean BMI of 37.75±1.13 kg/m², and group (B), with mean age 51.82±0.93 and mean BMI 35.75±0.70. At phase (1), group (A) followed a low caloric balanced diet (1000-1200 K calories), accompanied by the supplement made from soya bean flour mixed with 5% turmeric powder (formula 1) that was made in the form of Syrian bread, two services was consumed with breakfast (40g) and one service with dinner (20g), instead of Baladi bread. Group (2) consumed another formula of the bread made from soya bean flour mixed with 5% ginger powder (formula 2) with the same instructions. Phase (2) lasted for 4 weeks in which the volunteers were following only the same low caloric balanced diet, and were asked not to consume any food or sauce containing soya products during this phase.

Anthropometric Parameters and Blood Pressure Measurements
Blood pressure for each patient was measured 3 times in the sitting position and the mean was recorded.Relevant anthropometric measurements were reported [26]. BMI was calculated (weight in kg/ height² in meter). Waist circumference was measured using a no stretchable tap measure at the narrowest level without any pressure to the unclothed body surface.Waist height ratio (WHtR) was calculated [Waist cm / height in cm] value> 0.5 denotes obese with high risk of CVD [27]. Body fat (BF as a percent from the body weight), lean body mass and basal metabolic rate (BMR: is the energy expenditure without any contribution from exercise) were measured using Geratherm Body Fitness (B-5010), German.

Blood Sampling and Biochemical Analysis
Fasting blood samples (12 hours) were drawnfrom all subjects. 2ml of Blood samples werecollected on EDTA tubes for detection of glycated hemoglobin (HbA1c) in the fresh whole blood. The restof the blood samples were collected on plain tubes, leftto clot and then centrifuged at 3000 rpm for 10 minutesand the sera were separated. Quantitative colorimetric determination of Glycated HbA1c was performed by cation exchange resin. Stanbio-Laboratory no.102181Ce, USA [28]. Glucose and lipid profile were measured by Olympus AU400. Serum C peptide was done by ELISA kit. PR, Code=2725-300A, USA [29]. Modified homeostatic model assessment of insulin resistance (M.HOMA-IR) was calculated, where M.HOMA-IR=1.5+fasting blood glucose x fasting c- peptide/2800 [30]. Serum Apolipoprotein J (clusterin) was detected by Human Clusterin ELISA Kit cat 194034200R, Bio Vender-Laboratornimedicinaa CZECH [31].

Dietary Recalls
Collecting detailed data about nutritional habits and intake through: 24 recall Diet history. Analysis of food items using World Food Dietary Assessment System (WFDAS, 1995); University of California, USA.

Statistical Analysis
All values were expressed as mean± SE. Two tailed student t-test was used to compare between different phases in the same group. P values <0.05 were considered statistically significant. SPSS window software version 17.0 (SPSS Inc. Chicago, IL, USA, 2008) was used.

RESULTS

Data presented in table (2), it's clear that moisture, total sugar, total carbohydrates and fat were higher in Syrian bread fortified with turmeric than the Syrian bread fortified with ginger.

A table (3) shows the minerals and the total phenols contents of the soya bean flour and the two supplements. Adding either of the ginger or the turmeric to the soya flour enriched its iron and total phenols contents, but decreases the other mineral as calcium, potassium and magnesium.

Table (4) shows that the three samples have high content of the glutamic acid and the branched chain amino acids Leucine, isoleucine and Lysine. Tyrosine amino acid was found only in the two supplements. Addition of the turmeric powder or the ginger powder to the soya bean flour increases its content of the linolenic, linoleic and oleic fatty acids in various ranges.

Table (5) shows the analysis of the food intake by World food analysis program; the contents of calories, carbohydrate and fat of their habitual diet were higher than that of the hypocaloric Diet with Turmeric bread, Ginger bread and Baladi Bread.

Table (6) shows the mean ± SE of age, anthropometric parameters and blood pressure among obese subjects at the basal and different phases of dietary therapy. Most of the anthropometric measurements of the two groups decreased significantly ($p<0.05$-0.01) at the end of the two phases. BF % decreased significantly at the end of phase (1) in both groups, while no significant reduction in the LBM was observed. BMR increased significantly at the end of phase (1) and then decreased significantly at the end of phase (2). Systolic blood pressure decreased significantly in both groups at the end of phase (1), while significantly increased at the end of phase (2), diastolic blood pressure numerically decreased at the end of phase (1), and significantly increased at the end of phase (2) in both groups.

Table (7) shows the mean± SE of biochemical parameters of the two groups at the basal and the end of the two phases of the dietary therapy.The biochemical results showed significant improvement in the serum lipids profile and FBG values at the end of the first phase in both groups. The M.HOMA levels, C-peptide and Apo J concentrations significantly decreased at $p<0.05$-0.01 in both groups at phase (1). In group (B), M.HOMA and C-peptide significantly increased at the end of last phase.

Table (8) shows the percentage of change in anthropometric and laboratory parameters after consumption of soya bean bread for four weeks in both groups.

Table (2): Chemical composition of the two different formulae of Syrian bread

Formula	Moisture	Protein	Fat	Ash	Fiber	T. CHO	T. sugars	Reducing sugars	Non Reducing sugars
(1)	21.28 ±0.18[a]	32.30 ±0.15[b]	7.11 ±0.06[a]	5.75 ±0.01	2.55 ±0.02[a]	27.12 ±0.15[a]	9.08 ±0.07[a]	1.46 ±0.02[b]	7.62 ±0.07[a]
(2)	16.86 ±0.15[b]	34.60 ±0.17[a]	6.96 ± 0.09[b]	5.80 ±0.01	2.47 ±0.02[b]	17.42 ±0.14[b]	6.28 ±0.05[b]	1.96 ±0.01[a]	4.32 ±0.03[b]
LSD at 0.05	0.075	0.120	0.096		NS	0.035	0.071	0.045	0.091

Table (3): Minerals and phenols content in dry tested samples

Samples	P (mg/100g)	K (mg/100g)	Ca (mg/100g)	Mg (mg/100g)	Fe (mg/100g)	Total phenol (As tannin)
Turmeric bread	263.1	150.2	370	456	150	7530.57
Ginger bread	253	118.6	358	428	145	7561.66
Soy beans flour	327.8	200	423	561	102	5796.98

Table (4): Amino acids levels (mg/g) in tested samples

Amino acids	Turmeric bread	Ginger bread	Soya bean flour
Aspartic	15.5	12.3	15.5
Therionine	4.2	2.8	3.3
Serine	10.5	8.3	9.8
Glutamic	119.2	97.8	119.6
Glycine	5.8	5.3	5.8
Alanine	16.7	15.0	20.2
Valine	5.9	4.0	5.6
Methionine	8.6	8.1	9.4
Isoleucine	3.3	3.0	3.5
Leucine	15.9	13.9	19.8
Tyrosine	22.7	19.8	-
Phenylalanine	43.2	39.5	87.2
Histidine	24.6	22.3	29.1
Lysine	16.0	13.6	19.2
Arginine	24.4	16.6	29.9
Proline	2.5	2.2	3.2

Table (5): Nutrient contents of the habitual diet and the three different types of the hypocaloric diet consumed by the obese volunteers

Nutrient intake	Habitual diet	Hypocaloric Diet with Baladi Bread	Hypocaloric Diet with Turmeric bread	Hypocaloric Diet with Ginger bread	RDAs
	Mean ± SE %RDAs				
Energy (kcal)	2717.53±235.01 123.52%	974.25±152.11 44.28%	904.28±70.59 41.10%	901.02±67.20 40.96%	2200
Protein (g)	91.23±27.30 182.46%	52.63±19.17 105.26%	52.23±14.67 104.46%	53.05±11.34 106.10%	50
Fat (g)	123.57±37.08 190.11%	30.17±16.31 46.42%	28.04±13.20 43.14%	27.18±12.37 41.82	65
Carbohydrate(g)	310.12±60.96 103.37%	123.05±32.51 41.02%	110.75±28.71 36.92%	111.05±24.61 37.02%	300
Dietary fiber (g)	18.83±9.97 75.32%	29.19±10.02 116.76%	35.47±8.91 141.88%	35.60±7.84 142.40%	25

Table (6): Mean ± SE of age, anthropometric parameters and blood pressure among obese subjects at the basal and different phases of dietary therapy

Parameters	Group (A) (n= 38)			Group (B) (n=34)		
	Base	Mid	Last	Base	Mid	Last
Age (year)	46.53±1.70			51.82±0.93		
Height (cm)	156.74±0.85			156.29±0.90		
Weight (kg)	93.03±3.11	89.87±2.98^{**a}	89.03±3.03^{**b}	87.24±1.70	84.85±1.73^{**c}	84.44±1.72^{*d}
BMI (kg/m²)	37.75±1.13	36.47±1.08^{**a}	36.14±1.11^{**b}	35.75±0.70	34.77±0.71^{**c}	34.61±0.70^{*d}
MWC (cm)	100.50±1.89	93.95±1.89^{**a}	89.64±1.70^{**b}	94.10±1.28	89.29±1.38^{**c}	86.76±1.44^{**d}
WHtR	0.64±0.07	0.59±0.01^{**a}	0.57±0.07^{**b}	0.60±0.01	0.57±0.06^{**c}	0.56±0.01^{**d}
% BF	47.72±0.98	46.97±0.99^{*a}	46.41±1.04	47.54±0.67	46.39±0.67^{**c}	46.47±0.66
LBM	44.70±0.95	44.46±0.94	44.39±0.88	42.88±0.53	43.18±0.61	42.74±0.52^{**d}
BMR	2082.26±52.89	2152.84±46.85^{*a}	2093.26±37.09^{**b}	1979.53±34.97	2127.00±41.15^{**c}	2049.53±31.24^{**d}
Chest (cm)	100.37±1.23	94.71±1.29^{**a}	92.34±1.03^{**b}	97.24±0.77	92.38±0.70^{**c}	90.56±0.79^{**d}
Abdominal (cm)	121.76±2.34	117.47±2.29^{**a}	114.34±2.17^{**b}	119.65±1.67	114.94±1.60^{**c}	112.47±1.68^{**d}
Hip (cm)	122.61±2.26	117.97±2.21^{**a}	115.45±2.14^{**b}	121.53±1.45	116.29±1.52^{**c}	114.62±1.57^{**d}
WHR (cm/cm)	0.82±0.008	0.80±0.009^{**a}	0.78±0.008^{**b}	0.78±0.01	0.77±0.01^{**c}	0.76±0.01^{**d}
SBP (mmHg)	123.42±2.86	118.68±2.38^{**a}	118.68±2.38	113.53±1.71	111.47±1.63^{*c}	115.29±2.20^{**d}
DBP (mmHg)	71.05±2.06	69.74±1.97	71.32±1.1.96^{**b}	65.88±1.20	64.12±0.86	68.24±1.40^{**d}

BMI: Body mass index, MWC: Minimal waist circumference, WHtR; waist height ratio, %BF: % Body fat, LBM; Lean body massBMR: Basal metabolic rate, WHR: Waist hip ratio, SBP: Systolic blood pressure, DBP: Diastolic blood pressure a:basal vs.Mid & b :Mid vs.last in group A, c:basal vs. Mid &d Mid vs. last in group B

**P< 0.05 **P < 0.01*

Table (7) Mean± SE of Biochemical parameters of the two groups at the basal and the end of the two phases of the dietary therapy

Biochemical Parameters	Group (A) (n= 38)			Group (B) (n=34)		
	Base	Mid	Last	Base	Mid	Last
FBG (mg/dl)	112.87±4.66	99.53±3.89^{**a}	114.02±4.84^{**b}	119.58±5.48	103.19±4.77^{**c}	106.38±4.20
HbA1c	5.95±0.14	4.93±0.09	5.17±0.1	6.17±0.11	4.87±0.08	4.89±0.11
C-peptide (ng/ml)	4.93±0.97	3.72±0.85^{*a}	4.05±0.91^{*b}	5.07±0.74	3.59±0.47^{**c}	3.72±0.56
Modified HOMA	1.69±0.04	1.63±0.03^{**a}	1.67±0.04^{**b}	1.72±0.04	1.64±0.02^{**c}	1.65±0.03
Triglyceride(mg/dl)	139.28±13.10	88.86±8.27^{**a}	118.69±7.91^{**b}	135.24±9.30	103.87±7.37^{**c}	102.09±5.41
VLDL-C (mg/dl)	27.86±2.62	17.77±1.65^{**a}	23.74±1.58^{**b}	27.05±1.86	20.77±1.47^{**c}	20.42±1.08
TC (mg/dl)	243.54±10.18	185.32±6.62^{**a}	205.09±10.53	217.01±9.05	180.57±7.31^{**c}	183.72±5.99
HDL-C (mg/dl)	47.93±1.53	54.33±1.74^{**a}	51.98±1.53	46.39±1.38	51.81±1.29^{**c}	51.25±1.64
Non-HDL (mg/dl)	195.61±10.84	130.98±7.16^{**a}	153.11±10.88^{*b}	170.61±8.93	128.76±7.87^{**c}	132.47±6.07
LDL-C (mg/dl)	167.74±10.16	113.21±7.55^{**a}	129.37±10.44	143.56±8.75	107.99±7.87^{**c}	112.05±5.67
Risk factor	5.17±0.29	3.47±0.18^{**a}	3.99±0.26^{*b}	4.73±0.22	3.54±0.18^{**c}	3.63±0.15
Apo J (µg/ml)	138.84±20.25	109.49±9.95^{*a}	112.67±8.93	124.87±7.50	99.90±4.94^{**c}	99.09±5.61

FBG: Fasting blood glucose, HbA1c: Glycosylated hemoglobin,*TC: Total cholesterol, VLDL-C: Very low density lipoproteincholesterol, HDL-C: High density lipoprotein cholesterol, M.HOMA-IR: Modified homeostatic model assessment of insulin resistance, Apo J: Apolipoprotein J*
a: Basal vs. Mid & b :Mid vs. Last in group A, c: :Basal vs. Mid in group B
*P< 0.05 **P < 0.01

Table (8): Percentage of changes in the anthropometric and biochemical parameters after intervention vs. basal values

parameters	Turmeric group	Ginger group	Parameters	Turmeric group	Ginger group
Weight	- 3.4	-2.7	**FBG**	-11.8	-13.7
BMI	-3.4	-2.7	**C peptide**	-24.5	-29.2
% body fat	-1.6	-2.4	**Modified HOMA**	-3.6	-4.7
Waist circ	-6.5	-5.11	**TG**	-36.2	-23.2
WHtR	-7.8	-5.0	**T C**	-23.9	-16.79
WHR	-2.4	-1.29	**HDL**	+13.4	+11.6
LBM	+0.13	+0.7	**LDL**	-32.5	-24.8
BMR	+3.4	+7.45	**Risk factor**	-32.9	-25.2
SBP	-3.8	-1.8	**Non HDL-C**	-33.04	-24.5
DBP	-1.84	-2.7	**Apolipoprotein J**	-21.1	-20

DISCUSSION

The main aim of this study was to explore the effect of some of biological active ingredients in two supplements, made from soy bean flour with either 5% turmeric or 5% ginger on body weight, blood sugar and other adiposity parameters. Bread is an essential food in Egyptian diet. Data of this study showed the advantageous impacts of the two dietary treatments on all the adiposity parameters.

The results revealed that low caloric diet alone lead to decrease muscle mass and metabolism. Soya bean flour rich in protein provide a benefit way to preserve lean mass and increase the metabolism which results in decreasing % BF. The body of human act as a machine which breaks down the food intake to be converted to nutrients easily for absorption and produced energy necessary for metabolism and other process that the body's cells need to function [32]. BMR is the energy needed to maintain the function of the body at rest (as breathing, circulation, brain function, nerves functions, and muscle contraction…..). BMR accounts for about 70% of the burned calories per day; it is affected by body composition, sex, age, and physical activity. The more muscle human has, the higher his BMR, as the muscle can burn calories 4 times more than fat [33]. This was in agree with Kim et al., on 2014 who declined that protein has recently received a lot of attention with new research showing its satiating ability as well as its thermogenic fat burning characteristics asthe body has no storage capacity limit for protein, higher protein diets help satiety when contrasted with lower protein diets [34].

On 2014, Dominik and Varman [32] demonstrated that proteins are found in all tissue in human's body especially in muscle. When human work out, their body expands the span of your muscles by adding extra proteins to the muscle filaments. This requires amino acids, the building squares of proteins. Eating more protein gives the body a greater amount of these amino acids to use in making muscle, with a potential direct impact on bulk. Protein stimulates the thermic effect which implies that the body burns more energy provided by dietary protein than it does carbohydrates or fats [33].

Soya bean consumption help in losing weight, so bread formed of soya flour is an excellent choice in weight loss program, as it is a good source of protein , it's balanced in essential amino acids, especially branched chain amino-acids to meet the body's needs to build lean muscle mass. Soya bread helps feeling full for longtime as any snake composed of protein helps feeling less hungry especially when ingested at night. More ever, soya bean is low in fat, carbohydrates, and has a low glycemic index which is our target for diabetic patients to avoid rapid rise in blood glucose levels [35].

One of the fatal complications of diabesity is cardiovascular diseases (CVD), waist-to-height ratio more than 0.5 denotes high risk for cardiac complications. The superiority of WHtR as an index to predict coronary risk clusters among women and men, results from dependency on central obesity and waist circumference, ignoring weight which is variables without denoting fat accumulation, as it reflects all body composition (muscle, fat, water and bone) [26, 36]. Consumption of soya bread (either fortified with curcumin or ginger) for four weeks decreased the ratio significantly and the Apo.J level. Won et al. (2014) revealed a positive correlation between plasma Apo J level and indices of obesity. Apo J is a protein biosensor of inflammation and oxidative stress, which increase in some pathological conditions including atherosclerosis [37]. Chronic upregulation of Apo J protein is considered a biomarker and a sensitive prognostic indicator in CVD [38]. This means to get the highest quality amino acids with fewer calories and less fat than others breads. In addition, soya beans have hypo-cholesterol effects; it lowers blood level of total cholesterol, LDL and triglycerides, with increases in HDL cholesterol in patients with dyslipidemia, due to the high contents of phytoestrogen isoflavones, high soluble fiber, and polyunsaturated fats, with absence of saturated fat [39].

This study demonstrated the hypolipidemic benefits of curcumin more than ginger and the superiority of ginger as an antidiabetic more than curcumin. Both had antiobesity effects. Bread fortified by curcumin reduced more the percentage of change of the anthropometric parameters (BMI, mean body weight, waist circumference, WHtR and WHR), lipid profiles (curcumin decreased total cholesterol, non-HDL-C, LDL, TG, and increased HDL level).Whereas, ginger is a natural antidiabetic, it reduced the percentage of change of insulin sensitivity,fasting blood glucose level and hemoglobin A1C more than curcumin.

Previous study had verified that curcumin can reduce inflammatory and neuropathic pain, and improve diabetic complications such as diabetic nephropathy, cardiomyopathy and retinopathy. They suggested that turmeric is a potent anti-inflammatory and antioxidant; it reduces proinflammatory cells known to be overactive in obese patients (cytokines IL-1, IL-6 and TNF) and improve insulin response [40, 41]. Curcumin blocks protein transcription factor activity known as nuclear factor KB responsible in proinflammatory pathways and becomes activated in patients with high blood glucose levels [42].

CONCLUSION

Soy bread fortified with ginger or turmeric can help in achieving weight loss goals, as soya beans are an excellent source of protein, it helps in building lean muscle mass while losing percentage of body fat and improving the basal metabolic rate. Weight loss is linked to the improvement in insulin sensitivity and overall metabolism in patients with diabesity. So both supplements can be used to prevent or delay the onset of diabesity related co-morbidities by controlling the metabolic disorders.

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