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EFFECT OF OAT AND OKRA FLOURS ON RATS FED ON HIGH FAT DIETS

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ABSTRACT: ***This work was performed to investigate the effect of using oat and /or okra flours at different levels as a replacement of wheat flour on rats fed on high fat diets for 7 weeks. The obtained results indicate that the feeding on diets contained oat and okra flours together at higher level led to reduce the rats body weight compared with those contained oat and okra flours at lower level and that contained okra flour without oat flour. Decreases in TG, TC, LDL-C and VLDL-C were observed in both rats fed on high fat balady bread, either replaced by oat and okra flours or okra flour comparing to rats fed on high fat balady bread made from 100% wheat flour. The liver and kidney functions of rats fed on high fat balady bread contained oat and /or okra flours were significantly lower than these of rats fed on high fat balady bread which made from wheat flour only. The results show that the rats fed on high fat bread prepared from 100% wheat flour had the highest liver, kidneys and heart weights but the rats fed on high fat bread replaced by higher level of oat and okra flours (25 and 10%) had the lowest weights of these organs. This study recommend to incorporate the oat and okra flour with wheat flour for preparation diets for reducing the body weight and improve the health state.***

Key words: *Oat flour, Okra Flour, High fat diet and rats.*

INTRODUCTION

Obesity is a complex physiologic state that is associated with several metabolic changes as hyperinsulinemia, hyperglycemia, hyperlipidemia, altered adiopokine profile (higher leptin and lower adiponectin) and generalized inflammation, which increase the risk factor for insulin resistance, type 2 diabetes, heart disease and many other chronic diseases (Khandekar *et al.,* 2011). The problem starts when there is a positive balance between energy consumption, mainly stored as triglycerides, and food intake. Excess of stored energy is mainly accumulated in form of adipose tissue as triglycerides. When adipose tissue function is compromised during obesity, excess of fat which is stored in adipose tissue, liver and other organs predisposes individuals to development of metabolic changes which increase disease risk (Spiegelman and Flier, 2001). According to the American Heart Association (2013), nearly 70% of Americans are either overweight or obese, leading to an increase in the health problems associated with obesity such as cardiovascular disease, stroke, and hypertension. Overall, 23.2% of the world's adult population in 2005 were overweight, and 9.8% were obese (Kelly*et al.,*2008). The principal factors to increase obesity are the feeding habits as energy dense foods (principally related their fat content but sometimes their carbohydrates content), high energy drinks and large portion sizes (Swinburn *et al.,* 2004).

Foods rich in dietary fiber provide an option to handle the body weight. They may influenced body-weight regulation by physiological mechanisms involving intrinsic, hormonal and colonic effects (Pereira and Ludwig, 2001). Soluble fiber reduces blood cholesterol, triglycerides and glucose levels. Insoluble fiber functions as a water-holding-capacity agent and can reduce intestinal transit time when present in adequate amounts in food (Laroche and Michaud, 2007). A high intake of dietary fiber, particularly soluble type, improves glycemic control, decreases hyperinsulinemia and lowers plasma lipid concentrations in patients with diabetes mellitus type 2 (Cani *et al.,*2008). Diets rich in dietary fiber promote a healthy weight because of its effects through all gastrointestinal tract, first with releasing and regulation of satiety hormones and regulating metabolite levels as HDL, LDL, triglycerides (Requena *et al.,* 2016).

Oat products have achieved a very positive consumer image due to the health benefits that have been associated with the consumption of fiber products. There is an inverse relationship between dietary oat fiber and serum cholesterol level, giving oat fiber a highly positive consumer perception (Hughes *et al.,* 1997). Oat bran decreases the total cholesterol and TG levels in serum and liver (Grajeta 1999). Oat is an excellent food grain because of the high nutritional quality of its protein, and the major constituent of oat is starch and dietary fiber. It may be helpful in the control of obesity, hypertension, diabetes and heart disease (Kerr *et al.,* 2005). Oats are rich in soluble fiber components especially, β–glucan (3-7%w/w) these non-starchy polysaccharides are partially water soluble and are known to alleviate disease symptoms, such diabetes, heart disease and colon cancer (Xu *et al.,* 2006).

Okra was used as a mucilaginous food additive against gastric irritative and inflammatory diseases. The anti-adhesive qualities of okra were assumed to be due to a combination of glycoproteins and highly acidic sugar compounds making up a complex three-dimensional structure (Lengsfeld *et al.,* 2007). Okra is a flowering plant in the *mallow* family, valued for its edible green fruits. Okra gum derived from the immature pods of okra plant is widely used in several cuisines as a thinking agent (Wikimedia, 2008). The aim of this work was to study the effect of using oat and /or okra flours at different levels as a replacement of wheat flour on rats fed on high fat diets for 6 weeks.

MATERIALS AND METHODS

Materials

Naked oat flour, okra fruits, cheap fat and ingredients used to make the balady bread were purchased from local market at Tanta City, Egypt. Okra fruits were cleaned by water, air dried in oven at (40ºC to 50ºC) and grinded using an electric blender to obtain okra flour. The oat and okra flours were kept in polyethylene bags and preserved in deep freezer at (-18ºC) until use.

All chemicals and solvents used in this study were purchased from El-Gomhoria Company of Chemicals and Drugs, Tanta City, Egypt.

Male albino rats were obtained from the Faculty of Science, Tanta University, Egypt.

Methods

Determination of proximate chemical composition

Moisture content, crude protein content, ether extract, ash and crude fiber of samples were determined as described in the A.O.A.C. (2010). All analyses were carried out in triplicates and the values were expressed as the mean on dry weight basis. Total carbohydrates content was calculated by subtracting protein, ash and ether extract contents from the total mass of 100 and

available carbohydrates were calculated by subtracting crude fiber content from total carbohydrates as reported by Tadrus (1989).

Preparation of bread used in the study

Dry ingredients including sugar, dry yeast (in Table 1), salts mixture (Table 2), vitamins mixture (Table 3) and powder milk (to increase the protein content to about 20%) were added to each types of flour with warm water and oil. The ingredients were thoroughly mixed together manually. Dough was left to ferment at room temperature (30 ± 2 ºC) for 30 min. Dough was divided into pieces and left 10 min to rest. The fermented pieces were shaped to the final form and fermented again at 30 ºC and 90% relative humidity for 30 min. Fermented pieces were baked at 220°C for 30 min (Aper and Bezaro, 1990). In case of using oat or okra flour, different levels of them were substituted of wheat flour as shown in Table (1).

After baking bread samples were left to cool at room temperature for one hour. The samples were divided to two parts the first was used for physical properties and organoleptic evaluation in fresh samples. The second part was packed in polyethylene bags until using to feed the rats in the biological experiment.

Table (1): Ingredients (g) used to prepare the bread blends

Ingredients	Blend 1	Blend 2	Blend 3	Blend 4
Wheat flour (85%)	100	80	65	90
Sugar	5	5	5	5
Milk sorting powder	10	10	10	10
Salts mixture*	4	4	4	4
Vitamins mixture**	1	1	1	1
Dry yeast	0.6	0.6	0.6	0.6
Oat flour	-	15	25	-
Okra flour	-	5	10	10

*, ** as shown in Tables 2 and 3

Table (2): Composition of salts mixture*

Salt	Quantity	Salt	Quantity
KH_2PO_4	645 g	$Fe (C_6H_5O_7).6H_2O$	55 g
$CaCO_3$	600 g	$MnSO_4$	10 g
NaCl	333.3 g	KI	1.6 g
$MgSO_4.7H_2O$	204 g	$CuSO_4.5H_2O$	0.6 g
$CaHPO_4$-$2H_2O$	150 g	$ZnCl_2$	0.5 g

*According to A.O.A.C. (2010)

Table (3): Composition of vitamins mixture*

Vitamin	Quantity	Vitamin	Quantity
Vit. A	2000 IU	Calcium pantothenate	4.0 mg
Vit. D	200 IU	p-amino benzoic acid	1.0 mg.
Vit. E	10 IU	Riboflavine	0.8 mg
Vit. K	0.50 IU	Thiamine HCl	0.5 mg
Vit. B12	300 mg	Pyridoxine HCl	0.5 mg
Choline choloride	200 mg	Folic acid	0.2 mg
Niacin	4.0 mg	Biotin	0.04 mg

*According to A.O.A.C. (2010), Vit = vitamin

Design of biological experiment:

Twenty five of male albino rats weighting 20-24 g were individually housed in a wire bottomed, stainless steel cages, under the normal conditions, on a 12 hr light- dark cycle (lighted from 6.00 to 18.00). Rats were given free access to feed and water throughout the experimental period of 7 weeks. Diets and rats groups were designed as in Table (4).

After feeding on basal diet (presented in Table 5) for one week, rats were divided into 5 groups (five rats of each group).

The experimental period was seven weeks and during this period the rats were fed on diets illustrated in Table (4). Feed intake and animal weight were recorded twice a week and body weight gain (BWG%) was calculated. Feed intake was determined by deducting remained and spilled feed from the total amount supplied per day. Feed conversion efficiency (FCE) and feed efficiency ratio (FER) were also determined according to the equation of Squibb, *et al.* (1959) as follows:

BWG% =

$$\frac{\text{Final body weight - initial body weight}}{\text{Initial body weight}} \times 100$$

FCE = gram of feed intake / gram of weight gain

FER = (Daily body weight gain/Daily feed intake) x100

At the end of experiment, animals were scarified by decapitation after an overnight fast, and the blood of each rat collected in tubes and centrifuged at 3000 rpm for 20 min to obtain the serum which was kept in the deep-freezer at -18oC until analysis.

Table (4): Ingredients used to prepare the diets for feeding the rats groups

Ingredients	G1	G2	G3	G4	G5
Starch	600	500	340	230	430
Casein	200	200	185	170	190
Corn oil	100	-	-	-	-
Cellulose	50	50	30	10	35
Salts mixture	40	40	35	30	35
Vitamins mixture	10	10	10	10	10
Sheep fat	-	200	200	200	200
Oat flour	-	-	150	250	-
Okra flour	-	-	50	100	100

G1: (Negative control) fed on basal diet.
G2: (Positive control) fed on diet contains 20% fat and 80% balady bread made of 100% wheat flour.
G3: Fed on diet contains 20% fat and 80% balady bread made of 80% wheat flour, 15% oat flour and 5% okra flour.
G4: Fed on diet contains 20% fat and 80% balady bread made of 65% wheat flour, 25% oat flour and 10% okra flour.
G5: Fed on diet contains 20% fat and 80% balady bread made of 90% wheat flour and 10% okra flour.

Table (5): Composition of basal diet*

Component	Corn starch	Casein	Corn oil	Cellulose	Salts mixture	Vitamins mixture
Amount g/kg	600	200	100	50	40	10

* According to Lan- Peter and Pearson (1971)

Analysis of serum lipids:

Serum lipids parameters were measured depending on using the commercial kits (bio diagnostic Egypt). Triglycerides (T.G) were determined according to the method of Fossati and Principe (1982). Total cholesterol was determined colorimetrically according to the method of Allain *et al.,* (1974). High density lipoprotein cholesterol (HDL-C) was determined at 520 nm according to the method of Richmond (1973) using spectrophotometer DU7400 and calculated from the following equation:

HDL-c concentration (mg/dL) =

$$\frac{\text{Absorbance of sample}}{\text{Absorbance of standard}} \times 180$$

Low density lipoprotein cholesterol (LDL-c) was calculated from the following equation according to Friedewald *et al.,* (1972):

LDL-c concentration (mg/dL) = Total cholesterol - (T.G/5 + HDL-cholesterol).

Analysis of liver functions:

Serum alanine amino transferase (ALT or GPT) and aspartate amino transferase (AST or GOT) levels were determined colorimetrically according to the method described by Reitman and Frankel (1957). The activity of ALT and AST were calculated and expressed as international units (I.U) by using special Table provided with kits.

Determination of kidney functions

Urea was determined according to the method of Tabacco *et al*. (1979). Creatinine was determined according to the method described by Bartels and Bohmer (1971).

Calculate the weight of the organs:

At the end of the feeding period, the rats were fasted overnight then sacrificed. After sacrificing the liver, kidneys and heart were removed by careful dissection and plotted free of adhering blood immediately. The organs were washed with cold saline solution and then dried using filter paper and weighted. The relative weight of the organ was calculated by the following equation:

Relative organ weight =

$$\frac{\text{Organ weight}}{\text{Animal weight}} \times 100$$

RESULTS AND DISCUSSION

As shown in Table (6) oat flour contains 13.86% protein, 6.97% ether extract, 3.39% crude fiber, 3.25% ash and 72.53 available carbohydrates.

Table (6): Approximate chemical composition of oat and okra flours (g/100g on dry weight basis).

Sample / Components%	Oat	Okra
Moisture	11.77	12.03
Crude protein	13.86	19.06
Ether extract	6.97	2.91
Crude fiber	3.39	12.91
Ash	3.25	9.06
Total carbohydrates	75.92	68.97
Available carbohydrates	72.53	56.06

Okra flour contains higher amounts of protein, crude fiber and ash, but it has lower amounts of ether extract and carbohydrates compared with oat flour. In comparison with other cereals, naked oat grain is characterized by a larger amount of total protein and crude fat (Biel *et al.,* 2009). They found that naked oat grain contains 14.3% protein, 8.4% oil, 3.2% crude fiber and 2% ash. As reported by Medel *et al.,* (1999) the crude fiber content ranges from 1.3 to 2.2% in wheat. Sterna *et al.,* (2016) found that naked oat contains 17.7% protein, 9.7% fat and 22.9% total dietary fiber.

Effect of oat and okra flours on some body parameters of rats fed on high fat diets

The results of body weight gain, feed intake, feed conversion efficiency and feed efficiency ratio for rats fed on basal diet or high fat diets replaced partially by oat and/or okra flours were recorded in Table (7). The results show that the highest body weight gain was found to be for the rats fed on high fat wheat flour bread (G2) followed by that of rats fed on high fat bread replaced by 10% okra flour (G5). But the rats fed on basal diet had the lowest body weight gain.

The results of Chang *et al.* (2013) showed that consumption of oat reduced body weight, BMI and body fat. The obtained results indicate that the feeding on diets contained oat and okra flours together at higher level led to reduce the rats body weight as compared with that contained oat and okra flours at lower level and that contained okra flour without oat flour. These results may be due to the higher total and insoluble dietary fiber content in oat and okra flours comparing to the wheat flour.

Table (7): Effect of oat and/or okra flour on body weight gain, food intake, feed conversion efficiency and feed efficiency ratio of rats for 7 weeks

Rats groups	Initial body weight (g)	Final body weight (g)	Body weight gain		Food intake		FCE	FER
			(g)	%	g/7 weeks	g/day		
G1	22.5^{b}	26.3^{c}	3.8^{d}	16.8	462.6^{a}	9.4	121.7	0.82
G2	24^{a}	35^{a}	11^{a}	45.8	319.0^{d}	6.4	29.0	3.45
G3	20.8^{c}	28.3^{b}	7.5^{b}	36.1	315.0^{d}	6.5	42.0	2.38
G4	24^{a}	28.5^{b}	4.5^{c}	18.8	334.0^{c}	6.8	74.2	1.35
G5	20^{c}	27.8^{b}	7.8^{b}	39.0	428.2^{b}	8.7	54.9	1.82

Each value is an average of five determinations.
*Values followed by the same letter in column are not significantly different at P ≤ 0.05

G1: (Negative control) fed on basal diet.

G2: (Positive control) fed on diet contains 20% fat and 80% balady bread made of 100% wheat flour.

G3: fed on diet contains 20% fat and 80% balady bread made of 80% wheat flour, 15% oat flour and 5% okra flour.

G4: fed on diet contains 20% fat and 80% balady bread made of 65% wheat flour, 25% oat flour and 10% okra flour.

G5: fed on diet contains 20% fat and 80% balady bread made of 90% wheat flour and 10% okra flour.

From the obtained data, it can be observed that significantly lower feed intakes were consumed by rats fed on high fat bread either made from wheat flour (G2) or that replaced partially by oat and/or okra flour (G3, G4 and G5) compared to normal control rats (G1). Rats fed on basal diet (G1) had 9.4 g/day of feed intake; whereas a feed intake of about 6.5 g/ day was obtained for the rats fed on high fat diets either contained wheat flour (G2) or that contained wheat flour with oat and okra flours (G3 and G4).

On the other hand, the rats fed on high fat diet contained wheat flour bread replaced by 10% okra flour (G5) had feed intake 8.7 g/day which is near from that of rats fed on basal diet (G1). The significant higher feed intake for rats fed on basal diet or high fat balady bread made from 90% wheat flour and 10% okra flour (G5) compared to other groups (G2, G3 and G4) may be due to the quality of taste and odor of diet which increase the appetite of rats.

Because of values in feed intake were not parallel to the growth of rats, as shown in Table (7), the feed conversion efficiency (FCE) for the tested diets was calculated. The low FCE value means the diet has high efficiency (Mongeau *et al.*, 1991).

It is also apparent from the results in Table (7) that the value of feed efficiency ratio (FER) was 0.82 for rats fed on the basal diet (G1). This value markedly increased to 3.45 for rats fed on high fat balady bread made from wheat flour (G2). The FER value of rats fed on high fat bread contained the higher level of oat and okra flours (G4) was lower than that of rats fed on high fat bread contained the lower level of oat and okra flours (G3) and that of rats fed on high fat bread contained okra flour without oat flour (G5). The FER of G5 was lower than that of G3 but higher than that of G4. These results indicate that supplement of wheat balady bread with oat and/or okra flour lead to reduce the body weight and FER of rats fed on high fat diets, consequently improved their healthy status.

It can said that the relative difference in body weight gain of rats fed on high fat diets contained oat and/or okra flour was not due to decrease in food consumption, but it probably due to the fibers which may form a certain complex with lipids preventing their absorption which produces a good utilization of the other constituents such as protein, carbohydrates, minerals and vitamins.

Effect of oat and/or okra flour on total triglycerides and lipoprotein cholesterol in rats fed on high fat diets for 7 weeks.

Total triglycerides (TG) and lipoprotein cholesterol [total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), high density lipoprotein cholesterol (HDL-C) and very low density lipoprotein cholesterol (VLDL-C)] concentrations were determined in serum of rats groups and the results are given in Table (8).

Several studies have shown that an unusually large number of people with coronary heart disease have high levels of triglycerides in the blood, although elevated triglycerides may not directly cause atherosclerosis but may accompany with other abnormalities that speed its development. The levels of HDL-C and LDL-C in the blood are used to evaluate the risk of atherosclerosis (in human) (Lawson *et al.,* 1995).

Table (8): Triglycerides concentration (mg/dl) and lipoprotein cholesterol (mg/dl) in rats fed on high fat diets contained oat and okra flours for 7 weeks.

Group of rats	TG	TC	HDL-C	LDL-C*	VLDL-C**	TC/HDL-C ratio	TC/LDL-C ratio	LDL-C/HDL-C ratio
G1	68.5[c]	107.3[d]	49.1[b]	44.5	13.7	2.2	2.4	0.9
G2	103.6[a]	168.1[a]	42.7[d]	104.7	20.7	3.9	1.6	2.5
G3	71.7[c]	114.4[c]	49.2[b]	50.9	14.3	2.3	2.2	1.0
G4	69.1[c]	111.2[c]	51.1[a]	46.3	13.8	2.2	2.4	0.9
G5	97.5[b]	135.9[b]	47.4[c]	69.0	19.5	2.9	2.0	1.5

*Values followed by the same letter in column are not significantly different at $P \leq 0.05$
G1 - G5 as in below of Table 7, *LDL-C=TC- (HDL-C+VLDL-C), ** VLDL-C = TG/5
Normal values in human should be in the range of:
TG. 50 to 250; TC <200; HDL-C > 45 and LDL-C <160 mg/dl (Baur, 1995).

The data obtained in Table (8) show that triglycerides of normal control rats (G1) was 68.5 mg/dl, while total cholesterol level was 107.3 mg/dl. HDL-C; LDL-C and VLDL-C of this group of rats showed concentrations of 49.1; 44.5 and 13.7 mg/dl, respectively. Results in Table (8), also indicated that feeding on high fat balady bread made from wheat flour (G2) was effective in increasing TG, TC, LDL-C and VLDL-C levels in rats, where their values increased to 103.6; 168.1, 104.7 and 20.7 mg/dl, respectively.

From the results in Table (8), it could be observed that rats fed on high fat balady bread made from wheat flour (G2) had significant higher TG, higher TC, higher LDL-C and higher VLDL-C values, but they had a significant lower HDL-C value compared to rats fed on basal diet (G1).

On the other hand, obvious decreases in TG, TC, LDL-C and VLDL-C were occurred for both rats fed on high fat balady bread, either replaced by oat and okra flours (G3 and G4) or okra flour (G5) as compared to rats fed on high fat balady bread made from 100% wheat flour (G2). As reported by Li *et al.* (2016), the long-term oat intake had a significant effect on the reduction of TG. The mechanism of serum lipid-lowering effect seems to be related to the increased viscosity attributed to the oat β-glucan, which can lead to the reduction in cholesterol absorption (Wang and Ellis, 2014).

In 1997, the US Food and Drug Administration approved health claims for oat fiber, based on the relationship demonstrated between dietary soluble β-glucan fiber and a decrease in serum cholesterol concentrations. The Food and Drug Administration has concluded that fiber is efficacious in lowering total cholesterol and LDL-cholesterol (LDL-C) by about 5 – 10 %, at doses of 3 g/d from oat bran. This amount is provided by approximately 55 g oat bran. According to Chang *et al.* (2013), oat decreased serum cholesterol and LDL-C, thereby improving the lipoprotein profiles. The liver function indexes were ameliorated by oat treatment, and thus the occurrence or aggravation of fatty liver was avoided.

The results in Table (8) show that rats fed on diet contained okra flour without oat flour (G5) had significantly higher TG, higher TC, higher LDL-C and higher VLDL-C; but lower HLD-C concentrations,

than those fed on diets contained okra flour with oat flour (G3 and G4). These results indicate that oat flour when it is incorporated with okra flour become more effective on lipids profile of the rats serum. The rats fed on diets contained higher replacement levels of oat and okra flours (G4) had TG, TC, LDL-C and VLDL-C values lower but HDL-C higher than those of rats fed on diets contained lower replacement levels of oat and okra flours (G3).

Elevated serum cholesterol concentration was widely regarded as a primary risk factor in the development of atherosclerosis and coronary heart disease. The LDL-C/ HDL-C ratio is a major determinant of the risk of ischemic heart disease (Marshall *et al.,* 2000)

It has stated that the ratio of TC to HDL-C to be desirable below 4.0; borderline between 4.0 and 6.0, and at high risk of heart disease above 6.0 (Baur, 1995). The decrement in TG and TC values of rats fed on diets contained oat and okra flours may be due to the oat flour contain high fiber amount that increases degradation of cholesterol to fecal bile acids and okra is rich in flavonoids that could reduce the risk of obesity. The obtained results are in agreement with Parsaeyan (2012) and Huang *et al.,*(2014).

Finally, it can be concluded that the different experimental diets varied in their effect showing significant reduction in serum TG concentrations and the lipoprotein profile, and the blood parameters were different among all the five groups of rats

Effect of oat and okra flours on alanine transaminase (ALT) and aspartate transaminase (AST) activities of rats

The transaminases, particularly alanine transaminase (ALT); formerly was known as glutamic- pyruvic transaminase (GPT); and aspartate transaminase (AST); formerly was known as glutamic-oxaloacetic transaminase (GOT), are the enzymes assayed most commonly in liver dysfunction. The ALT and AST activities were measured in rats fed on basal diet (negative control rats, G1) and rats fed on high fat baldy bread made from 100% wheat flour (G2), as well as in those fed on high fat balady bread made from wheat flour partially replaced by oat and okra flours (G3 and G4) or okra flour (G5) and the results were recorded Table (9).

Table (9): Serum alanine amino transferase (ALT) and aspartate amino transferase (AST) activities of rats fed on high fat balady bread contained oat and okra flours for 7 weeks.

Group of rats	ALT (IU/L)	AST (IU/L)	AST/ALT ratio
G1	17^{c}	25^{d}	1.47
G2	45^{a}	75^{a}	1.67
G3	18^{c}	26^{d}	1.44
G4	19^{c}	30^{c}	1.58
G5	25^{b}	42^{b}	1.68

G1 – G5 as in below of Table (7)
***Values followed by the same letter in column are not significantly different at P ≤ 0.05**
Normal values should be as follows:
ALT: 5-30 IU/L, AST: 8-40IU/L, AST/ALT : 1.1-1.3IU/L (Foster *et al.,* 1980).

The results in Table (9) show that the ALT and AST activities of rats fed on high fat balady bread made from 100% wheat flour (G2) had the highest values but they for rats fed on basal diet (G1) had the lowest ones compared with those of other groups of rats.

It is could be noticed that the values of ALT and AST activities of negative control rats (G1) were 17 and 25 IU/L and a little bit increases were obtained for the rats fed on diets replaced by oat and okra flours at lower levels (G3). While, the values of ALT and AST activities of rats fed on high fat balady bread made from wheat flour replaced by 10% okra flour (G5) were significantly higher than those of negative rats or these fed on high fat balady bread made from wheat flour replaced partially by oat and okra flours (G3 and G4).

In healthy humans, the concentration, of cellular enzymes in the extracellular fluids are fairly low, ranging between 5-30 IU/L (Foster *et al.,* 1980). Thus, the results in Table (9) indicated that values measured for ALT and AST activities in rats either fed on basal diet (G1) or fed on high fat balady bread contained different levels of oat and okra flours were within the reference values in humans. But the value of AST for rats fed on high fat balady bread contained 10% okra flour (G5) was a little higher value than the reference one.

As shown in Table (9); replacement of the wheat flour balady bread partially by 15% oat flour and 5% okra flour induced reductions from 45 to 18 and from 75 to 26 IU/L for ALT and AST activities, in respect to the positive control rats (G2), respectively. The findings of Chang *et al.* (2013) showed that ALT was significantly lowered in the oat-treated group compared with the control, implicating that oat is beneficial for preventing fatty liver.

From the AST/ALT ratios, it might be possible to determine the extent and activity of the cell damage. It is obvious from the results in Table (9) that AST/ALT ratio for normal rats (G1) and that fed on high fat balady bread contained 15% oat flour and 5% okra flour (G3) were nearly the same, being 1.47 and 1.44, respectively. The AST/ALT ratios for the rats fed on high fat balady bread made from 100% wheat flour (G2) and rats fed on high fat balady bready contained 10% okra flour (G5) were high as a result of high AST value for these groups compared to other groups.

Kidney functions (urea and creatinine).

Urea, and creatinine concentrations in plasma of rats at the end of the experimental period, as measures of kidney functions, are presented in Table (10). The findings in this Table showed relative increases in urea, and creatinine levels in rats fed on high fat balady bread made from 100% wheat flour (positive control group) as compared to other groups of rats either fed on basal diet (negative control rats) or fed on high fat balady bread partially replaced by oat and/or okra flour (G3, G4 and G5). The urea content of the normal control rats was 45 mg/dl, while creatinine content of this group of rats (G1) was 0.54 mg/dl. The normal values of urea and creatinine in men should be in the range 45 and 0.6-1.3 mg/dl, respectively.

The data in the a forementioned Table clearly show that feeding on diets contained oat and/or okra flour (G3, G4 and G5) led to significant decreases in urea and creatinine concentrations. These decrements may be related to the oat and okra flour contain high contents of fiber and antioxidants which play an important role in the protection against diseases (Thompson, 1994).

Effect of feeding at high fat balady bread contained oat and okra flours on the relative organs weight of rats for 6 weeks

Liver, heart and kidneys of rats fed on the basal diet, as well as rats fed on high fat balady bread made from wheat flour or on that partially replaced by oat and/or okra flour, were weighted at the end of experimental period (7 weeks), and the ratio of each organ weight to the final body weight of rats, was calculated. The percentage of this ratio relative to G1 was also computed and the results were recorded in Table (11). As shown in Table (11), means for organs weight of different groups of rats express that diets prepared from selected compositions have meaningful effects on liver, heart and kidneys weights.

Table (10): Serum urea and creatinine (mg/dl) in normal and obese rats fed on balady bread contained oat and okra flours for 7 weeks.

Group of rats	Urea	Creatinine*
G1	45^{b}	0.54^{b}
G2	68^{a}	1.09^{a}
G3	46^{b}	0.43^{c}
G4	37^{d}	0.40^{c}
G5	43^{c}	0.44^{c}

*Values followed by the same letter in column are not significantly different at $P \leq 0.05$
G1-G5 as in below of Table (7).
Normal value of creatinine in man should be in the range of 0.6-1.3mg/dl. (Gaber, 1998).
Normal serum urea level is between 20-45 mg/dl.

Table (11): Effect of feeding at high fat balady bread contained oat and okra flours on the relative organs weight of rats for 6 weeks

Group of rats	Final body weight (g)	Liver			Kidneys			Heart		
		(g)	ROW	Relative to G1	(g)	ROW	Relative to G1	(g)	ROW	Relative to G1
G1	26.3^{c}	1.19^{d}	4.52	100	0.42^{c}	1.59	100	0.16^{b}	0.60	100
G2	35.0^{a}	1.96^{a}	5.60	124	0.59^{a}	1.68	106	0.24^{a}	0.68	113
G3	28.3^{b}	1.55^{b}	5.48	121	0.46^{b}	1.62	102	0.18^{b}	0.64	107
G4	28.5^{b}	1.43^{c}	5.00	111	0.44^{b}	1.54	97	0.17^{b}	0.60	100
G5	27.8^{b}	1.51^{b}	5.43	120	0.45^{b}	1.61	101	0.17^{b}	0.61	102

Each value was an average of five determinations.
Value followed by the same letter in column are not significantly different at $P \leq 0.05$

*Relative organ weight (R.O.W) = $\frac{\text{Organ weight}}{\text{Animal weight}} \times 100$

G1-G5 as in below of Table (7).

Liver weight of rats was apparently increased by feeding on high fat bread, either made from wheat flour or replaced by oat and/or okra flour. The results show that the rats fed on high fat bread prepared from wheat flour (G2) had the highest liver, kidneys and heart weights followed by rats fed on high fat bread replaced by 15% oat flour and 5% okra flour (G3). The results show also that the rats fed on high fat bread replaced by higher level of oat and okra flours (25 and 10%) had the lowest weights of liver, kidneys and heart. It could be observed that the effect of feeding on high fat diets on the liver weight was higher than that of other organs. It is well established that animal liver contains generally about 5% lipids, and this percentage could be increased up to 30% under the influence of diet or pathological and physiological disturbances (Leninger *et al.,* 1993). As according to Metwalli (2005), the increase of liver weight may be due to the accumulation of fat in liver tissues.

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تأثير دقيق الشوفان و دقيق الباميا على الفئران المغذّاة علي حمية عالية الدهون

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الملخص العربي

تم تنفيذ هذا العمل لدراسة تأثير استخدام دقيق الشوفان ودقيق البامية على مستويات مختلفة كبديل لدقيق القمح على الفئران التي غذيت على حمية عالية الدهون لمدة ٧ أسابيع.تشير النتائج التي تم الحصول عليها إلى أن التغذية على وجبات حمية تحتوي على مستوي أعلي من دقيق الشوفان ودقيق البامية معًا أدت إلى تقليل وزن الفئران مقارنةً بتلك التي تحتوى دقيق الشوفان ودقيق البامية بمستوي أقل، والتي تحتوي على دقيق البامية بدون دقيق الشوفان.وقد حدث انخفاض واضح في TG ، TC، LDL-C و VLDL-C لكل من الفئران المغذّاة على خبز بلدي عالي الدهون ، تم استبداله إما بدقيق الشوفان ودقيق البامية أو دقيق البامية مقارنة بالفئران التي غذيت على خبز بلدى عالي الدهون مصنوع من ١٠٠٪ دقيق قمح. كانت وظائف الكبد والكلى للفئران المغذّاة على خبز بلدي عالي الدهون الموجود في دقيق الشوفان و / أو دقيق البامية أقل بكثير من تلك الفئران التي غذيت على خبز بلدى عالي الدهون مصنوع من دقيق القمح فقط. وأظهرت النتائج أن الفئران التي غذيت على خبز عالي الدهون محضر من دقيق القمح ١٠٠٪ كان لديها أعلى مستويات من وزن الكبد والكليتين والقلب ولكن الفئران التي غذيت على خبز عالي الدهون تم استبداله بمستويات أعلى من الشوفان ودقيق البامية (٢٥ , ١٠٪) كان لديها أوزان أدنى من هذه أعضاء. توصي هذه الدراسة بمزج دقيق الشوفان والبامية مع دقيق القمح لتحضير حمية غذائية لتقليل وزن الجسم وتحسين الحالة الصحية.

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