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EFFECTS OF KARIESH CHEESE CONTAINING WHEAT BRAN ON SERUM CHOLESTEROL LEVEL, LIVER AND KIDNEY FUNCTIONS OF RATS FED ON A CHOLESTEROL-ENRICHED DIET

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The consumption of wheat bran has been correlated with reduced risk of several types of diseases due to the high fiber content found in wheat bran. So, this study aims to examine the effects of Kareish cheese containing wheat bran on the levels of serum cholesterol, liver and kidney functions of rats fed on a cholesterol-enriched diet. Forty eight male Albino Wister rats assigned to four groups. The groups were fed their respective diets for 8 weeks. The Protein Efficiency Ratio (PER) of diet 4 was significantly lower than the diet 2 and the same results were obtained for the biological value (BV), food efficiency ratio (FER) and relative nutritive value (RNV). The addition of wheat bran to the diet resulted in reduced the levels of total cholesterol (TC), triglyceride (TG) and LDL-cholesterol (LDL-C) of rats fed on diet 4, and increased HDL-cholesterol (HDL-C). Treatment with 10 % wheat bran for rats led to a major reduction TC about 28.13%. The concentrations of the liver enzymes such as Glutamate Oxaloacetate Aminotransferase (AST) and Glutamate Pyruvate Aminotransferase (ALT) were significantly (P<0.01) reduced by feeding on diet 4. At concentration 10% wheat bran, albumin level was decreased. Also, feeding on diet 4 was able to decrease creatinine and uric acid levels significantly (P<0.01) compared with diet 2 (positive control). It may be concluded that feeding Kareish cheese containing 10% wheat bran was able to markedly affect on the serum lipids and improve the functions of kidney and liver.

Keywords: Wheat bran fiber, Serum cholesterol, Kariesh cheeses, Liver and kidney functions

INTRODUCTION

The consumption of fibre appeared from Burkett's research (Burkitt *et al.*, 1971), who studied the relationship between health and consumption of fiber-containing foods (dietary fibre hypothesis). Fiber has been defined as edible parts of analogous carbohydrates or plants, which are resistant to absorption and digestion in the small intestine, but may be digested in the large intestine (Casiglia *et al.*, 2013).

Wheat bran is important by-product generated in large quantities during wheat processing and recognized as a good source of dietary fiber (Hollmann and Lindhauer, 2005), because it contains 45-50 % of fibre, 28.3% hemicellulose, 8.7% cellulose, 10.3% moisture, 3.0% pectin, 3.2% lignin and 2.64% nitrogen (Güler, 2013). The fibre has been show to inhibit several types of diseases. First, several types of cancers such as oral, colorectal, breast, small intestine and larynx (Park *et al*., 2009), possibly by increasing viscosity and fecal bulking or by producing short chain fatty acids, especially butyrate, which produced by the fermentation of cell wall fibre in the colon or by increasing the binding

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between carcinogens and bile acids, or by increasing levels of antioxidants (such as lignans, flavonoids and phytic acid) (Adlercreutz *et al*., 1987). Second, hypercholesterolemia by reducing serum total and LDL cholesterol, due to increase the rate of bile excretion (Story *et al*., 1997), or production of short chain fatty acids, specifically propionate, which has been shown to inhibit cholesterol synthesis, or by reducing energy intake, a marker of inflammation and a predictor for coronary heart disease (Amaral *et al*., 1992). For all those reasons, the recommended daily intake for fibre for adults has been set at 20 g for women and 35 g for men, but a recent survey of dietary fiber intake levels reports a median of 12.1-13.8 and 16.5-17.9 g/day for women and men, respectively and should come from various sources such as fruits, cereals, leafy vegetables and legumes (Slavin, 2005).

Kareish, *Karish* or *Kariesh* cheese is the most popular types of soft cheese consumed in Egypt and it is made from defatted milk (buffalo or cow's milk or a mixture of both) by acid coagulation. Nutritionally, *Kareish* cheese is rich in protein, calcium, amino acids, vitamins, phosphorus and many micronutrients (Abou-Donia, 2008).

Several researches have focused on the health effect of *Kareish* cheese, relatively little is yet known regarding the potential role of the health-promoting effects of *Kareish* containing wheat bran by reducing cholesterol. Therefore, the aim of this investigation was to study the effects of *Kareish* cheese containing wheat bran on the levels of serum cholesterol, liver and kidney functions of rats fed on a cholesterol-enriched diet.

MATERIALS AND METHODS

Wheat Bran

Wheat bran was obtained from Middle and West Delta Company for Milling, Damanhour city, Behera Governorate, Egypt. The bran was milled and passed through a 0.125 mm sieve and its composition: 87.3% dry matter; 14.7% protein; 49.3% total dietary fibre and 6.1% ash. Fresh skimmed cow's and buffaloes' milk obtained from the herd of Damanhour Secondary School of Agriculture, Damanhour city, Behera Governorate, Egypt.

Starter Organisms

Yogurt starter cultures (YO-MIX495 LYO 250 DCU, DANISCO, and Denmark) were used in cheeses preparation.

Chemicals

Kits for biochemical analysis of serum total cholesterol, triglycerides, HDL-Cholesterol from Bio-Adwic El Nasr Pharmaceutical, Egypt. Kits of AST, ALT, ALP, uric acid and creatinine were obtained from Diamond Diagnostic, Egypt.

Production of Kareish Cheese

Kareish cheese was made as described by Abou-Donia (2008) from pasteurized skimmed mixture of cow and buffalo's milk (1:1) (0.1% fat) by using yoghurt cultures. Resulting cheese was dried for rats feeding experiments at 50-60 °C for 2 days and packed in polyethylene bags, stored at refrigerated temperature (10 °C) until using.

Animal Experiments and Diet Formulation

Forty eight male Albino Wister rats weighing about 70±5 g were purchased from the Animal Breeding Colony of the High Institute of Public Health, Alexandria University. The rats were housed individually in controlled room (25±1 °C, 50% relative humidity) with a natural lighting cycle (12 hours). Rats were provided with basal diet and tap water ad libitum for 1 week, the rats were randomly allocated into four groups (n = 12) for a period of 8 weeks (group 1; received diet 1, group 2; received diet 2, group 3; received diet 3, group 4; diet 4). Table 1 shows the compositions of these diets, which were prepared from dry ingredients. The amounts of uneaten food and body weight were measured every day and every week, respectively. Three rats from each group were sacrificed after 2, 4, 6 and 8 weeks. After sacrifice, blood samples were drawn from the ether-anesthetized rats, and serum was obtained by sedimentation for 30 min, centrifugation at 1740 × g for 10 min. All samples were stored at –10 °C until analysis.

Nutritional Indexes

The nutritional indexes of the different diets were determined for each group, according to Mittchell and Block (1964), Danke and Tillman (1965), Evancho *et al.* (1977) and Lopz-Aliaga *et al.* (2003), using the formulas: Protein efficiency ratio PER = weight gained (g/rat/week)/protein intake (g/rat/week). Biological value (BV) = 49.9+10.53 PER. Food efficiency ratio (FER) = weight gain (g/rat/week)/diet intake (g/rat/week). PER = 0.286 + 0.022 RNV.

Biochemical Analysis

Serum Total Cholesterol (TC) was determined by Allian *et al.* (1974), triglycerides (TG) by Fossati and Prencipe (1982), and high density lipoprotein cholesterol (HDL-C) levels were determined by Burstein *et al.* (1970). Low Density Lipoprotein Cholesterol (LDL-C) levels were calculated

Table 1: Compositions of the Experimental Diets (%)

Ingredient	Diet 1	Diet2	Diet 3	Diet 4
Kareish cheese	33.53	33.53	32.31	31
Cholesterol	0	1	1	1
Cholic acid	0	0.2	0.2	0.2
Wheat bran	0	0	5	10
Casein	0	0	0	0
Corn Starch	40	40	40	40
Sucrose	11.47	10.27	6.59	2.9
DL-Mothionine	0.3	0.3	0.3	0.3
Corn Oil	5	5	4.9	4.8
Vitamin Mixture†	1	1	1	1
Mineral Mixture†	3.5	3.5	3.5	3.5
Cellulose	5	5	5	5
Choline Chloride	0.2	0.2	0.2	0.2
Total	**100**	**100**	**100**	**100**

Note: † Composition of the AIN-93M diet (Reeves *et al.*, 1993).

according to Friedwald *et al*. (1972) using the following formula:

LDL-cholesterol = Total cholesterol - (HDL-C + TG/5)

Glutamate oxaloacetate aminotransferase (AST) and glutamate pyruvate aminotransferase (ALT) were determined according to the method described by Reitman and Frankel (1957), while Alkaline Phosphatase (ALP) method reported by Rec (1972). Activities were assayed using colorimetric methods as described in the commercial assay kits instructions. The absorption of the test samples against blank were read at 546 nm for AST and ALT and at 510 nm for ALP. Albumin determination was carried out according to the method reported by Doumas *et al*. (1971) using Diamond Diagnostics Kits.

Creatinine determination was done according to Henry (1974) and uric acid determination was carried out according to the method reported by Fossati *et al*. (1980) by using the specified kits from Gesellschaft for Biochemical and Diagnostic (Germany) according to the instructions of the suppliers.

Statistical Analysis Method

Data were analyzed using the Statistical Analysis System software (SAS) mixed model analysis of variance procedure in SAS 9.2 (SAS, 2009). Analyses of variance were performed using two-way analysis of variance (ANOVA) procedures. Significant differences between means were determined using Duncan's multiple range test. For all analysis, statistical significance was set as $P \leq 0.01$. Principal Component Analysis (PCA) was applied to the average values of nutritional indexes Biochemical analysis data (Jolliffe, 2002). All calculations were carried out with Adinsoft (Paris, France).

RESULTS AND DISCUSSION

Nutritional Indexes

In the present study, there were no significant differences in the weight of food intake among groups (Table 2). Similar results have been obtained by Tamai *et al*. (1996) and Wang *et al*. (2011). PER was significantly ($p \leq 0.01$) higher in the diet 1 (negative control) than in the diet 2 (positive control). Also, body weight gain (Table 2) was significantly higher for diet 1 (negative control) than for the other dietary treatments. The mean of body weight gain ranged 31.25 – 44.06 g/week, these results were confirmed the work of other investigators (Wang *et al.*, 2011), who reported that body weight gain of rats fed diet varying from 5.34 to 6.46 g/day. In agreement with the literature (Maeda *et al.*, 2009), this increase may be attributed to the cholesterol content or by reducing energy intake. By the end eighth week, it observed that both the cholesterol and wheat bran retarded body weight gain in comparison with diet 1 (negative control). The higher wheat bran content of these diets proportionately decreased the energy content, resulting in effect on body weight gain. This result agrees with Jackix *et al*. (2013). Biological Value (BV), Food Efficiency Ratio (FER) and Relative Nutritive Value (RNV) of diet 1 (negative control) were significantly higher than that the other groups. The effective of wheat bran depends on a number of factors, such as, the length of feeding period and the concentration of wheat bran, so the body weight gain in diet 4 was lower than in the diet 3 after 8 weeks. The PER and BV were higher in rats fed a diet 4 as compared to the diet 2 (positive control). This result is in agreement with finding of Wang *et al*. (2011). The present results show that 5% wheat bran is not long enough to increase the growth parameters, while a increasing occurs in 10% wheat bran during the eighth week of the feeding period affected on the growth parameters.

To show the relationship between Food Intake (FI), Body Weight Gain (BWG), and Protein Efficiency Ratio (PER), Biological Value (BV), Food Efficiency Ratio (FER) and

Table 2: Effect of Feeding Rats on Dietary Supplemented with of Wheat Bran on Food Intake (FI), Body Weight Gain (BWG), Protein Efficiency Ratio (PER), Biological Value (BV), Food Efficiency Ratio (FER) and Relative Nutritive Value (RNV)

Rat Group	Time (Weeks)	Food Intake (g/week)	Body Weight Gain (g/week)	PER	BV	FER	RNV
Diet 1	2	75.22*^{def}	39.11^{cd}	2.60^{abc}	77.31^{abc}	0.520^{b}	105.18^{d}
	4	76.35^{cde}	40.46^{c}	2.65^{ab}	77.80^{ab}	0.529^{b}	107.45^{c}
	6	79.31^{ab}	42.82^{ab}	2.70^{a}	78.33^{a}	0.566^{a}	109.72^{b}
	8	80.11^{a}	44.06^{a}	2.75^{a}	78.85^{a}	0.566^{a}	112.00^{a}
Diet 2	2	73.46^{f}	28.50^{l}	1.94^{j}	70.37^{h}	0.388^{j}	75.18^{m}
	4	75.50^{def}	31.25^{k}	2.07^{hi}	71.72^{gh}	0.414^{i}	81.09^{l}
	6	78.32^{abc}	34.46^{ghi}	2.20^{fgh}	73.10^{efg}	0.440^{gh}	87.00^{j}
	8	79.61^{a}	36.62^{efg}	2.30^{efg}	74.11^{def}	0.459^{fg}	91.54^{gh}
Diet 3	2	75.08^{def}	33.03^{ijk}	2.20^{fgh}	73.07^{efg}	0.440^{gh}	87.00^{j}
	4	75.11^{def}	33.79^{ij}	2.25^{efgh}	73.62^{efg}	0.45^{fgh}	89.27^{i}
	6	78.38^{abc}	37.77^{def}	2.41^{cdef}	75.28^{cde}	0.483^{de}	96.55^{f}
	8	79.67^{a}	40.79^{bc}	2.56^{abcd}	76.88^{abc}	0.512^{bc}	103.36^{d}
Diet 4	2	74.89^{ef}	32.05^{jk}	2.14^{ghi}	72.45^{fgh}	0.428^{hi}	84.27^{k}
	4	74.90^{ef}	34.30^{hi}	2.29^{efgh}	73.11^{def}	0.458^{fg}	91.09^{gh}
	6	77.24^{bcd}	36.14^{fgh}	2.34^{defg}	74.61^{def}	0.468^{ef}	93.36^{g}
	8	78.19^{abc}	38.67^{cde}	2.47^{bcde}	75.93^{bcd}	0.494^{cd}	99.36^{e}

Note: *Means of triplicates. Means followed by the same superscript are not significantly different at P<0.01.

Relative Nutritive Value (RNV), Performance Analytics was performed (Figure 1). As shown in the chart correlation, there are a positive correlation among FI, BWG, PER and RNV, i.e., the correlation factor between FI and BWG was r = +0.76, while it was r = +0.99 between FER and RNV.

In order to reduce the dimensionality of the dataset, PCA was applied to compare diets effects on Food Intake (FI), Body Weight Gain (BWG), and Protein Efficiency Ratio (PER), Biological Value (BV), Food Efficiency Ratio (FER) and Relative Nutritive Value (RNV) of the treatment groups of rats (Figure 2). The first dimension (Dim 1) and the second dimension (Dim 2) explained, respectively 90.86% and 8.86% of the total variability.

Serum Lipids

Serum total concentration of cholesterol, triglyceride, LDL-cholesterol and HDL-cholesterol rats during dietary supplementation with wheat bran feeding for 8 weeks are presented in Table 3. The total concentration of serum cholesterol was significantly higher in diet 2 (Positive control) than in diet 1 (negative control). The raise in total concentration of serum cholesterol may be due increased uptake of cholesterol and decrease cholesterol catabolism (Vijaimohan *et al*., 2006). This result is consistent with other researches on human and animals (Newman *et al*., 1989; and Shenana *et al*., 2015). Total cholesterol of rats fed diets 2 (Positive control) ranging from 126.08 to 141.87 mg/dl. By end eighth week in the diet 3 and diet 4, the addition of wheat bran significantly ($p \leq 0.01$) amplified the decrease of total cholesterol in the serum, the reduction of serum cholesterol levels may be due to increase rate of bile excretion (Story *et al*., 1997), or production of short chain

Figure 1: Chart Correlation of Body Weight Gain (BWG), Food Intake (FI), Protein Efficiency Ratio (PER), Biological Value (BV), Food Efficiency Ratio (FER) and Relative Nutritive Value (RNV) of Rats Fed on Kariesh Cheese with Cholesterol at Different Wheat Bran Concentrations

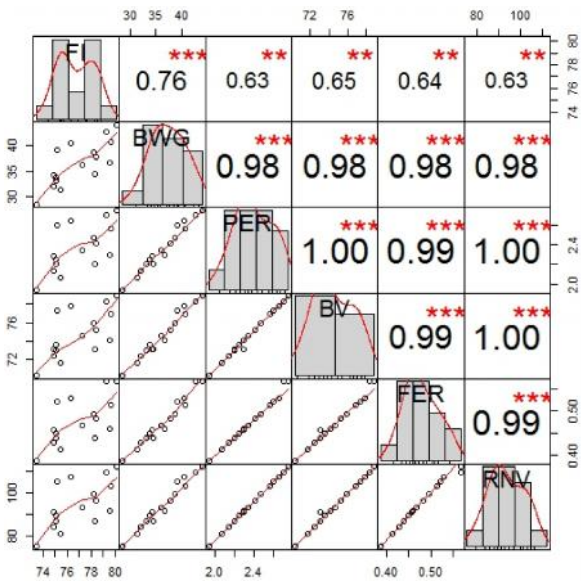


Figure 2: Principal Component Analysis (Percent of Variation Explained) for Body Weight Gain (BWG), Food Intake (FI), Protein Efficiency Ratio (PER), Biological Value (BV), Food Efficiency Ratio (FER) and Relative Nutritive Value (RNV) of Rats Fed on Kariesh Cheese with Cholesterol at Different Wheat Bran Concentrations

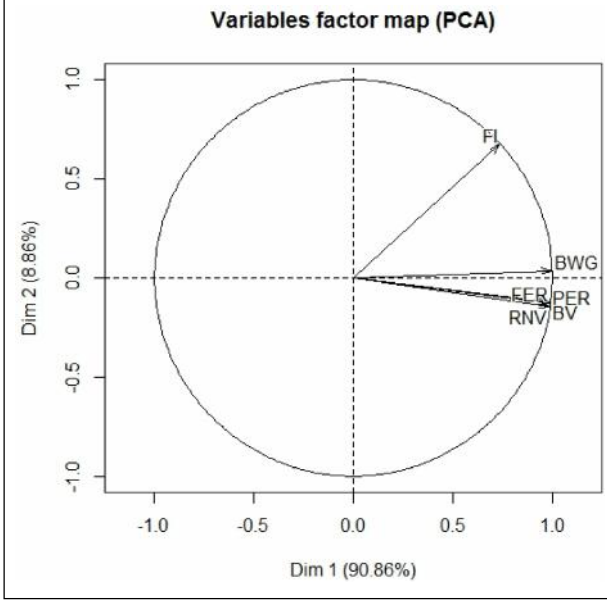


Table 3: Effect of Feeding Rats on Dietary Supplemented with Wheat Bran on Total Cholesterol (TC), Triglyceride (TG), LDL-Cholesterol (LDL-C) and HDL-Cholesterol (HDL-C)

Rat Group	Time (weeks)	Total Cholesterol (mg/dl)	Triglyceride (mg/dl)	LDL-Cholesterol (mg/dl)	HDL-Cholesterol (mg/dl)
Diet 1	2	98.90^{l}	103.83^{jk}	36.32^{l}	41.81^{ab}
	4	99.05^{l}	102.79^{jk}	36.93^{l}	41.56^{ab}
	6	99.67^{kl}	102.66^{jk}	37.02^{l}	42.11^{a}
	8	100.67^{kl}	101.90^{jk}	38.11^{kl}	42.18^{a}
Diet 2	2	126.08^{d}	142.31^{c}	71.30^{d}	26.31^{g}
	4	131.21^{c}	143.76^{bc}	76.89^{c}	25.56^{g}
	6	137.41^{b}	145.54^{ab}	83.30^{b}	25.00^{g}
	8	141.87^{a}	146.36^{a}	87.92^{a}	24.67^{g}
Diet 3	2	120.31^{e}	135.01^{d}	63.49^{e}	29.81^{f}
	4	118.50^{e}	130.20^{e}	59.24^{f}	33.22^{e}
	6	115.61^{f}	124.56^{f}	55.07^{g}	35.62^{de}
	8	113.32^{g}	117.41^{g}	53.66^{gh}	36.17^{d}
Diet 4	2	110.60^{h}	113.11^{h}	51.67^{h}	36.30^{d}
	4	107.07^{i}	109.89^{i}	47.31^{i}	37.78^{cd}
	6	104.13^{j}	104.23^{j}	43.78^{j}	39.50^{bc}
	8	101.95^{jk}	101.67^{k}	40.50^{jk}	41.11^{ab}

Note: *Means of triplicates. Means followed by the same superscript are not significantly different at P<0.01.

fatty acids, specifically propionate, has been shown to inhibit cholesterol synthesis (Amaral *et al*., 1992). In addition to, dietary fiber increased the intestinal viscosity and thus decreased the absorption of cholesterol (Vijaimohan *et al*., 2006). These results confirm the work of other investigators (Sheu *et al.* 2008; and Aly, 2012) who, reported that the supplementation of diet with either wheat bran or oat resulted in a significant decrease in the level of total cholesterol in serum.

The total concentration of serum triglyceride was significantly increased from 142.31 mg/dl in the positive control to146.36 mg/dl. In contrast, there was no significant ($p \leq 0.01$) difference in the total level of serum triglyceride detected between diet 1 (negative control) and diet 4 group (Table 3). It can also be seen that the total levels of serum triglyceride in the diet 3 was lower than that in the positive control group (diet 2). This result agrees with Kashtan *et al*., 1992), who reported that wheat fiber may lower serum lipids.

LDL-cholesterol values were significantly ($p \leq 0.01$) higher for diet 2 (positive control) in comparison to the other. The diet supplemented with 10% wheat bran was more effective in reducing serum LDL-cholesterol than the diet 2 (positive control) without wheat bran. Jenkins *et al.* (1999) stated that diets with wheat fiber may be associated with increased cereal proteins and this may result in lower triglycerides in serum.

Addition of 5% and 10% wheat bran increased the concentration of HDL-cholesterol in the serum. This result is agreement with that of Anderson (1980). Aly (2012) stated that the diet with either oat or wheat bran resulted in a significant increase in the level of serum HDL-cholesterol compared with those fed high cholesterol.

As shown in the chart correlation (Figure 3), there are a positive correlation among TC, TG, LDL-C and HDL-C, i.e., the correlation factor between TC and LDL-C was r = +1. To study the joint variability of serum lipids parameters, Principal Component Analysis (PCA) was applied to their mean values (Figure 4). The first dimension (Dim 1) and the second dimension (Dim 2) explained, respectively 98.67% and 1.02% of the total variability. TC, LDL-C and TG are on the right side of the plot, while HDL-C is on the left side.

Liver And Kidney Functions

Increased levels of glutamate oxaloacetate aminotransferase (AST) and glutamate pyruvate aminotransferase (ALT),

Figure 3: Chart Correlation of for Total Cholesterol (TC), Triglyceride (TG), LDL-Cholesterol (LDL-C) and HDL-Cholesterol (HDL-C) of Rats Fed on Kariesh Cheese with Cholesterol at Different Wheat Bran Concentrations

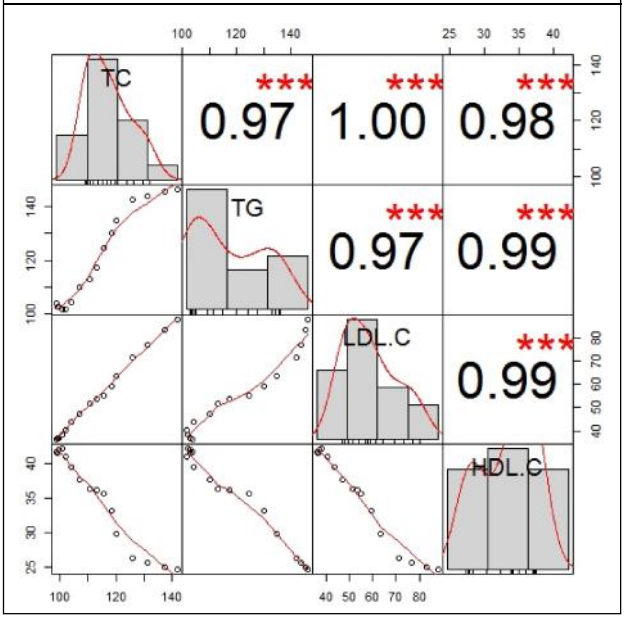


Figure 4: Principal Component Analysis (Percent of Variation Explained) for Total Cholesterol (TC), Triglyceride (TG), LDL-Cholesterol (LDL-C) and HDL-Cholesterol (HDL-C) of Rats Fed on Kariesh Cheese with Cholesterol at Different Wheat Bran Concentrations

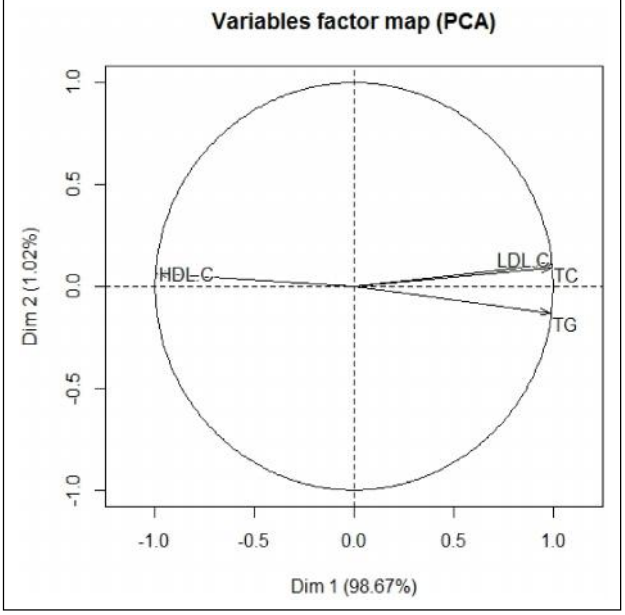


Table 4: Effect of Feeding Rats on Dietary Supplemented with Wheat Bran on Glutamate Oxaloacetate Aminotransferase (AST) and Glutamate Pyruvate Aminotransferase (ALT), Alkaline Phosphatase (ALP) and Albumin

Rat Group	After	AST (U/L)	ALT (U/L)	ALP (U/L)	Albumin (g/L)
Diet 1	2	22.79*^{i}	33.79^{h}	28.75^{h}	50.17^{h}
	4	24.16^{hi}	34.26^{h}	29.10^{gh}	53.06^{g}
	6	25.93^{gh}	35.91^{gh}	29.63^{gh}	55.70^{f}
	8	25.23^{h}	36.55^{fg}	30.51^{gh}	55.77^{ef}
Diet 2	2	41.11^{bc}	56.81^{a}	40.31^{bc}	61.71^{a}
	4	42.90^{ab}	57.01^{a}	41.11^{ab}	62.09^{a}
	6	43.80^{a}	57.93^{a}	42.50^{ab}	62.92^{a}
	8	44.57^{a}	58.31^{a}	43.31^{a}	63.19^{a}
Diet 3	2	39.37^{c}	50.13^{b}	38.72^{cd}	59.31^{b}
	4	36.49^{d}	49.63^{b}	38.00^{d}	58.71^{bc}
	6	34.65^{de}	48.01^{bc}	36.93^{de}	58.31^{bcd}
	8	33.81^{ef}	46.15^{cd}	35.12^{e}	58.00^{bcde}
Diet 4	2	31.71^{f}	45.31^{d}	36.51^{de}	57.81^{bcdef}
	4	28.14^{g}	43.92^{d}	35.61^{e}	57.21^{bcdef}
	6	27.81^{g}	40.31^{e}	32.82^{f}	56.66^{cdef}
	8	25.55^{h}	38.61^{ef}	31.01^{fg}	56.27^{def}

Note: *Means of triplicates. Means followed by the same superscript are not significantly different at P<0.01.

alkaline phosphatase (ALP) are indicative of acute damage and make disorder in the functional activity of liver, while increased serum albumin level is due to more synthesis, in the availability of increasing biliary pressure (Sheela *et al* ., 2013). The means of enzymes are given in Table 4. The activity of AST was significantly ($p \leq 0.01$) decreased in the serum of rats fed diet 1 (negative control), but addition of the cholesterol influenced the activity of this enzyme. Serum ALP activity and albumin values were significantly higher in the diet 3 than in the diet 1 (negative control). In contrast, the rats fed wheat bran showed a significant decrease in the levels of glutamate oxaloacetate aminotransferase (AST) and glutamate pyruvate aminotransferase (ALT), alkaline phosphatase (ALP) in serum compared with the diet 2 (positive control). This result agrees with the assumption that dietary fiber improves the level of liver function (Aly, 2012).

The results indicated that AST, ALT and ALP activities were significantly affected by the concentration of fibre and period of feeding (8 weeks). A significant improvement of the enzymes activity was observed especially in the rat fed on diet 4. This may be due to attributed to feeding dietary fibers containing natural antioxidants (David, 2001).

As shown in the chart correlation (Figure 5), there are a positive correlation among AST, ALT, ALP and Albumin, i.e., the correlation factor between AST and Albumin was r = +0.94. To study the joint variability of liver and kidney functions parameters, Principal Component Analysis (PCA) was applied to their mean values (Figure 6). The first dimension (Dim 1) and the second dimension (Dim 2) explained, respectively 97.23% and 1.91% of the total variability. AST, ALT, ALP and Albumin are on the right side of the plot, while AST, ALT and ALP are on the negative side.

Figure 5: Chart Correlation of Glutamate Oxaloacetate Aminotransferase (AST) and Glutamate Pyruvate Aminotransferase (ALT), Alkaline Phosphatase (ALP) and Albumin of Rats Fed on Kariesh Cheese with Cholesterol at Different Wheat Bran Concentrations

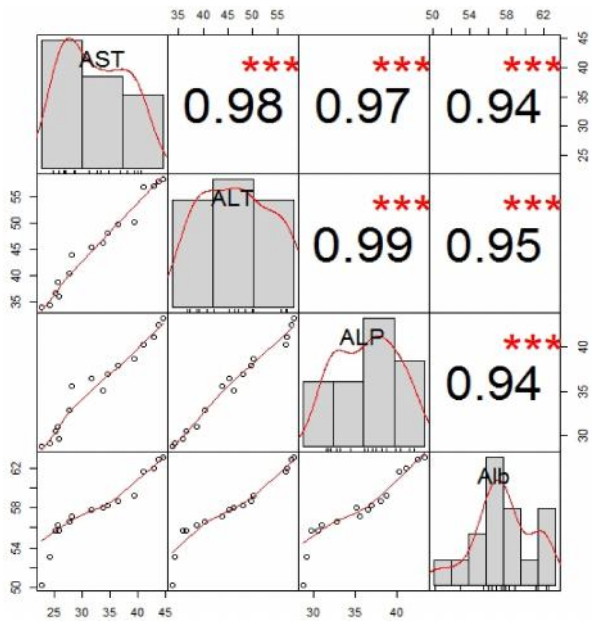


Figure 6: Principal Component Analysis (Percent of Variation Explained) for Glutamate Oxaloacetate Aminotransferase (AST) and Glutamate Pyruvate Aminotransferase (ALT), Alkaline Phosphatase (ALP) and Albumin of Rats Fed on Kariesh Cheese with Cholesterol at Different Wheat Bran Concentrations

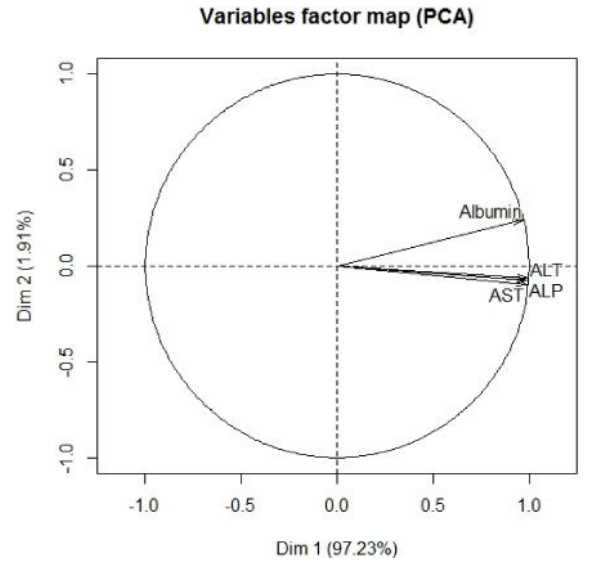


Table 5: Effect of Feeding Dietary Supplemented with Wheat Bran on Creatinine (Cr) and Uric acid (Ur)

Rat Group	After	Creatinine (Umol/L)	Uric Acid (mg/dL)
Diet 1	2	0.46^{*h}	2.11^{g}
	4	0.45^{hi}	2.16^{fg}
	6	0.43^{ij}	2.13^{g}
	8	0.41^{j}	2.15^{fg}
Diet 2	2	0.60^{c}	2.63^{abc}
	4	0.63^{b}	2.69^{ab}
	6	0.67^{a}	2.73^{ab}
	8	0.68^{a}	2.75^{a}
Diet 3	2	0.59^{c}	2.59^{abcd}
	4	0.56^{d}	2.51^{bcde}
	6	0.53^{e}	2.45^{cde}
	8	0.51^{ef}	2.37^{def}
Diet 4	2	0.49^{fg}	2.33^{efg}
	4	0.47^{gh}	2.29^{efg}
	6	0.46^{h}	2.18^{fg}
	8	0.42^{j}	2.14^{g}

Note: *Means of triplicates. Means followed by the same superscript are not significantly different at P<0.01.

In this investigation, there is a significant increase in the levels of serum creatinine and uric acid in diet 2 (positive control) compared with that of the diet 1 (negative control). These results are confirmed with other studies demonstrated a relationship between increased cholesterol in the diet and kidney disease (Schaeffner *et al*., 2003; and Trevisan *et al*., 2006). In contrast, the rats fed wheat bran showed a significant decrease in the levels of serum creatinine and uric acid compared with the diet 2 (positive control). This result agrees with the assumption that dietary fiber improves the level of kidney function (Rampton *et al*., 1984).

To show the relationship between creatinine (Cr) and uric acid (Ur), Performance Analytics was performed (Figure 7). As shown in the chart correlation, there are a positive correlation among Cr and Ur, i.e., the correlation factor between Cr and Ur was r = +0.98.

Figure 7: Chart Correlation of Creatinine (Cr) and Uric Acid (Ur) of Rats Fed on Kariesh Cheese with Cholesterol at Different Wheat Bran Concentrations

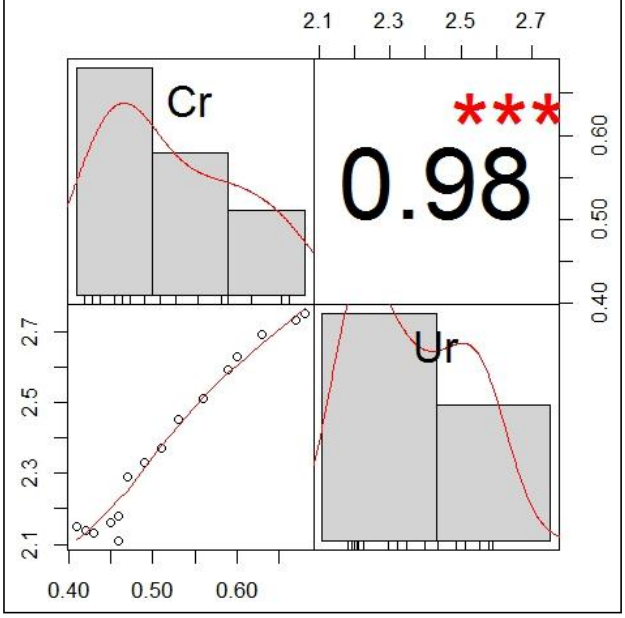
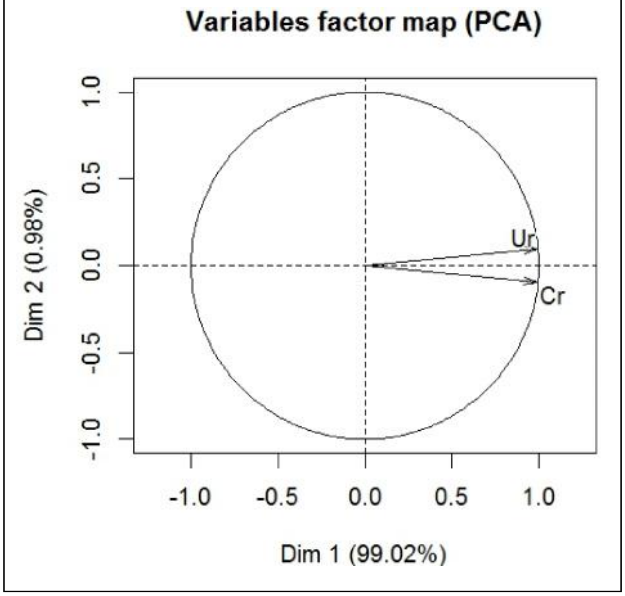


Figure 8: Principal Component Analysis (Percent of Variation Explained) for Creatinine (Cr) and Uric Acid (Ur) of Rats Fed on Kariesh Cheese with Cholesterol at Different Wheat Bran Concentrations



In order to reduce the dimensionality of the dataset, PCA was applied to compare diets effects on creatinine (Cr) and uric acid (Ur), of the treatment groups of rats (Figure 8). The first dimension (Dim 1) and the second dimension (Dim 2) explained, respectively 99.02% and 0.98% of the total variability.

CONCLUSION

This investigation has demonstrated that *Kareish* cheese containing 10% (W/W) wheat bran in the diet of rats fed a cholesterol-enriched diet had marked effect on the levels of TC, TG, LDL-C and HDL-C. Results demonstrate positive effect on liver and kidney function. The results also show an inverse relationship between *Kareish* cheese containing 10% (W/W) wheat bran and the levels of total serum lipids as well as functions of kidney and liver.

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