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**INTERNATIONAL JOURNAL OF  
 ADVANCED RESEARCH (IJAR)**

Article DOI: 10.21474/IJAR01/5471  
 DOI URL: <http://dx.doi.org/10.21474/IJAR01/5471>



### RESEARCH ARTICLE

## EFFECT OF HIGH FIBER CAKES PREPARED FROM SOME FRUITS AND VEGETABLE WASTES ON LIPID METABOLISM OF MALE ALBINO RATS.

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#### Manuscript Info

##### Manuscript History

Received: 19 July 2017  
 Final Accepted: 21 August 2017  
 Published: September 2017

##### Key words:-

Fruits and vegetable wastes- Potato peels- Guava seeds -Pomegranate peels- Hypercholesterolemia -Liver functions- High fiber cake.

#### Abstract

The present investigation aimed to assess the possibility of using some fruits and vegetable wastes including potato peels, guava seeds and pomegranate peels as different sources of dietary fiber. Dietary fiber from potato peels, guava seeds and pomegranate peels were used in preparation high fiber cakes at the levels 5, 7 and 10% dietary fiber. Thirty male albino rats were fed with basal diet and 0.25% cholesterol for 6 weeks to induce hypercholesterolemia then the diet was administered with the best dietary fiber cakes (5% dietary fiber) for another 6 weeks. The results showed that the pomegranate peels contained a high percentage of crude fiber, ash and total dietary fiber. Insoluble fiber in tested wastes was higher than soluble fiber. Regarding to the rheological properties of the prepared cake samples, the addition of the wastes dietary fiber at high levels led to increase the water absorption while the mixing time and mixing stability of the dough were decreased. The organoleptic properties recorded the higher grades for the cake samples prepared with 5 and 7% guava seeds followed by 5% of potato peel and 5% pomegranate peel. The feeding experiments of rats for other six weeks on the tested cake samples at the level 5% (which was the best choice in organoleptic and rheological properties) led to decrease the relative body weight of rats and reduced the levels of triglycerides, liver cholesterol, serum cholesterol and LDL-cholesterol. The liver functions for all the groups of rats feeding with tested cake samples were within normal limits and the absorption of iron and copper were retarded.

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#### Introduction:-

Potato, guava and pomegranate are considered among the most popular fruits and vegetables grown in Saudi Arabia. These fruits and vegetable are a highly preferred in processing for their color, flavor beside, it is a good source of vitamins, minerals and fiber (Anon, 1998). It is well known that guava seeds and pomegranate peels are widely processed from fresh juices industry while potato peels is a waste from the potato chips industry. Potato peels, guava seeds and pomegranate peels are the most important wastes remaining after the processing of potato, guava and pomegranate respectively. These wastes represented about 20.2, 32.5 and 42.3% of the fresh weight of potato,

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pomegranate and guava respectively (Egashira et al., 1998). On one side, the potato peels, guava seeds and pomegranate peels, which are the major portion of processing wastes, represent a severe disposal problems to the food industries, especially since the wet wastes are prone to rapid microbial spoilage. On the other side, these wastes contain an array of nutritionally and pharmacologically interesting components such as phenolic compounds, glycoalkaloids, and polysaccharides, which may be used as natural antioxidants, precursors of steroid hormones, and dietary fiber (Kabir et al., 2015). Dietary fiber (DF) refers to the parts of grains, vegetables and fruits that our body can't digest. The soluble and insoluble fibers in these food sources are made up of complex carbohydrates that contribute to our overall health (Anderson *et al.*, 2009).

Potato peels, guava seeds and pomegranate peels contain several structural polysaccharides, including insoluble (cellulose and lignin) and soluble (hemicelluloses and pectin) DF (Sanchez et al., 1995). Due to their physicochemical properties and indigestible characteristics, DF directly affects the digestive track with further indirect systematic physiological consequences. DF imposes positive modifications on viscosity, motility, nutrient absorption, content, transit time, emptying, and probiotic properties of the entire digestive track (Kritchevsky and Bonfield, 1995). These modifications may resolve constipation, reduce fat absorption, lower glycemic index and plasma insulin levels, alter colon fermentation and microbial proliferation, and reduce plasma cholesterol (Spillor, 2003). Therefore, adding recommended levels of DF to the diet is considered vital for normal intestine performance, good health, and for controlling major risk factors for diabetes, obesity, gallstones, hypercholesterolemia and heart disease (Al-Gubory et al., 2016).

Dietary fiber was stated to have a hypocholesterolemic effect in human and several experimental animal (Fernandez et al., 2001). The action of dietary fiber on the absorption of cholesterol or to the enhancement of the bacterial metabolism in the large bowel leading to the synthesis of volatile fatty acids which will be reabsorbed and affect hepatic cholesterol. Cholesterol was also shown to affect the level of other lipid fractions in the animal serum and decrease delivery of cholesterol to the liver (Leveille, 2002). This action was also explained by binding of bile salt and cholesterol giving rise to complexes unabsorbed in small intestine. This binding occur between the hydroxyl group and the free carboxyl group of fiber (Lybus et al., 2011).

The main objectives of this study were to study the effect of dietary fiber from potato peels, guava seeds and pomegranate peels on the chemical composition, rheological and sensory evaluation of tested cakes. Also, the effect of cake with dietary fiber from potato peels, guava seeds and pomegranate peels on some dietary and metabolic measures such as food consumption, weight gain, relative cecum weight, LDL-C, HDL-C content, plasma and hepatic cholesterol levels of hypercholesteremic rats.

## **Materials And Methods:-**

### **Materials:-**

Wheat flour (72% extraction) was obtained from North Cairo flour mills Co, Cairo, Egypt. Potato peels were obtained from the output of "Misr Food Industries Co." Six of October, Cairo, Egypt, Guava seeds and pomegranate peels was obtained from "kaha Company", El-kalubia governorate, Egypt. Male albino rats of Sprague Dawley strain (30 rats) weighing  $80 \pm 5$  g. (in the beginning of experiment) were obtained from Medical Analysis Dep., Institute of Ophthalmology, Giza, Egypt. The basal diet components and cholesterol were obtained from El-Gomhoria Co., Egypt. Chemicals were from Kets Co., Tanta, Egypt.

### **Methods :-**

#### **Preparation of potato peels, guava seeds and pomegranate peels dietary fiber:-**

Potato peels, guava seeds and pomegranate peels were washed with tap water and scalded in a water bath to remove possible potential pathogenic microorganisms (vegetative cells). Afterwards, the wastes were pressed using a helical press to remove excess liquid prior to drying. Drying was carried out in an oven at  $50^{\circ}\text{C}$  for 24 h to improve tested wastes shelf-life without addition of any chemical preservative. A grinder mill and sieves were used to obtain a powder particle size of less than 0.2mm as reported by Fernandez et al. (2004). After that potato peels, guava seeds and pomegranate peels are soaking in citric acid 0.5% + Na Cl 0.5% for 10 min at  $25^{\circ}\text{C}$ . Dehydration by using the air drying for 24 h method as disalced by Larrauri et al. (1997). The dehydrated samples were ground sieved and packed in glass jars then stored at room temperature for analysis.

**Preparation of cakes:-**

Cakes were prepared according to Panel and Sonthgate (1978) to obtain the control sample. Other samples were prepared with dietary fiber from potato peels, guava seeds and pomegranate peels at the levels 5, 7 and 10% for each dietary fiber source (at expense of flour). The ingredients were as the following for the control one:

Wheat flour	25g
Sugar	15g
Eggs	15g
Baking powder	5 g
Water	up to 100 g

**Analytical Methods:-**

Moisture content, total fat, total protein, total ash and crude fiber were determined according to methods described in the A.O.A.C (1995). Total carbohydrates were calculated by difference. Determination of total dietary fiber, soluble fiber and insoluble fiber was according to the methods described by ASP et al. (1983).

**Rheological Characteristics:-**

Material water absorption, arrival time, mixing time, stability and softening of dough were determined according to the standard methods described in (AACC, 1987) using a Farinograph type (PL) (Barbender Farinograph, Germany). This test was carried out on the wheat flour and its blends with 5, 7 and 10% dietary fiber from potato peels, guava seeds and pomegranate peels.

**Organoleptic evaluation of cakes:-**

Control cake sample and cake containing 5, 7 and 10% of dietary fiber from potato peels, guava seeds and pomegranate peels were coded and served to panelists (10 panelists from the staff of the Faculty of Family Science, Taibah University) to rank them according to the degree of acceptability measured by color, odor, flavor and texture on a scale of zero to 10 (Kramer and Twigg, 1962).

**Experimental animals, diets and treatments:-**

A total 30 male albino rats weighing  $80 \pm 5$  g. were housed individually in stainless steel cages, fitted with wire-mesh bottoms, in a temperature-controlled room ( $25^\circ\text{C}$ ) with 12-h light and dark periods. They were allowed free access to water. In this study, rats fed on normal diet for 7 days as adaptation period, the basal diet according to AIN (1993) consisted of casein (12%), corn oil (10%), cellulose (5%), salt mixture (4%) (Hegsted et al., 1941), vitamin mixture (1%) (Campbell, 1963), methionin (0.3%), choline chloride (0.2%) and corn starch (up to 100%). After the first 7 days, rats (the initial weight was  $100 \pm 5$  g.) were divided randomly into five groups. The rats in group (1) were continued feeding on basal diet as a negative group (G1), the other groups were fed on basal diet with 0.25% cholesterol for 6 weeks to induce hypercholesterolemia when the mean of serum cholesterol was 250 mg/dl (Abdel-Raheim et al., 1986). Then hypercholesterolemic rats divided into 4 subgroups 6 rats per each, as follow:

-Group 2: basal diet+ 0.25% cholesterol as positive control(G2).
-Group 3: basal diet + 0.25% cholesterol + cakes of 5% potato peels dietary fiber(G3).
-Group 4: basal diet +0.25% cholesterol + cakes of 5% guava seeds dietary fiber(G4).
-Group 5: basal diet + 0.25% cholesterol + cakes 5% of pomegranate peels dietary fiber(G5).

The hypercholesterolemic rats in groups 3, 4 and 5 were administrated 5% dietary fiber cakes from potato peels, guava seeds and pomegranate peels (by adding to hypercholesterolemic diet at the expense of diet's energy sources) for another 6 weeks (treatment period) (Prosky, 1991). Daily feed consumption was recorded throughout the experimental period (12 weeks), body weight and feed efficiency ratio were recorded according to the methods of Chapman et al. (1959). Feces were collected during the last 5 d, dried and weighed. After 6 weeks, rats were deprived of food for 14 h and then scarified under ether anesthesia. The abdomen was opened and blood was collected from the abdominal aorta. Blood samples were centrifuged at 3000 rpm for 7 min and the clear serum was stored at  $-20^\circ\text{C}$ . Liver and cecum were removed, blotted, and cecum was weighed.

**Biochemical assays:-**

Serum and hepatic cholesterol levels were determined according to Seary and Bergquist (1960). triacylglycerol (TG), and high density lipoprotein cholesterol (HDL-c), low density lipoprotein cholesterol (LDL-c) levels were assessed using commercial enzymatic colorimetric kits. Low density lipoprotein cholesterol (LDL-c) was calculated

(Frost & Havel, 1998). Aspartate aminotransferase (AST) and Alanine aminotransferase (ALT) were determined according to Tietz (1976). Sodium and copper were determined according to AOAC (1995).

#### Statistical analysis:-

Data for sensory evaluation were statistically analyzed as reported by Snedecor and Cochran (1967), All of the values were expressed as the mean  $\pm$  SD. Interactions were analyzed by the general linear model procedure and Duncan's Multiple Range Test was used to separate means. Differences with P values  $\leq$  0.05 were considered significant

#### Results:-

Wheat flour, guava seeds, potato peels and pomegranate peels were analyzed for their chemical composition (total carbohydrates, total protein, total fat, crude fiber and ash). The obtained results are shown in table (1) on the dry weight basis. From the results, it could be noticed that, the pomegranate peel was rich in protein, lipid, fiber and ash, compared to wheat flour followed by potato peel while guava seed contained high amount of total carbohydrates.

Total dietary fiber including soluble dietary fiber and insoluble dietary fiber of wheat flour, guava seeds, potato peels and pomegranate peels in the dry state were determined. Results in table (2) show that insoluble dietary fiber was higher than soluble dietary fiber for all the mentioned samples. The ratio of soluble dietary fiber/total dietary fiber were 25.54, 23.22 and 21.96% for pomegranate peels, potato peels and guava seeds respectively while, wheat flour was 13.11%. But, the ratio of insoluble dietary fiber/total dietary fiber in wheat flour was higher than guava seeds, potato peels and pomegranate peels (86.87%).

Minerals content of guava seed, potato peels, pomegranate peels and wheat flour were determined. Data in table (3) show that, pomegranate peels contained a high amount of iron followed by potato peels, while guava seeds had higher content of copper than the others. Potato peels, guava seeds and pomegranate peels contained very low amounts of pb.

The farinograph test of cakes made from wheat flour substituted with different sources of dried dietary fiber of potato peels, guava seeds and pomegranate peels at the levels 5, 7 and 10% and the control sample were presented in table (4). Data show that the addition of dried dietary fiber at different levels increased water absorption of the dough as compared with the control sample. Results in this table indicated that, the stability (min) of dough was affected by the addition of different levels of dietary fibers. The increase of dietary fiber increased the softening of dough and decreased the stability (min) of dough. 5% of dietary fiber was the best level for all farinogram parameters for all cake samples.

A five member taste panel scored color, odor, flavor, texture and overall acceptability of cakes baked with 100% wheat flour and total dietary fiber from potato peels, guava seeds and pomegranate peels at the levels of 5, 7 and 10% as shown in tables (5). Data from this table show that cakes substituted with wheat flour as control and 5% total dietary fiber from potato peels, and guava seeds had the highest score (9). However, cakes prepared with 7% of total dietary fiber from potato peels and 7 and 10% of total dietary fiber from guava seeds recorded the second order in this evaluation. While, cakes prepared with total dietary fiber of pomegranate peel at the levels 7 and 10% had the lowest scores for the tested parameters.

Total feed consumption, daily feces excretion, and body weight gains were lower in rats consuming 5% total dietary fiber cakes of potato peels, guava seeds and pomegranate peels than both of control (Table 6). Regardless of the dietary fiber source, rats consuming the pomegranate peels fiber cake's diet with cholesterol had the lowest body weight gain when compared with the negative control group. Dietary fiber cake of pomegranate peels significantly reduced weight of hypercholestermic rats followed by dietary fiber of potato peels and the last one dietary fiber of guava seeds when compared with both of control groups. Among rats fed on dietary fiber cakes (G 3, 4 and 5), relative cecum weights were significantly higher than the negative and positive control groups, while no significant differences were observed in relative cecum weights in groups 3, 4 and 5.

Table (7) shows the levels of lipid pattern of serum male albino rats, it is noticeable that all types of total dietary fiber cake of potato peels, guava seeds and pomegranate peels (5%) reduced the levels of rat's liver cholesterol, serum triglycerides, total cholesterol LDL-C and VLDL whereas, HDL-C was increased by feeding on cake's diet

with 5% dietary fiber sources. Total dietary fiber cake of pomegranate peels significantly reduced all parameters followed by total dietary fiber cake of potato peels while, total dietary fiber cake of guava seeds was the lowest one. In the same table, data shows the level of serum liver functions AST and ALT of albino rats administered different types of total dietary fiber cake. It is evident that all values are nearly to normal range indicating the absence of any adverse effects of the dietary fiber on liver function.

The absorption of sodium as an example of monovalent cation was retarded by the presence of fiber' cake in the diet (table 8). Similarly, copper absorption was retarded by all dietary fiber sources especially Pomegranate peels source.

### **Discussion:-**

Dietary fibers may contribute to the prevention and treatment of adverse dietary and physiological situations in humans. Consumption of DF is encouraged because their benefits have been reported to include maintenance of the large intestine, reduction in the formation of gallstones, and control of major risk factors of vascular disease, ischemic heart disease, diabetes and obesity (Schneeman, 1998). Dietary fiber comes from the portion of plants that is not digested by enzymes in the intestinal tract. Part of it, however, may be metabolized by bacteria in the lower gut.

Fiber is commonly classified into two categories: those that don't dissolve in water (insoluble fiber) and those that do (soluble fiber). Insoluble fiber, this type of fiber promotes the movement of material through your digestive system and increases stool bulk, so it can be of benefit to those who struggle with constipation or irregular stools. Whole-wheat flour, wheat bran, nuts, many vegetables and vegetables & fruits peels are good sources of insoluble fiber. Soluble fiber, this type of fiber dissolves in water to form a gel-like material. It can help lower blood cholesterol and glucose levels. Soluble fiber is found in oats, peas, beans, apples, citrus fruits, carrots, barley and psyllium (Derek and Joanne, 2008).

Nutritional wastes as guava seeds, potato peels and pomegranate peels are considered important source of nutrient elements to human body so, they are with a great therapeutic and nutrient effect as it supplies vitamins, minerals as well as fiber. Potato peels and guava seed have no phytic acid (Toma et al., 1998). In Saudi Arabia, usually commercial types of bakery products contain bran (shorts) as a fiber source, potato peels and guava seeds have more soluble fibers than of bran, soluble fibers are more effective in lowering serum cholesterol from the economical point of view each of potato peels, guava seeds and pomegranate peels are a by-products and inexpensive (Babbar et al., 2015).

This investigation was carried out to clarify the possibility of using the dietary fiber from some wastes of food processing as potato peels, guava seeds and pomegranate peels to prepare high fiber cake and the effect of the bakery product on the lipid profile and some serum components of hypercholesterolemic rats. From results presented in table (1), it could be seen that potato peels and pomegranate peels were rich in crude fiber, compared to wheat bran. The values were 11.7, 18.1 and 7.56% on dry basis for potato peels, pomegranate peels and wheat bran respectively. Pomegranate peels contained high amount of total protein, total fat and ash more than the others, the values were 15.91, 7.56 and 15.67% respectively. While guava seeds had the highest content of total carbohydrates (86.38%). The high content of crude fiber and ash of tested wastes are expected to raise the nutritive value of wheat flour used for cakes making. These results are in agreement with those found by Pagnanelli et al.(2001) who reported that guava seeds play an important role in the bakery products as food additives. They are an acceptable source of dietary fiber, protein and a variety of micronutrients and phytochemicals but disagree with the present results which showed guava seeds high in fat nearly as wheat flour content. Also, Sharma (2002) showed that potato peels may have high content in dietary fiber so; it could be added to many food products as bakery and meat products. The results of Bingham (2003) were matched with the presented results which mentioned that pomegranate peel contains higher amount of protein, dietary fiber and minerals, which have been shown to have food supplementation as a good source of the above nutrients.

Results in table (2) showed that total dietary fiber was at a high level in pomegranate peels followed by potato peels and wheat flour (72%) while, guava seeds were the lowest one. The values were 56.45, 49.32 and 44.31% respectively, as reported by Anderson et al. (2009) who mentioned that pomegranate peels and potato peels are considered good sources of dietary fiber. The insoluble dietary fiber was higher than soluble for all mentioned samples. Beside, the ratio of soluble dietary fiber to total dietary fiber ranged between 21.96-25.54% for guava seeds

and pomegranate peels. While, the ratio of insoluble dietary fiber to total dietary fiber of wheat flour was the highest ratio when compared with the others. These results are in agreement with Babbar et al. (2015).

In case of minerals content of the tested wastes (table 3), it could be observed that all tested wastes contained iron, copper and zinc. These results are in accordance with Toma et al. (1998). Their contents from minerals were higher than wheat flour content except zinc. These results are in accordance with those reported by Abd El-Basir et al. (1989) and Sharaf et al. (2000). Lead content in all tested samples were very low and these amounts were lower than the result suggested by FAO and WHO, the average of lead was 100-300µg/day (Prentica, 1996).

The farinograph test of cakes made from wheat flour (72% extraction) substituted with different sources of dietary fiber (guava seeds, potato peel, and pomegranate peel) in the percentage of 5, 7 and 10% total dietary fiber and also the control sample (table 4). From the obtained results, it could be concluded that the addition of dietary fiber of guava seeds, potato peels and pomegranate peels at different levels increased the water absorption of the dough, while this increment was found to be related to the levels of dietary fiber. Those results were in accordance with those obtained by Mary and Susan (1991). Results in this table indicated that, the stability (min) of dough was affected by the addition of different levels of dietary fibers in the dough. Substituted with guava dietary fiber was nearly equal to the control dough. These results were in agreement with those of Morad (1984) who reported that water absorption related to the levels of dietary fiber. Also, these results were matched with Zhang and Moor (1997) who found that higher dietary fiber levels generally results in an increased water absorption, decreased mixing time and reduced mixing stability. Similar results were obtained by Sharaf et al. (2000) who found that higher fiber increased water absorption and decreased the softening and stability (min) of dough.

Color, odor, flavor, texture and over all acceptability as organoleptic properties were evaluated for cakes produced from wheat flour, guava seeds, potato peels and pomegranate peels as shown in table 5. The control sample scored (9). Cakes substituted with 5% total dietary fiber of guava seeds, potato peel had the highest scores (9) when compared with the other levels which ranged between 6-8. The treatments (5% and 7% of potato peel, 5, 7 and 10% of guava seeds) showed no significant changes in total scores as compared with the control sample. Such results were in agreement with those obtained by Orr et al. (1982). The decrease in appearance scores with higher replacement levels was mainly due to the Egyptian panelists who usually prefer white than the darker grades (Abd El-Basir et al, 1989). The same results reported by Sharaf et al. (2000) who indicated that bread with 5 and 7% guava seeds gave a product of acceptable quality. From the above results, it could be observed that 5% of all sources of dietary fiber gave the best rheological and organoleptic properties.

Data in table (6) show general decreasing effect of dietary fiber administration on the feed consumption (g/rats), body weight gain (g / 12 weeks.) and feed efficiency ratio (g weight gain /g feed consumption per day) of rats which fed on basal diet and cholesterol. This might be due to the dietary fiber which caused decreasing in food intake. Furthermore, in rats fed on different types of dietary fiber, body weight gains decreased as the amount of the fiber increased, but pomegranate peels showed a more pronounced effect than the others. These results were matched with Toma et al. (1998) who reported that rats were very sensitive to the bitter taste, and the possible occurrence of such substances in dietary fiber especially in case of pomegranate peel could have resulted in decreased feed intake, as actually observed (Table 6). A bitter taste in the dietary fiber cake may have developed during drying as a result of browning processes. However, when a panel of volunteers tasted the dietary sources cake, no criticism of any bitter taste was raised. Also, Rebello et al. (2014) reported that in the feeding period, rats stopped eating whenever they fulfilled their energy and nutrient needs. Rats consume more food when diets contained less DF compared with a non fiber control group. However, because nutritional wastes is not a pure fiber, thus, provided additional nutrients that could have increased the energy density of the meal. However, guava seeds, potato peel and pomegranate peel contained a soluble fiber fraction that could have been fermented in the cecum to provide some metabolic energy, but this was far less than the energy that would have been expected from the replaced starch. Jackson et al. (1996) reported that low food intakes observed in guava seeds, potato peels and pomegranate peels fed rats may also be explained by the swelling of fibers in the stomach and the small intestine, achieving early satiety signals in these rats. This is attributed to the water-holding capacity and induced viscosity of soluble fibers. Adam et al. (2015) showed that dietary fiber eliminated food intakes so, rats gained less body weight and required more food to gain a gram of body weight than their counterpart control fed rats.

The differences were highly significant at  $p \leq 0.05$  between the control and the tested groups (table 7). For serum cholesterol, it could be observed that including cholesterol in rat's diets led to increase the level of serum cholesterol

compared with those fed control diet. Adding dietary fiber cakes to hypercholesterolemic rats diet caused decreasing in serum cholesterol more than positive control group. In addition, although no differences were noted in hepatic cholesterol levels between guava seeds dietary fiber and positive control-fed rats, hepatic fat content was reduced by total dietary fiber cake diet. Lowering serum cholesterol was attributed to soluble DF, although exceptions were known (Lazarov and Werman, 2006). Only  $\geq 25\%$  of guava seeds, potato peels and pomegranate peels were soluble; thus, even at the highest fiber level, their amount (25 g/kg diet) might not have been sufficient to decrease serum cholesterol to negative control. High cholesterol level caused by elevated hepatic cholesterol production is unlikely because diets high in cholesterol suppress hepatic cholesterol synthesis (Arjmandi et al., 2009).

In the same table, it could be noticed that the levels of lipid components as triglycerides, LDL-cholesterol were reduced by adding the dietary fiber cakes diet but, there were significant differences  $p < 0.05$  between tested groups and negative control. There was no significant differences between potato peels group and guava seeds group. For VLDL-C, there was no significant differences between group dietary fiber cake of guava seeds and dietary fiber cake of pomegranate peels. This effect could be attributed to the impairment of the lipid component in a small intestine as a result of expected binding between fiber and cholesterol which would affect the absorption of the other food lipid components (Egashira et al., 1998 and Brouns et al., 2012). Sharma (2002) showed that potato peels have shown that it might have therapeutic activity to its high content in dietary fiber as hypercholesterolemia. Also, this result is in accordance with Han et al. (2015).

In case of AST and ALT as liver functions, the data presented in the table (7) show that the levels of AST and ALT in the rat's serum were within normal limits under the administration of different dietary fiber sources.

Sodium and copper as important elements were significantly decreased when dietary fiber cake sources were added to diet's rats (table 8). There were no differences between positive and negative control. Dietary fiber cake with 5% pomegranate peel caused decreased in the tested elements followed by potato peel and guava seeds. This minerals reduction might be due to the physical activity of dietary fiber with different degree of esterification. Dietary fiber with high degree of esterification was still active in binding minerals as elastic gel forms and this finding was as observed by Pmerontz and Mloon (2010).

### Conclusion:-

In this study data concluded that guava seeds, potato peels and pomegranate peels dietary fiber, used as a dietary fiber sources in food as bakery products as cake, affected food consumption, body weight gain, serum sodium, serum copper, cholesterol and fat metabolism in male rats. The liver functions were within normal levels. From that, It was suggested that the guava seeds, potato peel and pomegranate peel were good sources of dietary fiber. This dietary fiber might be use as food additive as another bakery products and animals products. These products were very useful for hypercholesterolemia, obesity, hypertension (by decreasing sodium level). May be people used these products for a long time need to trace elements supplementation (as copper).

### Acknowledgement and Funding:-

This research was financially supported by the Deanship of Scientific Research (grant 6254/1435), Taibah University, Al-Madinah Al-Munawarah, Kingdom of Saudi Arabia.

**Table 1:-** Chemical composition of potato peels (Tp), guava seeds (Gs), pomegranate peels (Mp) and wheat flour 72% (Wf) (on dry weight basis).

Constituents material	Total protein	Total fat	Crude fiber	Ash	Total carbohydrates
<b>Tp</b>	9.2	0.1	11.7	9.42	69.58
<b>Gs</b>	1.41	2.1	3.33	6.78	86.38
<b>Mp</b>	15.91	7.56	18.1	15.67	42.76
<b>Wf</b>	13.19	2.24	7.56	2.68	74.33

**Table 2:-** Total dietary fiber, soluble and insoluble dietary fiber content (%) of potato peels (Tp), guava seeds (Gs), pomegranate peels (Mp) and wheat flour 72% (Wf) (on dry weight basis).

Constituents %	Total dietary	Soluble dietary	Insoluble dietary fiber	Soluble dietary fiber / Total dietary	Insoluble dietary fiber / Total dietary
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	fiber	fiber		fiber	fiber
<b>Tp</b>	49.32	11.45	37.87	23.22	76.78
<b>Gs</b>	37.44	8.22	29.22	21.96	78.04
<b>Mp</b>	56.45	14.42	42.03	25.54	74.46
<b>Wf</b>	44.31	5.81	38.5	13.11	86.89

**Table 3:-** Mineral content (p.p.m) of dried potato peels (Tp), guava seeds (Gs), pomegranate peels (Mp) and wheat flour 72% (Wf)

Material	Iron	Copper	Zinc	Lead
<b>Tp</b>	1004	143	4	0.002
<b>Gs</b>	436	200	2	0.006
<b>Mp</b>	3016	189	7	0.005
<b>Wf</b>	20	21	20	0.007

**Table 4:-** Farinogram parameters for dough prepared flour containing 0-10% fiber from potato peels (Tp), guava seeds (Gs) and pomegranate peels (Mp)

Blends			Water absorption	Arrived time min	Stability min	Softening of dough	
						After 10min	After 20 min
<b>Control blend</b>	100	0	55.5	1.5	11.5	22	58
<b>Blend A Tp</b>	95	5	65.7	3.32	9.21	22	72
	93	7	71.6	5.0	8.64	22	88
	90	10	77.0	6.1	8.45	22	106
<b>Blend B Gs</b>	95	5	55.5	1.5	11.5	0	59
	93	7	60.5	2.45	11.67	0	46
	90	10	63.4	2.75	12.51	0	40
<b>Blend C Mp</b>	95	5	70.4	4.5	11.67	0	44
	93	7	79.2	5.75	12.21	0	40
	90	10	88.1	9.45	12.35	0	36

**Table 5:-** Organoleptic properties of cake with total dietary fiber from potato peels (Tp), guava seeds (Gs) and pomegranate peels (Mp)

Organoleptic	Control	cake with Tp			Cake with Gs			cake with Mp		
Properties		5	7	10	5	7	10	5	7	10
<b>Color</b>	9 <sup>a</sup>	9 <sup>a</sup>	8 <sup>a</sup>	8 <sup>a</sup>	9 <sup>a</sup>	9 <sup>a</sup>	9 <sup>a</sup>	8 <sup>a</sup>	7.7 <sup>b</sup>	6 <sup>c</sup>
<b>Odor</b>	9 <sup>a</sup>	9 <sup>a</sup>	8 <sup>a</sup>	7 <sup>b</sup>	9 <sup>a</sup>	9 <sup>a</sup>	9 <sup>a</sup>	7 <sup>b</sup>	6 <sup>c</sup>	6 <sup>c</sup>
<b>Flavor</b>	9 <sup>a</sup>	9 <sup>a</sup>	8 <sup>a</sup>	7 <sup>b</sup>	9 <sup>a</sup>	9 <sup>a</sup>	9 <sup>a</sup>	7 <sup>b</sup>	6 <sup>c</sup>	6 <sup>c</sup>
<b>Texture</b>	9 <sup>a</sup>	9 <sup>a</sup>	8 <sup>a</sup>	7 <sup>b</sup>	9 <sup>a</sup>	8 <sup>a</sup>	8 <sup>a</sup>	8 <sup>a</sup>	7 <sup>b</sup>	6 <sup>c</sup>
<b>Overall acceptability</b>	9 <sup>a</sup>	9 <sup>a</sup>	8 <sup>a</sup>	7 <sup>b</sup>	9 <sup>a</sup>	8 <sup>a</sup>	8 <sup>a</sup>	8 <sup>a</sup>	7 <sup>b</sup>	6 <sup>c</sup>

Data are mean, n = 10 panelist . Values with different superscripts differ significantly,  $P \leq 0.05$ . Same letter means non-significant,  $P \geq 0.05$ .

**Table 6:-** Feed consumption, body weight gain, feed efficiency ratio, feces and cecum of different groups with or without cholesterol for 12 weeks.

Groups of rats	Feed consumption (g/rat)	Body weight gain (g/12 weeks)	Feed efficiency ratio (g gain /g feed) per day	Feces (g/d)	Cecum (mg/g body)
<b>G1</b>	10.87 ± 0.62 <sup>a</sup>	94.92 ± 6.0 <sup>c</sup>	0.104 ± 0.08 <sup>b</sup>	1.56 ± 0.20 <sup>d</sup>	0.96 ± 0.16 <sup>c</sup>
<b>G2</b>	10.74 ± 0.88 <sup>a</sup>	121.97 ± 6.1 <sup>a</sup>	0.135 ± 0.003 <sup>a</sup>	1.52 ± 0.16 <sup>d</sup>	1.23 ± 0.22 <sup>b</sup>
<b>G3</b>	8.84 ± 0.21 <sup>c</sup>	65.35 ± 1.3 <sup>c</sup>	0.088 ± 0.008 <sup>c</sup>	2.08 ± 0.16 <sup>b</sup>	1.50 ± 0.21 <sup>a</sup>
<b>G4</b>	9.85 ± 0.1 <sup>b</sup>	77.78 ± 1.0 <sup>d</sup>	0.094 ± 0.002 <sup>b</sup>	1.98 ± 0.16 <sup>c</sup>	1.55 ± 0.21 <sup>a</sup>
<b>G5</b>	8.06 ± 1.5 <sup>c</sup>	64.99 ± 1.6 <sup>c</sup>	0.096 ± 0.006 <sup>b</sup>	2.80 ± 0.07 <sup>a</sup>	1.56 ± 0.23 <sup>a</sup>



Data are mean  $\pm$  SD, n = 6 rats for each group. Values with different superscripts differ significantly,  $P \leq 0.05$ . Same letter means non-significant,  $P \geq 0.05$ .

**Table 7:-** Effect of 5% dietary fiber from potato peels (G3), guava seeds (G4) and pomegranate peels (G5) on serum total cholesterol (mg/dl), Liver cholesterol ( $\mu\text{mol/g}$ ), LDL, HDL, triglycerides (TG) (mg/dl), ALT and AST ( U/L) in male albino rats for 6 weeks.

Groups of rats	Serum total cholesterol mg/dl	Liver cholesterol $\mu\text{mol/g}$	LDL-C mg/dl	HDL-C mg/dl	TG mg/dl	VLDL-C	ALT U/L	AST U/L
G1	190.59 $\pm$ 0.2 <sup>c</sup>	8.0 $\pm$ 1.0 <sup>h</sup>	43.55 $\pm$ 2.60 <sup>d</sup>	114.8 $\pm$ 3.50 <sup>a</sup>	162.70 $\pm$ 3.40 <sup>m</sup>	32.65 $\pm$ 1.40 <sup>f</sup>	19.8 $\pm$ 0.31 <sup>b</sup>	25.1 $\pm$ 0.27 <sup>b</sup>
G2	258.28 $\pm$ 4.8 <sup>a</sup>	52.18 $\pm$ 8.7 <sup>a</sup>	72.42 $\pm$ 6.70 <sup>a</sup>	109.26 $\pm$ 2.50 <sup>c</sup>	386.30 $\pm$ 3.10 <sup>a</sup>	76.93 $\pm$ 1.22 <sup>a</sup>	28.91 $\pm$ 0.51 <sup>a</sup>	34.2 $\pm$ 0.31 <sup>a</sup>
G3	189.22 $\pm$ 2.4 <sup>c</sup>	46.48 $\pm$ 6.1 <sup>b</sup>	24.46 $\pm$ 3.90 <sup>e</sup>	111.5 $\pm$ 3.50 <sup>b</sup>	276.41 $\pm$ 3.20 <sup>e</sup>	53.26 $\pm$ 3.45 <sup>d</sup>	22.4 $\pm$ 2.5 <sup>b</sup>	29.5 $\pm$ 0.41 <sup>b</sup>
G4	185.27 $\pm$ 4.8 <sup>c</sup>	49.68 $\pm$ 5.7 <sup>a</sup>	29.17 $\pm$ 2.30 <sup>e</sup>	113.15 $\pm$ 3.90 <sup>a</sup>	214.76 $\pm$ 2.20 <sup>g</sup>	42.95 $\pm$ 0.4 <sup>e</sup>	25.7 $\pm$ 2.52 <sup>a</sup>	30.1 $\pm$ 0.51 <sup>a</sup>
G5	177.69 $\pm$ 0.2 <sup>d</sup>	34.5 $\pm$ 1.0 <sup>d</sup>	21.24 $\pm$ 1.50 <sup>f</sup>	113.65 $\pm$ 3.20 <sup>a</sup>	199.8 $\pm$ 3.20 <sup>i</sup>	42.8 $\pm$ 1.45 <sup>c</sup>	20.7 $\pm$ 4.25 <sup>b</sup>	26.7 $\pm$ 0.25 <sup>b</sup>

Data are mean  $\pm$  SD, n = 6 rats for each group. values with different superscripts differ significantly,  $P \leq 0.05$ . Same letter means non-significant,  $P \geq 0.05$ .

**Table 8:-** Effect of feeding 5% dietary fiber cake from potato peels, guava seeds and pomegranate peels on serum sodium and copper in albino rats for 6 weeks (Ug/dl).

Character	G1	G1	G1	G1	G1
Sodium	210.35 $\pm$ 9.21 <sup>a</sup>	217.54 $\pm$ 5.21 <sup>a</sup>	189.06 $\pm$ 6.58 <sup>c</sup>	195.52 $\pm$ 8.29 <sup>b</sup>	168.37 $\pm$ 8.27 <sup>d</sup>
copper	112.65 $\pm$ 5.95 <sup>a</sup>	115.20 $\pm$ 6.37 <sup>a</sup>	85.35 $\pm$ 5.15 <sup>c</sup>	97.81 $\pm$ 6.02 <sup>b</sup>	68.81 $\pm$ 4.58 <sup>d</sup>

Data are mean  $\pm$  SD, n = 6 rats for each group. values with different superscripts differ significantly,  $P \leq 0.05$ . Same letter means non-significant,  $P \geq 0.05$ .

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