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Biological Evaluation of Cake Incorporated with Psyllium Husk and Lemon Peels for Obese Rats

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ABSTRACT:

One of the essential outcomes of weight problems on world health in the 21st century is a greater danger of death and morbidity worldwide. The investigation aimed to examine the impact of cakes incorporated with 5 and 10% psyllium husk, lemon peels, or a combination of them on the biochemical indicators in obese albino rats. Forty-eight male albino rats, weighing 140±10 g., were divided into eight groups, each with 6 rats. The first group was once given a basal diet as a negative control group. Six of the seven groups had been fed on a high-fat diet with 5 and 10% psyllium husk, lemon peels, or a mixture of each for 28 days, whilst the different groups utilized a positive control group. The following parameters have been determined: lipid fraction (cholesterol, triglyceride, high-density lipoprotein (HDL-c), low-density lipoprotein (LDL-c), and very low-density lipoprotein (VLDL-c), glucose ratio, liver activity (ALT, ALP, and AST), and renal activities (urea, uric acid, and creatinine). Data confirmed that, in evaluating a positive control group, the utilized plant byproducts statistically decreased sugar, liver enzymes, renal biomarkers, lipid profile, and the reverse with HDL-c. The group that received cake containing a 10% combination had great results, observed by 10% psyllium. In conclusion, the combination of these byproducts confirmed the great effects on the biochemical parameters of obese rats and may be incorporated into obese patients' daily diets.

Keywords: *Obesity, Psyllium Husk, Lemon Peels, Rats*

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1- INTRODUCTION

Strong metabolic circumstance could lead the obesity. It is described as a chronic effective energy unbalance accompanied by means of immoderate weight attain those reasons an immoderate buildup of fats in the body [1]. Obesity is a complicated sickness that regularly consists of extended oxidative stress, insulin resistance, and the production of inflammatory markers [2]. Energy consumption and expenditure are out of balance, which leads to obesity. It is introduced via modifications in the metabolism of lipids, particularly lipogenesis and lipolysis. Triglycerides are the result of the procedure known as lipogenesis, that preserves free fatty acids [3]. In a same manner, glycerol is idea to be a product of lipolysis, and triglycerides are broken down

into free fatty acids. Hyperlipidemia, which is described as a surprisingly extended blood lipid level, coupled with weight problems [4]. According to the National Nutrition Institute [5) in Egypt, the incidence of childhood and teenage overweight is rising, with 5.8% of guys and 9.7% of ladies affected. In latest years, several ailments are handled using normal medicinal drug and medicinal herbs, which can serve as a correct alternative for artificial medicines [6].

Psyllium (*Plantago ovata*), additionally acknowledged as Ispaghol also, is the famous identify for *P. ovata*. Psyllium is frequently used for several participants of the plant genus Plantago. The organic and pure soluble fiber regarded as psyllium is acquired taken from the hulls of blonde psyllium seeds. The contents of psyllium husk (protein, fat, ash, and carbohydrates) were 6.83, 4.07, 3.85, and 0.94, respectively [7]. A big quantity of hemicellulose, which is made up of a xylan spine related to galacturonic acid, rhamnose, and arabinose units (arabinoxylans), is additionally current in psyllium husk [8]. Because psyllium husk is a moderate, herbal laxative, it helps with digestion. When immersed in water, it turns gelatinous and sticky and absorbs water to lift out its special functions. Because of its excessive water-soluble fiber content, it helps these with hypercholesterolemia through decreasing their glycemic and lipid responses. Psyllium husk has anti-obesity advantages due to the fact it incorporates acidic and impartial polysaccharides that comprise galacturonic acid in the proper percentage of soluble to insoluble fiber [9]. Dietary fiber derived from psyllium husk is notion to feature as a bulking agent, helping in weight administration and fats removal. Increasing satiety, reducing calorie intake, ingestion rate, and nutrient absorption are necessary variables in this context. In addition to the fewest poor effects, it helps overweight and hypercholesterolemic humans with their lipid profile and glucose homeostasis [10].

Among the best extensively planted citrus fruits in the world with enormous therapeutic importance is the lemon (*Citrus limon*). Lemons are rich in naturally occurring resources that benefit humans, including phenolic compounds, vitamin C, and citric acids. Though most of the peel is lost as a byproduct, it is regularly processed into juice [11]. The ranges of rat's cholesterol at liver and plasma had been reduced by means of polyphenols, flavonoids, and citrus peel. Additionally, lemon peels have an anti-obesity impact by using elevating β-oxidation, lipolysis in the adipose tissue of mice fed an HF diet that effects in obesity, and breakdown of glucose, particularly insulin receptor activity, transportation of glucose, and fats breakdown, which are essential for controlling weight [12]. Citrus peel powder delivered to enriched biscuits decreased LDL-c, triglycerides, and total cholesterol-all of which are recognized to be related with conditions like diabetes, obesity, and decreased danger of coronary heart disease (13].

The impact of adding psyllium husk and lemon peel fortified with cake on obese rats was investigated in this study by evaluating biochemical indicators including lipid profile, glucose, liver and kidney biomarkers.

2. MATERIALS AND METHODS

Materials

Chemicals and diet

Psyllium husk (*Plantago ovata*) was obtained from local herbalist, while lemon was obtained from local market. Choline chloride, methionine, vitamins mixture, minerals mixture, casein, and cellulose were obtained at El-Gomhoria Co. Cairo, Egypt. Corn starch was obtained from the Egyptian Starch and Glucose, Motored Factory, Qalyubia, Egypt. Orders have been made for serum testing kits from Gamma Trade Company for Chemicals in Cairo. Corn oil, ghee, psyllium husk and lemon peels obtained from local market.

Animals

Obtained from the Experimental Animals' Station of the Agriculture Research center in Giza, forty-eight adult male albino rats (Sprague Dawley strain) weighing 140±10 g.

Cake Ingredients

The components of the cake consist of wheat flour, sugar, butter, eggs, water, baking powder, vanilla powder, and powdered skim milk. These items had been bought from Cairo, Egypt's nearby market and the North Cairo Mills Company.

Methods

Preparation of powder from psyllium and lemon peels

Fresh lemon pieces were hand cleaned and separated to get rid of any undesirable materials. For 4 hours, the cleaned peels were dried at 50 ^{o}C for lemon peels in hot air oven. The corresponding powder is then produced by grinding at an extremely fast grinding speed.

Cake recipe and components

The dough for the control cake used to be made using the formula (14) that is proven in Table (a). The identical recipe used to make cake that had been more advantageous with powdered psyllium husk and lemon peel, with the addition of 5% and 10% instead of wheat flour.

Table (a): The formula and ingredients of cakes with psyllium husk or lemon peels or mixture of them

Ingredients (g)	Cake ingredient			
	Control	Psyllium husk and lemon peels powder		Mixture peels
		5%	10%	10%
Wheat flour (72% extraction)	100	95.0	90.0	90.0
Psyllium husk and lemon peels powder	-	5	10	10
Sugar powder	50	50	50	50
Margarine	25	25	25	25
Fresh whole egg	15	15	15	15
Milk	50	50	50	50
Cocoa powder	10	10	10	10
Vanillin	0.25	0.25	0.25	0.25
` Baking powder	3	3	3	3
Sodium chloride	1	1	1	1

Cake preparation

According to [15], approved techniques for cake manufacturing have been incredibly modified. Dry cake ingredients, aside from sugar, had been combined. Using a mixer, the butter and extra components have been blended and combined at a medium speed for three minutes. Next, sugar was brought to the combination and blended for three more minutes. Finally, crushed vanilla and whole eggs have been added, blended for an extra two more min., and linked to the creamed fat-sugar mixture, which was once then without difficulty whipped for 5 instances at an average speed. The combination time once gradually supplemented with wheat flour and different components and blended for 5 minutes. After filling 30 size pans, the batter used to be Scaled into a buttered pan and cooked in the heated oven at 180°C for 25 min., after which it was room temperature air chilled and sealed in polyethylene packages.

Biology tests

Meal composition

The final constituents of the standard diet are (10%) protein, (10%) maize oil, (1%) vitamin combination, (4%) minerals combination, (0.20%) choline chloride, (0.3%) methionine, (5%) cellulose, and maize starch make up the final ingredients, according to [16]. 10% of the rats' diet used to be supplemented with a

fortified cake containing varying quantities of byproducts instead of maize starch.

Induction of obesity

Rats are given a diet excessive in fats by adding 20% fat to the basal diet (10 oil + 10 saturated fat] for two weeks to cause obesity [17].

Experimental animal design

The Scientific Research Ethics Committee (Animal Care and Use) of Menoufia University obtained ethical approval for this study, which was once carried out at the Animal House of the Faculty of Home Economics. The committee's number is #17-SREC-11-2022.

Forty-eight mature male Sprague-Dawley albino rats weighing 140±10 g had been kept in clean, well-ventilated cages for a week to allow them to acclimatize. The rats have been divided into two main groups after they had been on a standard diet for a week as an adaptation period. Six rats made up the first group, which was once utilized as a control group that is negative and given a standard diet. Divided into seven subgroups (n = 6 rats per group), the 2nd main group (n = forty-two rats) supplemented with a high fat diet utilized a control group that is positive. The second and third subgroups were given diet rich in fat along with cake supplements containing 5% psyllium husk and 5% lemon peels, respectively. The fourth and fifth groupings received a high fat diet that included 10% psyllium cake and 10% lemon peel cake, respectively. Five and ten percent of the subgroups that had been fed a diet rich in fats were incorporated with blended cake, respectively.

Collected blood sampling

When experiment period finished, the animals were fasted overnight, after that each rat was weighed, anaesthetized and sacrificed, then samples of blood had been obtained from the aorta, then samples had been placed in clean, dry tubes, allowed to clot at room temperature, and then, in accordance with Drury and Wallington [18], centrifuged for ten minutes at 3500 rpm to separate the serum. The samples were then frozen at -20 ° C till analysis.

Biological analysis

Serum triglycerides (TG), total cholesterol (TC) and HDL-c had been measured the usage of the Buccolo & David [19] and Natio [20] and Natio [21] techniques. The following equations from Friedewald *et al.,* [22] have been used to calculate low density lipoprotein (LDL-c) and very low-density lipoprotein cholesterol (VLDL-c): LDL cholesterol is calculated as total cholesterol - HDL cholesterol - V LDL cholesterol, and very low-density lipoprotein (VLDL) cholesterol is equal to TG/5.

Blood glucose was carried out calorimetrically according to Trinder, [23]. Liver enzymes were determined by technique follows Aspartate-amino transferase (AST) and alanine-amino transferase (ALT) activities according to Yound [24], and Tietz, [25] respectively. Creatinine, uric acid, as well as urea were assessed based on the enzymatic technique of Henry [26]; Patton & Crouch [27], and Schirmeister [28].

Statistical evaluation

Results have been statistically assessed by a computer program called One-way ANOVA test. Results have been shown as mean ± SD. According to [29], variations amongst regimens were deemed significant when ($P \leq 0.05$).

RESULTS AND DISCUSSION

Results in Table (1) revealed the total cholesterol (TC) and triglycerides (TG) values for positive control groups performed extensively larger ($P \leq 0.05$) than the untreated groups (V-). The corresponding readings were 107.01& 96.5mg/dl and 161.06& 148.5 mg/dl, respectively. The obtained outcomes suggested that the treatment group that consumed 10% of a mixture of psyllium husk and lemon peels had the lowest TC and TG,

then that of treated groups consumed 5 or 10% of powdered lemon peels or psyllium husk. Those results corroborated earlier findings presented by [30] who found that psyllium husk was added to dairy calves to improve their physiological processes, performance, and general health. They considered that it contains ash, carbs, proteins, and flavonoid that may help prevent weight gain, lower cholesterol, most tumors, and end constipation, among other illnesses.

Moreover, psyllium husks contain soluble fiber, essential fatty acids such as oleic, linoleic, linolenic and phytochemicals like phenolic substances, flavonoids, caffeic acid, and chlorogenic acids are responsible for their hypolipidemic effect. Flavonoids should work through increasing the density of LDL-c receptors in the liver and binding to apo-lipoprotein B, permitting liver cells to put off LDL-c from the bloodstream extra efficiently [31].

Furthermore, the consequences agree with the findings of [32] who located that lemon peel enhances the lipid fraction in serum and continues these factors at regular ranges. Lemon peels have earlier been proven to have a considerable hypocholesterolemic impact on rats fed a rich cholesterol diet in the presence of 7.5% lemon peel.

Lemon peel and pulp include hesperidin, a flavonoid that reduces cholesterol and triglycerides. Additionally, pectin, a naturally occurring fiber that lowers cholesterol, can be discovered in lemon peel. [33].

Table (1): Influence of cake incorporated with various concentrations of lemon peels or psyllium husk and mixture powder on total cholesterol and triglycerides of obese rats

Parameters Groups	Total cholesterol mg/dl	Triglycerides mg/dl
G1 C (-)	107.01e± 3.42	96.5d± 3.65
G2 C (+)	161.06a± 4.64	148.5a± 2.5
G3 (Cake +5% lemon)	139.08b ± 2.08	123.01b± 3.03
G4 (Cake+5% psyllium)	133.5b±3.21± 3	118.04b± 7.12
G5 (Cake +10% lemon)	124.15c± 3.85	115.5b± 2.2
G6 (Cake+10% psyllium)	120.5d± 4.58	109.5c± 2.5
G7(Cake mixture 5%)	130.5c± 3.25	122.04b± 5.44
G8 (Cake mixture 10%)	113.01d± 4.76	100.8c± 9.2
LSD≤ 0.05	8.29	9.32

Values are provided as mean ± SD. There is a considerable variance (P ≤0.05) between the mean values of different letters in the same column.

Table (2) displays the influence of psyllium husk, lemon peels, and their mixture on the blood lipid fractions that is low-density lipoprotein (LDL-C), very low-density lipoprotein (VLDL-C), and high-density lipoprotein (HDL-C) of obese rats. Based on the research results, the LDL-C and VLDL-C ranges of control positive groups had considerably greater values when compared to control negative groups, and the vice versa with HDL-C. Regarding groups that have received high fat diet, no significant difference among groups 4,5,6 and 7 for HDL, while for VLDL, there is no significant differences among 3,4,5,6 and 7 .The treatment group that consumed 10% mixture of psyllium husk and lemon peels (group 8) had the highest effect on lipid profile, then that of treated groups consumed 5 or 10% of powdered lemon peels or psyllium husk. The findings are consistent with [34], found that Psyllium fiber supplementation has been proven to extensively enhance lipid fractions and is suggested for humans with a range of cardiovascular danger factors. Furthermore, psyllium lowers total cholesterol by way of 2%

to 20% and LDL-c by means of 6% to 24% when in contrast to a placebo.

Furthermore, the considerable increase in HDL-C ranges suggests that citrus peels may also speed up the fall of radical species produced after cholesterol administration. HDL-c decreases beta-lipoprotein peroxidation by means of serving as a free radical scavenger [35].

Table (2): Influence of cake incorporated with various concentrations of lemon peels or psyllium husk and mixture powder on lipid fractions of rats suffering from obesity

Parameters Groups	HDL-C mg/dl	LDL-c mg/dl	VLDL-c mg/dl
G1 C (-)	49.12a±1.23	38.58f± 2.08	19.31c± 1.2
G2 C (+)	27.68d± 2.68	103.62a± 4.12	29.76a± 2.3
G3 (Cake +5% lemon)	34.64c± 1.36	79.75b± 2.43	24.69b± 0.04
G4 (Cake+5% psyllium)	37.4b± 3.8	72.5c±3.09	23.6b± 0.81
G5 (Cake +10% lemon)	39.67b± 4.33	61.38d± 3.92	23.1b± 1.95
G6 (Cake+10% psyllium)	41.9b± 3.87	56.7d± 5.8	21.9b±1.1
G7(Cake mixture 5%)	39.36b± 3.14	66.74c±5.99	24.4b± 2.15
G8 (Cake mixture 10%)	45.5a± 5.25	47.4e±2.9	20.11c± 3.05
LSD≤ 0.05	5.62	6.18	3.15

HDL-C = High density lipoprotein cholesterol. LDL-c = Low density lipoprotein cholesterol. VLDL-c = Very Low-density lipoprotein cholesterol. Values are provided as mean ± SD. There is a considerable variance (P ≤0.05) between the mean values of different letters in the same column.

The positive control group had a considerably higher suggestion blood glucose than the negative control group, with values of 197.5 and 105mg/dl, respectively. All overweight rats fed a variety of diets confirmed a statistically drop in suggest glucose readings data in Table (3) displays the mean blood glucose of overweight rats fed a variety of diets. when in contrast to the positive control group. It has observed that the increasing of lemon peels and psyllium husk led to significant decrease in mean value of blood glucose and the best mean value was recorded for eighth groups which fed on 10% of cake with 10% mixture of lemon peels and psyllium husk in contrast with the positive control group. These findings are consistent with those of [36 and 37], who indicated that obesity is a key risk factor for kind two diabetes due to the fact body weight gain enhances the risk of kind two diabetes, especially when blended with extra body fats gain. Adipose tissues produce free fatty acids through improved lipolysis, which reasons muscular and hepatic insulin resistance, as nicely as lowered insulin manufacturing by using the pancreatic ß-cells.

Moreover, polyphenols dramatically decreased several aspects of obesity, inclusive of weight growth, fats buildup, hyperlipidaemia, excessive blood glucose levels, and insulin resistance. Citrus peel consists of a range of essential oils. Citrus peels incorporate essential oils that have an antiperoxidative and diabetes-lowering impact due to the fact of their excessive total polyphenol content [38].

Psyllium husk is a viscous and contains high amount of fiber, mostly water-soluble fiber, it has demonstrated that they serve as a successful device in conjunction with dietary interventions to minimize glucose levels. Although the actual methods are uncertain, dietary fiber may also enhance glucose homeostasis with the aid of lowering intestinal glucose absorption, lengthening stomach emptying, regulating hormone synthesis, and/or reducing sensitivity to carbohydrate load. In non-diabetic persons, psyllium husk fiber has been proven to substantially

decrease postprandial blood glucose and insulin ranges [39].

The most effective lipid fractions, (TC, TG, HDL-c, LDL-c, and VLDL-c), had shown in obese rats fed a 10% psyllium husk powder. This powder has numerous health benefits and can be used in everyday meals and baked products

Table (3) Influence of cake incorporated with various concentrations of lemon peels or psyllium husk and mixture powder on glucose of obese rats

Parameters Groups	Glucose (mg/dl)
G1 C (-)	105.04g±2.12
G2 C (+)	197.5a±3.22
G3 (Cake +5% lemon)	170.4±0.85
G4 (Cake+5% psyllium)	159.5c±0.75
G5 (Cake +10% lemon)	161.13c±0.98
G6 (Cake+10% psyllium)	149.5d±0.04
G7(Cake mixture 5%)	146.01e±1.14
G8 (Cake mixture 10%)	136.5 f ±0.75
LSD (p ≤ 0.05)	1.751

Values are provided as mean ± SD. There is a considerable variance (P ≤0.05) between the mean values of different letters in the same column.

The average levels of serum liver enzymes are presented in Table (4). Comparing the liver enzyme ranges of the different groups, the control negative group exhibited reduced levels, while the positive control was higher than the others with significant differences except the third group which treated with 5% lemon peels. No significant differences between groups 5 and 6 in ALT enzymes were found between groups 5 and 7 for AST enzyme. The best effect was found at obese group giving cake with 10% mix of lemon peels and psyllium husk. In agreement with the findings of [41] discovered that obesity may additionally be related with liver harm and the development of hepatic disorders, and that obesity can influence the liver's overall performance via a range of mechanisms.

In addition, there are many benefits of lemon peels; they possess antioxidant, antitoxic and hepatoprotective properties for its content from phytochemical compounds. The approach involved enhancement of all the essential structural as nicely as purposeful consists of the liver, specifically metabolism, biosynthetic, and detoxifying capabilities [42]. Furthermore, treatment of intoxicated rats with Psyllium husk decreased liver enzymes to regular levels. This alluded to the antioxidant power and free radical scavenging ability, or the restoration can also be linked to the stabilization of the cell membrane due to regression of hepatic enzyme leakage into the cytosol [43].

Table (4): Influence of cake incorporated with various concentrations of lemon peels or psyllium husk and mixture powder on liver activities of obese rats

Parameters Groups	ALT U/L	AST U/L
G1 C (-)	22.31e±0.09	30.44 e±0.03
G2 C (+)	47.51 a±0.78	49.50 a±0.54
G3 (Cake +5% lemon)	45.26a±1.22	47.23 a±2.53
G4 (Cake+5% psyllium)	43.07 b±1.97	44.52 b±1.45
G5 (Cake +10% lemon)	39.53 c±1.75	40.15 c±1.34

G6 (Cake+10% psyllium)	37.06c±2.50	35.07 d±0.67
G7(Cake mixture 5%)	42.23 b±0.25	41.21 c±1.38
G8 (Cake mixture 10%)	36.14 d±1.76	34.52 d±2.19
LSD (P ≤ 0.05)	2.531	3.022

Values are provided as mean ± SD. There is a considerable variance (P ≤0.05) between the mean values of different letters in the same column.

Impacts of cake with psyllium husk, lemon peels, as well as their mixture at the levels 5 and 10% on the serum renal biomarkers of obese rats are demonstrated using the information in Table (5). The outcomes confirmed that the values have been increased in the positive control groups. (P≤0.05) of renal functioning as serum urea, uric acid, and creatinine in contrast to the negative control, mean corresponding values were 42.46, 5.8& 0.82 and 24.50, 2.44& 0.34 mg/dl respectively with significant difference. The eighth group gave the best reduction in comparison with the other treated groups.

Considering obese groups, it was observed that the law level of tested wastes (5%) had high serum urea, uric acid, and creatinine mean values, whereas 10%level gave the highest effect especially in the mixture group which contained both of psyllium husk and lemon peels with significantly varying ranges. From the results, it was found that the uric acid was more affected by psyllium husk, lemon peels and their mixture. As the above study of [44]. The correlation among hyperfiltration and overweight to satisfy the expanded metabolic demands of the greater body weight was once discovered. An elevation in intraglomerular stress has the practicable to damage the kidneys and make bigger the long-term risk of chronic kidney disorder (CKD).

According to [45], psyllium husk treatment resulted in significantly lower renal biomarker ranges in fatty liver affected as contrasted with the control rats. The addition of varying dosages of Psyllium husk considerably reduced renal function in contrast to the (+ve) control group.

Rats fed with 5% psyllium husks had extensively decrease urea ranges than rats treated with psyllium seeds, however no big changes had been observed for renal functions such as creatinine, ureic acid, and urea [46].

Lemon peel incorporated at modest doses over time can enhance the kidney's overall performance due to the fact it contains many phytochemicals, which modify many biochemical processes. The administration of aqueous lemon peel extract to the positive group resulted in considerably decreased blood creatinine, urea, and uric acid levels, suggesting more desirable kidney elimination of these compounds [47].

Table (5): Influence of cake incorporated with various concentrations of lemon peels or psyllium husk and mixture powder on kidney biomarkers of obese rats

Parameters Groups	Urea (mg/dl)	Uric acid (mg/dl)	Creatinine (mg/dl)
G1 C (-)	24.50e±2.32	2.41e±0.15	0.34e±0.01
G2 C (+)	42.46a±1.96	5.80a±0.02	0.82a±0.05
G3 (Cake +5% lemon)	37.56b±1.06	4.53b±0.17	0.73b±0.06
G4 (Cake+5% psyllium)	34.76b±2.01	4.39b±0.04	0.71b±0.02
G5 (Cake +10% lemon)	33.25c±1.78	3.75c±0.19	0.59c±0.02
G6 (Cake+10% psyllium)	30.855c±2.19	3.51c±0.26	0.55c±0.04
G7(Cake mixture 5%)	35.09b±3.46	4.09b±0.43	0.68b±0.03
G8 (Cake mixture 10%)	29.24d±1.04	2.79d±0.21	0.49d±0.009
LSD ≤0.05	3.87	0.46	0.07

Values are provided as mean ± SD. There is a considerable variance (P ≤0.05) between the mean values of different letters in the same column.

Conclusion

Collected results confirmed that byproducts such as lemon peels, psyllium husk, and their combination expanded all blood biochemical markers, which includes lipid fractions. This used to be especially at 10% mixture, which has the potential to be used in bakery items for supporting these who are obese or have hypercholesterolemia.

Conflict of Interest

The authors declare that there is no conflict of interest.

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References

1. Kaur, J. A comprehensive review on metabolic syndrome. *Cardiology Research Practice,* (2014); 1: 1-21. https://doi.10.1155/2014/943162
2. Elmaadawy, A.; Arafa, R. and Elhassaneen, Y. Oxidative Stress and antioxidant defense systems status in obese rats feeding some selected food processing by-products applied in bread. *Journal of Home Economics,* (2016); 26 (1): 55-91. https://doi. 10.21608/MKAS.2016.167247
3. Mandrup, S. and Lane, M.D. (1997); Regulating adipogenesis. *Journal Biological Chemistry,* 272 (9): 5367-5370. https://doi.10.1074/jbc.272.9.5367.
4. Ducharme, NA. and Bickel, P.E. Lipid droplets in lipogenesis and lipolysis. *Endocrinology*, (2008); 149 (3): 942-949. https://doi. 10.1210/en.2007-1713
5. National Nutrition Institutes, Report on the prevalence of obesity in Egypt. (2004); 1: 1-27. https://www.sciepub.com/reference/196197
6. Zare, R.; Heshmati, F.; Fallahzadeh, H. and Nadjarzadeh, A. Effect of cumin powder on body composition and lipid profile in overweight and obese women. *Complementary Therapies in Clinical Practice,* (2014); 20 (4): 297-301. https://doi.10.1016/j.ctcp.2014.10.001
7. Khan A, Khalid W, Safdar S, Usman M, Shakeel M, Jamal N, et al. Nutritional and therapeutic benefits of psyllium husk (Plantago ovata). Acta Sci Microbiol. 2021;4(3):43–50. https://www.researchgate.net/publication/349279055_Nutritional_and_Therapeutic_Benefits_of_Psyllium_Husk_Plantago_Ovata
8. Katke, S.D.; Deshpande, H.W. and Tapre, A.R. Review on Psyllium Husk (Plantago ovata): A Novel Superfood for Human Health. *International Journal of Current Microbiology and Applied Sciences,* (2020); 9 (12): 1949-1959. : https://doi.org/10.20546/ijcmas.2020.912.232
9. Zhang, J.; Wen, C.; Zhang, H. and Duan, Y. Review of isolation, structural properties, chain conformation, and bioactivities of psyllium polysaccharides. *International Journal Biological Macromolecules,* (2019); 15:139:409-420. https://doi.org/10.1016/j.ijbiomac.2019.08.014
10. Shah, A.R.; Sharma, P.; Longvah, T.; Gour, V.; Kothari, S. L.; Shah, Y.; Ganie, S. A. Nutritional Composition and Health Benefits of Psyllium (*Plantago ovata*) Husk and Seed. *Nutrition Today,* (2020); 55(6): 313-321. https://doi.10.1097/NT.0000000000000450
11. Dhanavade, M. J.; Jalkute, C. B.; Ghosh, J. S. and Sonawane, K. D. Study antimicrobial activity of lemon (*Citrus lemon*, L.) peel extract. *British Journal of Pharmacology and Toxicology,* (2011); 2(3): 119–122.

https://doi.10.22159/ijcpr.2017v9i4.20962
12. Tinh, N. T. T.; Sitolo, G. C.; Yamamoto, Y. and Suzuki, T. Citrus limon peel powder reduces intestinal barrier defects and inflammation in a colitic murine experimental model. *Food*, (2021); 10(2):240. https://doi.10.3390/foods10020240
13. Youssef, M.K.E.; Youssef, M.K.E. and Mousa, R.M.A. Evaluation of antihyperlipidemic activity of citrus peels powders fortified biscuits in albino induced hyperlipidemia. *Food and Public Health,* (2014); 4 (1): 1-9. https://www.cabidigitallibrary.org/doi/pdf/10.5555/20143122632
14. Paul, A.A. and Southgate, D.A.T. The composition of foods. McCance and Widdowson's (4th Ed.), H.M. *Stationery Office*, (1978); London, United Kingdom. https://assets.publishing.service.gov.uk/media/60538e66d3bf7f03249bac58/McCance_and_Widdowsons_Composition_of_Foods_integrated_dataset_2021.pdf
15. Raeker, M.O. and Johnson, L.A. Thermal and functional properties of bovine blood plasma and egg white proteins. *Journal of Food Science*, (1995); 60 (4):685-690. https://doi.10.1111/j.1365-2621.1995.tb06206.x
16. Reeves, P.; Nielsen, F. and Fahey, G. AIN-93 Purified Diets for Laboratory Rodents: Final Report of the American Institute of Nutrition Ad Hoc Writing Committee on the Reformulation of the AIN-76A Rodent Diet. *Journal of Nutrition,* (1993); 123 (11):1939-1951. https://doi.10.1093/jn/123.11.1939
17. Min, L.; Ling, S.; Yin, L.; Stephen, C.; Randy, J.; David, D. and Patrick, T. Obesity induced by a high fat diet down regulates apolipoprtein A-IV gene expression in rat hypothalamus. *American Journal Physiological Endocrinology Metabolism,* (2004); 287 (2): 1-7. https://doi.10.1152/ajpendo.00448.2003
18. Drury, R. A. B. and Wallington, E. A. Carlton's Histological Techniques .5th Ed., *Oxford University Press.* (1980).
19. Buccolo, G. and David, H. Quantitative determination of serum triglycerides by use of enzymes. *Clinical Chemistry*, (1973); 19 (5): 476-482. https://doi.org/10.1093/clinchem/19.5.476
20. Naito HK. Cholesterol. In: Kaplan A, editor. *Clinical chemistry*. St. Louis, Toronto, Princeton: The C.V. Mosby Co; 1984. p. 437, 1194–1206. https://www.scirp.org/reference/referencespapers?referenceid=2965269
21. Naito, H.K. (1984) High-Density Lipoprotein (HDL) Cholesterol. Clinical Chemistry, 437, 1207-1213. https://www.scirp.org/reference/referencespapers?referenceid=3763478
22. Zheng H. Lipid profiling in obesity: the limitations of the Friedewald equation. *Am J Med*. 2024;138(2):172–174. https://chatgpt.com/c/6844a1e0-d630-8007-b04c-94293285617c
23. Trinder P. Enzymatic determination of glucose in blood serum. *Ann Clin Biochem*. 1969;6:24.https://chatgpt.com/c/6844a1e0-d630-8007-b04c-94293285617c
24. Rej R. Clinical chemistry through *Clinical Chemistry*: a journal timeline. *Clin Chem*. 2004;50:2415–58. http://doi:10.1373/clinchem.2004.042820
25. Tietz N. Fundamentals of clinical chemistry. Philadelphia: W.B. Saunders. 1976; 243. https://www.sciepub.com/reference/443103
26. Henry, R. Principal and Techniques. Harper and Publisher. New York, *Clinical Chemistry,* (1974); 2 (1): 11-15. https://www.sciepub.com/reference/305938
27. Patton G, Crouch S. Colorimetric method for the determination of serum urea. *Anal*

Chem. 1977;49(3):464–469. http://doi:10.1021/ac50011a034
28. Peake M, Whiting M. Measurement of serum creatinine—current status and future goals. *Clin Biochem Rev*. 2006 Nov;27(4):173–84. PMID: 17581641; PMCID: PMC1784008. https://pmc.ncbi.nlm.nih.gov/articles/PMC1784008/
29. Steel RGD, Torrie JH. Principles and procedures of statistics: a biometrical approach. 2nd ed. New York: McGraw-Hill Book Company; (1980); 2-633. https://www.scirp.org/reference/referencespapers?referenceid=383208
30. Crozier, A.; Jaganath, I.B. and Clifford, M.N. Phenols, polyphenols, and tannins: an overview. In: Crozier A, Clifford MN, Ashihara H (eds) Plant secondary metabolites: occurrence, structure, and role in the human diet. *Blackwell Publishing,* (2016); 26 (4):1-24. https://doi.org/10.1002/9780470988558.ch1
31. Akbarzadeh, Z., Nourian, M., Askari, G., Maracy, M. R., Rafiei, R. The Effect of Psyllium on Anthropometric Measurements and Liver Enzymes in Overweight or Obese Adults with Nonalcoholic Fatty Liver Disease (NAFLD). *Journal of Isfahan Medical School*, 2015; 33(355): 1771-1783. https://jims.mui.ac.ir/article_14760.html
32. Sohn HY, Son KH, Kwon CS, Kwon GS, Kang SS. Antimicrobial and cytotoxic activity of 18 prenylated flavonoids isolated from medicinal plants: *Morus alba* L., *Morus mongolica* Schneider, *Broussonetia papyrifera* (L.) Vent, *Sophora flavescens* Ait and *Echinosophora koreensis* Nakai. Phytomedicine. 2004 Dec;11(7–8):666–72. http://doi:10.1016/j.phymed.2003.09.005
33. El-Kholi E, Khater O, Khafagy M, Lotf A. Efficacy of psyllium husk and quinoa seeds on obese rat weight loss. J Home Econ. 2023;33(4):15–26. http://doi:10.21608/mkas.2023.208073.1223
34. Ashraf, H.; Masood, S.; Muhammad, J. and Hafiz, A.R. Citrus peel extract and powder attenuate hypercholesterolemia and hyperglycemia using rodent experimental modeling. *Asian Pacific Journal of Tropical Biomedicine,* (2017); 7 (10): 870-880. https://doi. 10.1016/j.apjtb.2017.09.012
35. Pultrin, A.M.;Galindo, L.K. and Costa,K. Effects of the essential oil from lemon (*Citrus aurantium,* L.) peels in experimental anxiety models in mice. *Life Science,* (2017); 78 (15): 1-7. https://doi.10.1016/j.lfs.2005.08.004
36. Shulman, G.I. Ectopic fat in insulin resistance, dyslipidemia, and cardiometabolic disease. *N. England Journal Medecine,* (2014); 371 (12):1131-41. https://doi. 10.1056/NEJMra1011035
37. Veit, M.; Asten, R.V.; Olie, A. and Prinz, P. The role of dietary sugars, overweight, and obesity in type 2 diabetes mellitus: A narrative review. *European Journal of Clinical Nutrition,* (2021); 76 (11):1497-1501. https://doi. 10.1038/s41430-022-01114-5
38. Gamboa-Gómez, C. I.; Rocha-Guzmán, N. E.; Gallegos-Infante, J. A.; Moreno-Jiménez, M. R.; Vázquez-Cabral, B. D. and González-Laredo, R. F. Plants with potential use on obesity and its complications. *EXCLI Journal,* (2015); 9 (14): 809-831. https://doi. 10.17179/excli2015-186
39. Basha, A.A.; Zia, U.D. and Imran, K. Effect of Psyllium husk fiber and lifestyle modification on human body insulin resistance. *Nutrition and Metabolic Insights,* (2022); 15 (1): 1-9. https://doi.10.1177/11786388221107797
40. El-Kholi, E.M.; Khater, O.R.; Khafagy, M.M. and Alaa Lotf, AA. Efficacy of psyllium husk and quinoa seeds on obese rat weight loss. *Journal of Home Economics,* (2023); 33(4):15-26.

HTTPS://DOI. 10.21608/MKAS.2023.208073.1223

41. Ashkar, F.; Rezaei, S. and Salahshoornezhad, S. The role of medicinal herbs in treatment of insulin resistance in patients with polycystic ovary syndrome: A literature review. *Biomolecule Concepts,* (2020); 11 (1):57-75. https://doi. 10.1515/bmc-2020-0005
42. Okasha, A. M. M., and Soliman, H. A. Dietary fiber of psyllium husk (*Plantago ovata*) as a potential antioxidant and hepatoprotective agent against CCl_4-induced hepatic damage in rats. *South African Journal of Botany,* (2020); 130 (1): 208-214. https://doi.org/10.1016/j.sajb.2020.01.007
43. Alex, B.; Orleans, M. and Frederick, A. *Citrus limon* (L.) Osbeck fruit peel extract attenuates carbon tetrachloride-induced hepatocarcinogenesis in Sprague-Dawley rats. *Biomedical Research International,* (2024); 1 (2): 1-9. https://doi. 10.1155/2024/6673550
44. Garofalo, C.; Borrelli,S.; Minutolo, R.; Chiodini,P.; De Nicola, L.; Conte, G. A systematic review and meta-analysis suggest obesity predicts onset of chronic kidney disease in the general population. *Kidney International, (*2017); 91:1224-1235. https://doi. 10.1016/j.kint.2016.12.013
45. Jose, M.B.; Derraik, G. B.; Brennan, C.M. and Smith, G.C. Psyllium supplementation in a adolescent improves fat distribution & lipid profile: A randomized, participant Blinded, Placebo-Controlled, *Crossover Trials,* (2012); 10 (1) :1-7. https://doi.10.1371/journal.pone.0041735
46. Elhassaneen, Y.; Rhman, A. N. A. and Hussin, N. A. The potential Effects of psyllium seeds and its husks (*Plantago ovata*) on diabetic rats. *Journal of Home Economics,* (2021); 31(2): 36-48. https://doi.10.21608/MKAS.2021.181265
47. Hassan, M. Y.; Alshuaib, W.B.; Singh, S. and Fahim, M. A. Effects of ascorbic acid on lead induces alterations of synaptic transmission and contractile features in murine dorsiflexor muscle. *Life Science,* (2003); 73 (8): 1017 -1025. https://doi.10.1016/s0024-3205(03)00374-6

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التقييم البيولوجي للكيك المحتوي على قشور السيليوم والليمون للفئران المصابة بالسمنة

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الملخص العربى:
إن إحدى النتائج الأساسية لمشاكل السمنة على صحة العالم فى القرن الحادي والعشرين هى زيادة خطر الوفاة والمرض فى جميع أنحاء العالم. كان هدف البحث هو دراسة تأثير الكيك المضاف إليه ٥ ،١٠% من قشور السيليوم والليمون أو مزيج من الاثنين على مجموعة متنوعة من المؤشرات الكيميائية الحيوية فى الفئران البيضاء البدينة. تم تقسيم ٤٨ من ذكور الفئران البيضاء، كل منها يزن ١٤٠ .١٥٠ جرامًا، إلى ثماني مجموعات، كل منها بها ٦ فئران. كمجموعة تحكم سلبية، تم إعطاء المجموعة الأولى نظامًا غذائيًا أساسيًا. تم تغذية ست من المجموعات السبع على نظام غذائى عالى الدهون مع ٥ ،١٠% من قشور السيليوم والليمون أو مزيج من كل منهما على مدى فترة ٢٨ يومًا، بينما استخدمت المجموعة الأخرى كمجموعة ضابطة موجبة. تم تقدير التحاليل التالية، صورة دهون الدم (الكوليسترول والدهون الثلاثية والبروتين الدهنى عالى الكثافة (HDL-c) والبروتين الدهنى منخفض الكثافة (LDL-c) والبروتين الدهنى منخفض الكثافة جدًا (VLDL-c) ومستويات الجلوكوز ونشاط الكبد (ALT وAST) ووظائف الكلى (اليوريا وحمض البوليك والكرياتينين). وأكدت البيانات أنه في التقييم للمجموعة الضابطة الموجبة، فإن الكيك المدعم بالقشور المستخدمة قللت بشكل معنوي من صورة دهون الدم والسكر وإنزيمات الكبد ومؤشرات الكلى والعكس مع البروتين الدهنى عالى الكثافة. مجموعة الفئران التى تغذت على الكيك المحتوي على مزيج القشور بنسبة ١٠٪ والكيك المدعم بقشور السيليوم بتركيز ١٠٪ كان لها نتائج مرتفعة، وفي الختام، لوحظ أن مزيج القشور لها تأثيرات مرتفعة على التحاليل الكيميائية الحيوية للفئران المصابة بالسمنة ويمكن دمجها في النظام الغذائي اليومي للمرضى.

الكلمات الكاشفة: السمنة، قشور السيليوم والليمون، المعاملات البيوكيميائية، الفئران.

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