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Efficacy of Psyllium Husk and Quinoa Seeds on Obese Rat Weight Loss

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Abstract:
The goal of the current study was to assess the influence of psyllium husk and quinoa seeds for weight loss in obese rats. Forty male Sprague-Dawley white male rats weighing 140-150g were consisted of 8 groups at random. Five rats used as a negative control group received just a standard diet. They were fed high fat diet could led to obesity, one group of these rats have been defined as a positive control group, and other six groups of rats received treatment with 5, 10, and a combination of both quinoa seeds, psyllium husks. The experimental duration used to be 28 days. Research also measured glucose levels, serum lipid fractions such as whole cholesterol, triglycerides, High-Density Lipoprotein (HDL), Low-Density Lipoprotein (LDL), Very Low-Density Lipoprotein (VLDL), Atherogenic Index (AI), some liver activities that is glutamic oxaloacetic transaminase (GOT) & glutamic pyruvic transaminase (GPT), and renal functions like uric acid, urea, and creatinine. The outcomes that were obtained showed that the plant under examination decreased blood sugar, liver activities, and renal biomarkers, serum LDL-c, VLDL-c and the reverse with HDL-cholesterol in contrast to the positive control group. In summary, overweight rats have been given a 10% psyllium husk and quinoa seed powder combination exhibited most effective lipid fractions, liver activities, renal biomarkers, and sugar ranges, which, in addition to its many health advantages, could be applied in our daily meals and bakery items.

Keywords*: Cereal, Rats, Hyperlipidemia, Biochemical analysis*

Introduction

Obesity is a medical disorder when greater fats content has built up a stage which might negatively impact medical care, leading to a decreased duration of life and/or more fitness issues (1). It has clinical disorder when there is so much extra body fat that it could be harmful to your health. It is determined by body mass index (BMI), and is then assessed for total cardiovascular risk variables, waist-hip ratio, and spread of fat. Both body and total fat are highly correlated with BMI (2). It is a complicated illness that frequently comes with

insulin resistance, elevated oxidative stress, and increased expression of inflammatory markers. Both the percentage of fat adults in developed countries and the percentage of obese babies born in developing nations are rising (3). Many phytochemicals work as anti-obesity products in several methods to lower their weight and related issues. It is mainly brought on by creating a discrepancy between utilization of energy and cost because of a calorie-controlled diet high in lipids (4). Individually, it is believed that most cases of obesity are caused through a mixture of immoderate dietary energy consumption and a lack of bodily exercise. A small number of cases are mostly brought on by genetics, illnesses, or mental disorders (5).

Plants in the Plantaginaceae family, including isabgol (Plantago ovata, Forsk), go by a variety of names. Only two of the roughly 200 species used in pharmaceuticals and other industries (6). The interaction of psyllium husk with acidic bile in the tiny gut and resulting reduction in intake of cholesterol lowers the level of cholesterol in many animal models. Psyllium husk could be added to the milk substitute given to newborn dairy calves to improve their physiological processes, performance, and general health (7). Considering that it includes flavonoids, ash, proteins, and carbohydrates which may help fight off various ailments like reducing weight gain, cholesterol, most tumors, and stopping constipation, psyllium husk has therapeutic characteristics (8). Plasma LDL cholesterol levels have regularly dropped significantly with psyllium ingestion, from 10% to 24%. In both animal and human models, psyllium was found to increase hydroxylase activity, which in turn stimulated the production of bile acids (9).

The plant known as quinoa (Chenopodium quinoa, Willd.) originated in the Andes regions. The research establishment has been paying close attention to its highly healthy composition (10). Quinoa's excessive dietary value, richness in proteins, healthy fats, essential elements, soluble fiber, and vitamins, as well as its exceptional stability of vital protein, have drawn attention from scientists. It is also notable for being a gluten-free grain, allowing celiac patients to incorporate it into their diets (11). Quinoa was deemed by the FAO to have a high nutritional value, a large biodiversity, and the possibility to contribute a significant function in achieving international meals safety (12). Quinoa is a complete food that aids in lowering the hazard of many diseases and has a good quantity of fat, fiber, carbs, protein, antioxidants, and omega-3 fatty acids compared to other food grain crops (13). All biochemical tests, including lipid profile, dramatically improved in each quinoa, including those that haven't germinated yet and those that have. The percentage of quinoa that germinated the best was 10%. As a result, germinated quinoa might possibly be a powerful nutraceutical therapy alternative for treating hyperlipidemic rats (14). Quinoa crops seed are a significant candidate for nutritional changes to treat obesity, and metabolic disorders, because they may generate a variety of secondary metabolism products using a wide range from bioactive components, such as some phenolic compounds, essential proteins, active steroids, and some inhibitors (15). A clinical trial found that patients who consumed 50 g of quinoa daily had lower serum triglycerides and were less likely to have metabolic syndrome (16).

Hence, the main objective of the research was to clarify the influence of different psyllium husk and quinoa seeds as well as their mixed diet concentrations on obese albino rats who consuming a high-fat diet.

Materials and methods

Materials:

Psyllium husk and quinoa seeds were purchased at an herbalist, at Shebin EL-Koum City, Menoufia Governorate, Egypt.

Experimental rats

A total of forty mature male white Sprague Dawley rats, weighing 135±10 g each, were purchased from Medical Insects Research Institute, Cairo, Egypt.

DL-Methionine, casein, cellulose, and choline chloride

We have purchased diet supplement that is casein, cellulose, powdered choline chloride, and powdered DL-methionine through the Morgan Company, in Cairo, Egypt.

Chemical kits

Al-Gomhoria Company for Trading in Chemical, Drug, and Medical Equipment, Cairo, Egypt, supplied the chemical kits that were used to determine the lipid fractions, renal biomarkers, liver activity, and glucose.

Methods

Preparations of psyllium and quinoa seeds

To make the dried powdered psyllium husk as well as quinoa seeds, they were bought from an herbalist. The husk and seeds were then weighed, ground with an air-powered mill by a high-speed blender (Broun, made in Germany), and served in powder form before being packaged in dark glass bottles and kept at -18 °C in a deep freezer until further treatments.

The induction of obesity

In earlier times, a standard diet enriched with high-fat meal contain 20% animal fat was used to induce obesity in regular healthful male albino rats (17).

Experimental approach

The research was once conducted in Animal House at the University of Menoufia in Egypt, which has been authorized, Department of Nutrition and Food Science, Faculty of Home Economics according to Ethical approval of the Science Research Ethics Committee of Faculty of Home Economics cleared the study protocol **#11-SREC-03-2017.**

In this study, 48 grown-up male white rats, ten weeks old, and averring weighed 135gm, were utilized. For seven days straight, all rats received a standard diet in this test in accordance with (18). Rats are then placed into 8 groups of 5 rats each after the time of adaptation, as follows: Group (1): Rats fed on standard diet and served as negative control group. Group (2) Overweight rats were fed on standard diet with a high fat diet (20% animal fat) and served as a positive control group. Group (3): Overweight rats were fed on standard diet and psyllium husk powder by 5% of the weight of the diet. Group (4): Overweight rats were fed on standard diet and psyllium husk powder by 10% of the weight of the diet. Group (5): Overweight rats were fed on standard diet and quinoa seeds powder by 5% of the weight

of the diet. Group (6): Overweight rats were fed on standard diet and quinoa seeds powder by 10% of the weight of the diet. Group (7): Overweight rats were fed on standard diet and mixes of psyllium husk and quinoa seeds powder by 5% of the weight of the diet. Group (8): Overweight rats were fed on standard diet and mixes of psyllium husk and quinoa seeds powder by 10% of the weight of the diet.

The research study lasted for twenty-eight days throughout the duration of the study. Each rat is weighed independently at the finish of the experiment before being slaughtered and having blood samples collected.

A blood tests:

After a 12-hour fast, blood samples of each rat were obtained from the hepatic portal vein at the finish line of each trial. The serum was taken away from the blood samples by centrifuging them for 10 min. at 4000 rpm after they had been drawn into dry, clean centrifuge tubes and allowed to clot for 30 minutes in a water bath (37°C). After gently collecting the serum into clean cuvette tubes, it was then frozen until analysis according to (19).

Biochemical analysis

Determination of serum lipids fractions

Using (20) colorimetric procedure, the cholesterol was measured. As stated by (21 and 22), serum triglycerides were measured using enzymatic techniques. The method described by (23 and 24) was used to calculate HDL-c. According to (25), very low density-lipoprotein was estimated in mg/dl applying the formula below: Triglycerides (mg/dl) = very low density-lipoprotein cholesterol / 5. According to (25), low density-lipoprotein cholesterol was estimated in mg/dl as below: Low density-lipoprotein cholesterol = Total cholesterol - High density-lipoprotein cholesterol - Low density-lipoprotein cholesterol. The concentration of atherogenic index (AI) was estimated according to (26) by calculation the follows: AI = VLDL-c + LDL-c/ HDL-c. Enzymatic determination of serum glucose was carried out calorimetrically according to the method of (27). Determination of serum glutamic oxaloacetic transaminase (GOT) was carried out according to the method of (28). While serum glutamic pyruvic transaminase (GPT) was carried out according to the method of (29). Urea was determined by enzymatic method according to (30). Serum uric acid was determined calorimetrically according to the method of (31). Serum creatinine was determined according to the method described by (32).

Statistical analysis

A completely randomized factorial design was used to analyze the data when a significant main effect was discovered (33). The means of the Student-Newman-Keuls test were distributed. Differences between treatments at $P \leq 0.05$ were found to be significant using the Costat Program. To be able to evaluate the biological effects, one way ANOVA was performed.

Results and Discussion

The influence of psyllium husk and quinoa seeds, as well as their mixes on the total cholesterol (TC) and triglycerides (TG) of obese male rats are revealed by the data displayed

in Table (1). The acquired results showed that TC and TG values for positive control groups were significantly (P≤0.05) higher than those for negative control group. The corresponding readings were 76.50 & 67.50 mg/dl and 154.00 & 132.50 mg/dl, respectively.

The obtained outcomes suggested that the treatment group that consumed 10% of a mixture of psyllium husk and quinoa seeds had the lowest TC and TG, then that of treated group consumed 5% of powdered quinoa seeds which had the significantly greatest value, the average readings were respectively 78.90&66.00 and 107.25& 92.50 mg/dl. Those results corroborated earlier findings presented by (34) who claimed that obese rats given 7% quinoa had the best impact on lipid fractions, that is TG and TC ranges when comparison with to control rat group.

According to (16), patients who take 40 g of quinoa daily who are overweight or obese had lower serum triglyceride levels, which reduces the occurrence of metabolic syndrome.

Additionally, quinoa in the diet could decrease oxidative stress, improve serum triglyceride, and total cholesterol, help to control body weight, and decrease cardiovascular disease. Also, quinoa may even prove beneficial in reversing the effects of these diseases (35).

Table (1): Impact of psyllium husk, quinoa seeds as well as their mixture on serum total cholesterol and triglycerides on obese rats

Treatments /parameters	Total cholesterol (mg/dl)	Triglycerides (mg/dl)
Control group (-)	12.12±76.50e	67.50d±3.53
Control group (+)	55.6±.00a154	132.50a±3.53
Obese rats with 5% psyllium husk	±7.42bc101.25	77.25c±2.47
Obese rats with 10% psyllium husk	±8.131bc96.75	82.95c±2.89
Obese rats with 5% quinoa seeds	±3.53b107.25	92.50b± 3.53
Obese rats with 10% quinoa seeds	±3.53.00cd90	80.25c±3.18
Obese rats with 5% mixture	±1.76de80.75	67.00 d±1.41
Obese rats with10% mixture	±0.14178.90de	66.00d±1.41
L.S.D (P≤0.05)	11.116	6.631

TC =Total cholesterol. TG=Triglycerides. Each value represents the mean ± SD of three replicates. Means in the same column with different letters (a, b, c & d) are significantly different at P≤0.05.

Table (2) displays the influence of psyllium husk, quinoa seeds, and their combination on the blood lipid fractions that is low-density lipoprotein (LDL-C), very low-density lipoprotein (VLDL-C), high-density lipoprotein (HDL-C) and atherogenic index (AI) with obese albino rats. According to results, the findings revealed that, the LDL-C, VLDL-C, and AI ranges of control positive groups had considerably greater values when compared to control negative groups, which have been 91.50 mg/dl,, 26.50, mg/dl, & 3.24% and, 10.50 mg/dl,, 13.50 mg/dl, & 0.46%, and the vice versa with HDL-C, being 52.40 & 36.35 mg/dl, respectively.

Regarding groups that have received high fat, it should be observed that the best possible LDL-C, VLDL-C, and AI ranges have been recorded for 5% psyllium husk and 5 % quinoa seeds, whilst the lowest values had been recorded for 10% mixes seeds with substantially differences, the corresponding average have been 51.66 mg/dl, 18.50 mg/dl, & 1.72% and 14.20 mg/dl, 13.20 mg/dl, & 0.53%, and vice versa with HDL-C, being 51.50 and 34.14 mg/dl, for 10%mixes seeds and 5 % psyllium husk, respectively. The findings are consistent with

those of (36), who discovered that rats given a high-cholesterol diet supplemented with quinoa seeds as powder at a high level had mean lipid profile values that have been decrease than these of the positive control group. Bile acid and cholesterol production may have decreased, while bile acid and cholesterol excretion from the feces may have increased, explaining this alteration.

Furthermore, (37) discovered that feeding psyllium husk for 4 weeks to hypercholesterolemic rats improved their lipid profiles. Many scientists who carried out related experiments discovered hypolipidemic actions on test animals.

Table (2): Influence of psyllium husk, quinoa seeds as well as their mixture on lipid fractions of obese rats

Treatments/ parameters	HDL-c (mg/dl)	LDL-c (mg/dl)	VLDL-c (mg/dl)	AI %
Control group (-)	52.40a± 3.676	10.50h ± 0.02	13.50f ±0.2	0.46e±0.10
Control group (+)	36.35a± 5.161	91.15a±0.15	26. 50a±0.01	3.24a±0.17
Obese rats with 5% psyllium husk	34.14a±5.44	51.66b±0.33	15.45e ±0.05	1.97b±0.15
Obese rats with 10% psyllium husk	43.50a± 3.53	36.65d± 0.21	16.59c± 0.01	1.22c±0.12
Obese rats with 5% quinoa seeds	39.50a±1.41	49.25c±0.05	18.50b±0.03	1.72b±0.14
Obese rats with 10% quinoa seeds	48.25a±1.76	25.70e±0.2	16.05d±0.05	0.87d±0.12
Obese rats with 5% mixture	34.50a±19.79	32.85f±0.05	13.40f±0.1	1.34c±0.13
Obese rats with10% mixture	51.50 a±2.12	14.20g±0.1	13.20g±0.04	0.53e±0.11
L.S.D (P≤0.05)	17.935	0.245	17.935	0.243

LDL-c =Low-density lipoprotein. VLDL-c=Very low-density lipoprotein HDL-c = High-density lipoprotein. AI= Atherogenic index. Each value is the average over three replicates or mean + SD. Means with distinct lettered letters in the same column (a, b, c, & d) are significantly different at P≤0.05.

The displayed data in Table (3) demonstrates the impacts of psyllium husk, quinoa seeds, as well as their mixes on serum glucose ranges of rats with obese. The outcomes showed observed between the larger glucose level which reported for the positive control group and the lesser glucose level observed for the negative control group were significantly. These estimated levels were 189.25 and 100.5 mg/dl, respectively. It should be noted that adding more psyllium husk, quinoa seeds, or combination levels led to the best decrease in glucose level. The lowest glucose level with significant variations was obtained for 10% a mix of a psyllium husk, quinoa seeds as powder; however, the highest value was recorded in the overweight group rats fed with 5% psyllium husk powder. The indicated values had been 155.00 and 111.25 mg/dl, respectively. These findings confirm the claims made by (38) stated that psyllium seeds and husks-added meal demonstrated a drop in blood sugar while insulin levels remained unchanged. Therefore, it was determined that using psyllium seeds and husks for a longer period and at higher quantities than is currently done may also be beneficial.

Furthermore, (39) showed that the bioactive phytochemicals present in quinoa improve cardiovascular health and insulin sensitivity. Leucine is an amino acid that increases the

release of insulin from pancreatic cells, which may benefit animals with weight gain and blood sugar levels.

Table (3): Influence of psyllium husk, as well as quinoa seeds on serum glucose of obese rats

Treatments /parameters	Glucose mg/dl
Control group (-)	100.75f ±3.47
Control group (+)	189.25a±5.77
Obese rats with 5% psyllium husk	155.00b± 5.66
Obese rats with 10% psyllium husk	150.50bc±6.36
Obese rats with 5% quinoa seeds	144.00cd±4.95
Obese rats with 10% quinoa seeds	141.00cd±4.41
Obese rats with 5% mixture	135.25d±3.89
Obese rats with10% mixture	111.25e±5.30
L.S.D (P≤0.05)	10.035

Each value is the average over three replicates or mean + SD. Means with distinct lettered letters in the same column (a, b, c, & d) are significantly different at P≤0.05.

The impacts of psyllium husk, quinoa seeds, as well as their mixes on the liver activities that is glutamic oxaloacetic transaminase (GOT) and glutamic pyruvic transaminase (GPT) of overweight rats are revealed by the data displayed in Table (4). The results showed a significant difference between the GOT, and GPT liver enzyme recorded by the positive and negative control group of rats. They were 92.85 & 74.25 and 29.10 & 19.66 U/L on average, respectively.

Regarding the liver enzymes GOT, and GPT of treated groups, it could be notice that 5% powdered quinoa seeds group recorded the greatest GOT, and GPT liver enzyme of the treatment (overweight) rats, but the 10% mixes of psyllium husk and quinoa seeds groups observed significantly the lowest. The average values were 72.00, & 51.60 and 55.00, 41.67 & 26.75 U/L, respectively. These findings are consistent with (40) who found that after 4 weeks of treatment, psyllium extract treatment dramatically lowered liver enzyme levels, suggesting that the plant had prevented liver damage. This improvement might be a result of psyllium's activity as an antioxidant agent.

Then again, contrasted with the additional therapy groups, the rats from hypercholesteremic group consumed 10% germinated quinoa powder had lower GPT and GOT enzyme levels. Quinoa seeds improve liver function, according to studies on animals (15).

Serum AST and ALT levels significantly decreased after consuming high-cholesterol meals that were supplemented with quinoa seeds powder at a 30% level. Rats receiving a 30% quinoa seed powder food supplement exhibited the best results in terms of liver activity (41).

Table (4): Influence of psyllium husk, quinoa seeds as well as their mixture on serum liver enzyme of obese rats

Treatments /parameters	GOT (U/L)	GPT (U/L)
Control group (-)	29.10d± 4.24	19.66d±3.91
Control group (+)	92.85a± 5.44	74.25a±7.424
Obese rats with 5% psyllium husk	57.56c± 3.18	31.60cd±4.42
Obese rats with 10% psyllium husk	61.60bc±3.68	45.75b± 7.28
Obese rats with 5% quinoa seeds	64.95bc± 5.59	41.9bc± 3.96
Obese rats with 10% quinoa seeds	72.00b± 5.66	51.600b±6.36
Obese rats with 5% mixture	61.75bc± 5.44	45.50b±7.64
Obese rats with10% mixture	55.00c± 4.24	26.75d±1.63
L.S.D (P≤0.05)	11.003	13.110

GOT = Glutamic oxaloacetic transaminase. GPT = Glutamic pyruvic transaminase. Each value is the average over three replicates or mean + SD. Means with distinct lettered letters in the same column (a, b, c, & d) are significantly different at P≤0.05.

The impacts of psyllium husk, quinoa seeds, as well as their mixes on the serum renal biomarkers of obese rats are demonstrated using the information in Table (5). The obtained results indicated that the positive control groups had higher values (P≤0.05) of renal functions that the obtained results indicated that the positive control groups had higher values (P≤0.05) of renal functions such as serum urea, uric acid, and creatinine than negative control, the mean corresponding values were 35.46, 9.98 & 1.46 and 20.70, 6.20 & 1.01 mg/dl, respectively.

Table (6): Influence of psyllium husk, quinoa seeds as well as their mixture on renal biomarkers of obese rats

Treatments/ parameters	Urea (mg/dl)	Uric acid (mg/dl)	Creatinine (mg/dl)
Control group (-)	20.70 c± 2.55	6.20b± 0.99	1.01b±0.09
Control group (+)	35.46a±2.70	9.98a±0.18	1.46a±0.27
Obese rats with 5% psyllium husk	25.325bc±3.6	7.70ab± 0.85	1.01b±0.057
Obese rats with 10% psyllium husk	29.40abc±2.55	7.50ab±1.69	1.01b±0.31
Obese rats with 5% quinoa seeds	31.15ab±3.89	8.20ab±1.84	1.26ab± 0.04
Obese rats with 10% quinoa seeds	29.80abc±7.07	6.93ab± 0. 95	1.06b± 0.11
Obese rats with 5% mixture	29.35 ±abc3.61	7.80ab±0.42	1.15ab±0.06
Obese rats with10% mixture	22.35bc± 0.95	6.70 ab±0.57	0.94b± 0.08
L.S.D (P≤0.05)	8.638	3.022	0.370

Each value is the average over three replicates or mean + SD. Means with distinct lettered letters in the same column (a, b, c, & d) are significantly different at P≤0.05.

Considering overweight groups, it ought to be observed that 5% avocado seeds had great serum urea, uric acid, and creatinine ranges, whereas 5% mixes psyllium husk and quinoa seeds had the smallest amounts with significantly varying ranges, the corresponding average were 31.15, 8.20 & 1.26 and 22.35, 6.70 & 0.94 mg/dl, respectively. The findings support those of (42), who discovered that including quinoa seeds in the diet can reduce renal activity

functions. The enhancement in kidney health could be ascribed to the major bioactive component, thymoquinone.

According to (43), psyllium husk treatment resulted in significantly lower renal biomarker ranges in fatty liver affected as contrasted with the control rats.

Conclusion

The results of obese rats showed that psyllium husk, quinoa seeds, along with their mixes as powdered enhance serum blood sugar, liver functions, renal functions, and lipid fractions, particularly with 10% mixture psyllium husk, and quinoa seeds powder, which could be used in our bakery products and daily dishes in addition to its many health benefits.

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فاعلية قشور السيليوم وبذور الكينوا في إنقاص الوزن لدى الفئران البدينة

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الملخص العربي:

صممت الدراسة الحالية لتحديد تأثير بذور السيليوم والكينوا ومخلوطهم معا على إنقاص الوزن لدى الفئران البدينة. تم استخدام ٤٠ ذكور الفرأن من ذكور الفرأن البيضاء من نوع سبراغ داولي وزنها ١٤٠-١٥٠ جم بشكل عشوائي إلى ثماني مجموعات. تم استخدام 5 فرأن كمجموعة ضابطة سالبة تغذت على نظام غذائي أساسي فقط بينما تم تغذية باقي الفئران على وجبة مرتفعة في الدهن الحيوانى للخث على السمنة، تم إعادة تقسيم هذه الفئران إلى مجموعة ضابطة موجبة، ست مجموعات من الفئران المعاملة ٥ %، ١٠ % قشور السيليوم وبذور الكنوا وخليطهم معا. كانت فترة التجربة ٢٨ يوما. تمَّ أيضاً قياس مستويات الجلوكوز، والكوليسترول الكلي، والدهون الثلاثية، والبروتين الدهني عالى الكثافة، والبروتين إلدهى منخفض الكثافة، والبروتين إلدهى منخفض الكثافة للغاية، ومؤسر تصلب الشرايين، ووظائف الكبد (الجلوتاميك أوكسالوسيتيك ترانساميناز وجلوتاميك بروفيك ترانساميناز) ،ووظائف الكلى (اليوريا وحمض البوليك والكرياتينين). أشارت النتائج المتحصل عليها إلى أن النباتات المخترة خفضت مستويات الجلوكوز ووظائف الكبد ووظائف الكلي والكوليسترول الكلي، والدهون الثلاثية، والبروتين الدهني عالي الكثافة، والبروتين الدهني منخفض الكثافة، والبروتين الدهى منخفض الكثافة للغاية، ومؤسر تضلب الشرايين والعكس مع البروتين الدهني مرتفع الكثافة مقارنة بالمجموعة الضابطة الموجبة. في الختام، أظهرت الفئران البدينة التي تم تغذيتها على ١٠٪ من قشور السيليوم ومسحوق بذور الكينوا تحسن ملحوظ فى صورة دهون الدم ومستويات جلوكوز ووظائف الكبد والكلى، والتي بالإضافة إلى مزاياها الصحية العديدة، يمكن تطبيقها في وجباتنا اليومية ومنتجات المخابز المختلفة.

الكلمات الكاشفة: الحبوب، الفئران، ارتفاع دهون الدم، التحاليل الكيميائية الحيوية.