Biological and Biochemical Effect of Green Peas and Lentils Sprouts on Rats with Fatty Liver

Abdel-Naser A Gadallah [1]; Alia AF Atia[2*]; Maymona AE El-Khlefa[2] and Adel AA Badr[3]

1. Professor of internal medicine, internal medicine Department. Menoufia University
2. Fellow Lecturer Therapeutic Nutrition Department. National Liver Institute-Menoufia University.
3. Nutrition Fellow – Menoufia University Hospital.

Corresponding author: Alia AF Atia, Email: aliaaaboslima5977@gmail.com
Mobil: +201556043101

ABSTRACT

One of the most prevalent chronic liver illnesses, fatty liver is frequently accompanied by other metabolic disorders such as obesity, insulin resistance, hypertension, dyslipidemia, poor fat metabolism, and an elevated risk of cardiovascular disease. Sprouts are a great source of antioxidants, necessary amino acids, and a variety of healthy vitamins and minerals. For this study, 30 albino rats were employed. They were split into 6 groups; the first group served as a negative control group and was fed a standard diet, while the other groups were provided a high-fat diet to induce fatty liver. The remaining rats were divided into four groups and fed 5 and 10% of lentil and pea sprouts for 28 days. One of them was still suffering from fatty liver and was administered a base diet as a positive control group. The chemical build and total phenolic and flavonoid content of pea and lentil sprouts. Additionally, estimates were made for body weight gain (BWG), feed intake (FI), the feed efficiency ratio (FER), kidney and liver functions, blood sugar levels, insulin hormones, and the levels of lipid peroxidation (MDA), and antioxidant enzymes. The findings demonstrated that, in comparison to lentil sprouts, pea sprouts had a greater positive impact on the investigated parameters; the level of 10% was noticeably higher than the value of 5%. Therefore, sprouts of peas and lentils are the most widely prescribed and the most effective agents for improving fatty liver.

Keywords: *Sprouts; liver; high-fat; liver enzymes; MDA*

INTRODUCTION

Le et al., (2017) showed that the prevalent liver ailment globally is fatty liver disease (FLD). According to epidemiologic research, FLD affects an estimated 25% of the world's population at present, with Latin America and the Middle East having the greatest prevalence rates. Chronic liver disease mortality increased in 2019 and ranked as the 10th leading cause of death globally. It is characterized by an excessive buildup of fat that accounts for more than 5% of the liver's weight in the parenchymal hepatocytes of the liver. Elevated insulin levels are primarily responsible for the improper control of fatty acids and the ensuing steatosis, which can expose the liver to oxidative stress. A number of histological issues, including steatosis, discomfort, necrosis, cirrhosis, tissue damage, and ultimately liver cancer, can be brought on by FLD. High intakes of saturated fatty acids (SFA), trans fatty acids (TFA), simple carbohydrates (CHO), drinks with sugar, and fructose are among the nutritional risk factors for fatty liver. Therefore, changing the way you eat and adopting an active lifestyle are the main steps in weight loss and FLD prevention **(Bedossa, 2013; Friedman *et al.*, 2018; Asrani and colleagues, 2019; Huang and others, 2021).** The focus is turning to exploring better ways to enhance the functionality of meals as people become more aware of the connection between nutrition and health. Edible seeds that have been sprouted recently have become more and more common in modern diets. There is a growing body of research about the therapeutic benefits of sprouted foods, and the consumption of legume seeds and sprouts is rising since they are regarded as "functional foods" because of their higher nutrient availability and bioactive substances. Sprouting seeds improve seed quality by lowering the amount of anti-nutritive substances while also enhancing resistant starch and digestibility. Sprouts additionnally contain proteins, enzymes, vitamins, and minerals **(Abdallah, 2008; Wieca et al., 2015).** The bioavailability of substances including B vitamins and vitamin C is facilitated by sprouting, which also regulates phytic acid.

Lentils (*Lens culinaris L.*) have a benefit over other types of legumes and grains in that it has a very low amount of phytic acid and a high total amount of phenolic substances. In addition to having a large amount of protein, a relatively low-calorie value, and high levels of vital nutrients like fiber, vitamin C, and folate. So, according to **Hoover et al. (2003); Thavarajah and others (2011); Magkos and colleagues (2019)**, this legume is a good source of nutrients, high-quality protein, and amino acids. Isoleucine and lysine are two of the essential amino acids found in lentils, but methionine and cysteine are typically under-represented. If lentils are sprouted before cooking, however, all of the essential amino acids including methionine and cysteine—are present. Sprouting helps break down some of the carbohydrates in lentils that cause intestinal gas in order to prevent gastrointestinal issues, reduce body weight and body fat, and improve antihypertensive function (**Xu et al., 2010; Benincasa and work team, 2019).**

Peas (*Pisum sativum L.*), a significant dietary legume, is mostly utilized globally for the production of grains. Peas seeds are a special dual-purpose crop that is rich in both energy and protein and includes a reasonable amount of nutritious protein and a high level of carbohydrate. Since ancient times, germination has been utilized to soften the structure of the kernel, enhancing its nutritional content, lowering anti-nutritional effects, and enhancing the functionality of seed protein. One of the greatest vegetable sources of protein, pea sprouts can deliver the same amount of protein as one-third of an egg. Peas sprouts are a great source of vitamin K, delivering

66% of the daily value (DV) from a one-cup dose. Pea sprouts are high in antioxidants and carotene, supplying around 35% of the DV of vitamin C and 15% of the DV of provitamin A. It naturally aids diabetic people to maintain a close watch on their blood sugar level and helps the body battle against free radical damages that may induce cancer-related ailments (**Cousin, 1997; Kaukovirta-Norja et al., 2004; Abdallah and Abo El-Naga, 2013; Ijarotimi and Keshinro, 2013**).

The new study was done to investigate lentils and green pea properties towards fatty liver diseases.

MATERIAL AND METHODS

Materials

Green peas (*Pisum sativum L.*) and lentils (*Lens Culin-aris L.*) were purchased from the community market in Shebin El- Kom City, Menoufia Governorate, Egypt, from Morgan Co. Cairo, Egypt, and received casein, cellulose, choline chloride, and DL-methionine powder.

30 adult normal male albino Sprague Dawley rats were acquired from the Vaccine and Immunity Organization, Ministry of Health, Helwan Farm, Cairo, Egypt, for a total weight of 160 ± 5 g. Al-Gomhoria Company for Chemical, Medical, and Instruments, Cairo, Egypt, provided the chemical, kits used for biochemical determination.

Methods

The induction of experimental fatty liver

A high-fat diet (HFD) containing 20% animal lipid (ghee) was fed to normal, healthy male albino rats for two weeks while also serving as a positive control group in order to induce fatty liver (**Xu et al., 2010).**

Perpetration of lentil and green pea sprouts

To prepare the seeds for sprouting, they were first well-cleaned under running water, dried in the shade, and then soaked for 8 to 12 hours in cool water (1 cup of seeds). Finally, they were thoroughly rinsed and drained. Every 8 to 12 hours, rinse and drain with cool water. On day 11, when the majority of the beans have short roots, Sporter was eventually harvested after being housed in a low-light environment. They were then processed into a fine powder using dried in an air oven at 50°C and milled **(Shanmugam et al., 2015).**

Estimation of the chemical compositions, total flavonoid, total phenols, and antioxidants activity of lentil and pea sprouts

According to **A.O.A.C. (2012),** moisture, protein, fat, ash, and crude fiber were measured.

Total carbohydrates g% = 100- (moisture + protein + fat + ash).

According to **Nzikou et al. (2009),** the atomic absorption spectrophotometer was used to evaluate the mineral concentration. Using the colorimetric approach created by **Klein and Perry (1982),** vitamin C was determined. As estimated by the method of **Klein and Perry (1982),** pro-vitamin A. The aluminum chloride colorimetric method was used to quantify the total amount of flavonoid **(Park et al., 1997)**. The Folin Ciocalteu reagent was used to calculate the total phenols in each of the sprouts under test using the **Singleton and Rossi (1965)** method. **Blois (1958)'s** method for measuring the 2,2-diphenyl-1-picrylhydrazyl (DPPH) comp-pound's capacity to scavenge free radicals was used.

Experimental design

The study was carried out in compliance with the Guide for the Care and Use of Laboratory Animals, and approval for the study was granted by the Monofia University, Faculty of Medicine Research Committee (Protocol No: M11-2).

30 adult male white Sprague Dawley strain rats, weighing (160g), for seven days straight, were fed on a casein-based basal diet prepared in accordance with **Reeves et al. (1993).** Following this period of adaption, rats were split into six groups (5 rats/ group), as follows: Rats fed a basic diet served as the negative control

group in Group (I). The remaining groups were fed 20% animal ghee for two weeks to induce fatty liver, and they were separated into the following categories: group 2 as a positive control. Rats with fatty livers in groups 3 and 4 were fed powdered lentil sprouts at a rate of 5 and 10% of their basal food weight, respectively. Rats in groups 5 and 6 were given powdered peas sprouts at a rate of 5 and 10% of their basal meal weight, respectively. After the starting period, there was a 28-day experiment period. Every day of the study period, the diet that was consumed was recorded, and every week, body weight was registered. According to **Chapman et al. (1959),** the BWG, FER, and the weights of several organs were calculated. **using** the following equations:

BWG = Final weight (g) – Initial weight (g)

FER = Body weight gain (g/day) / Feed intake (g/day).

Blood sampling

Initially, blood was drawn from the retro-orbital vein to check for the presence of liver enzymes that could indicate the development of a fatty liver. Each rat was slaughtered at the conclusion of the experiment, and blood samples were taken from the hepatic portal vein after 12 hours of fasting. According to the procedure outlined by **Schermer (1967),** blood samples were collected into a dry, clean centrifuge glass tube, allowed to clot in a water bath (37°C) for 30 minutes, and then centrifuged for 10 minutes at 4000 rpm to separate the serum. The serum was then carefully aspirated, transferred into a clean Eppendorf tube, and stored frozen in a deep freezer (-20 C) until analysis. The brain and liver were separated, washed, and weighed.

Biochemical analysis

Total protein (Tp) (Serum total protein (g/dl) = Serum globulin +Serum albumin), Albumin (Alb), and globulin (Glb) were carried out as stated by **Weichsel-Baum, (1964) and Domas and Biggs (1971).** Aspartate amino-transaminase (AST), alanine aminotransferase (ALT), and alkaline phosphatase (ALP) were measured as claimed by **Henry (1974), Reitman and Frankel (1957); IFCC (1983)** respectively. Urea, uric acid, and creatinine were determined on the report of **Patton and Crouch (1977); Baraham and Trinder (1972); Henry (1974).** Blood glucose was determined as maintained by **Trinder (1969)** while, insulin hormones were estimated by **Matthews *et al.*, (1985).** Serum total cholesterol, triglyceride, and HDL-c were determined according to the method described by **Thomas (1992)**, **Young (1975), and Friedewaid (1972). LDL-c and** VLDL-c were calculated in mg/dl according to **Lee and Nieman (1996)** using the following formula:

VLDL-c (mg/dl) = Trigly-cerides / 5

LDL-c (mg/dl) = Total chole-sterol – HDL-c – VLDL-c.

Butyrylcholinesterase was determined in serum according to the method of **Ellman *et al.*, (1961).** Lactate dehydrogenase (LDH) was determined in serum using a test reagent kit according as maintained by **Tietz, (1995).** Glutathione peroxidase (GPX), superoxide dismutase (SOD), catalase (CAT), glutathione s-transferases (GSTs), and malondialdehyde (MDA) were measured by the method of **Zhao (2001); Sun *et al*. (1988); Diego (2011); Koracevic (2001); Ohkawa and others (1979)** respectively.

Statistical analysis:

The mean values of the results are presented along with their standard deviation of the mean. One-way ANOVA and the Duncan post hoc test were used to analyze statistical differences between groups in SPSS version 11.0 for Windows (SPSS, Chicago, IL, USA). **Snedecor and Cochran (1980)** defined differences as significant when (p0.05).

RESULTS AND DISCUSSION

Measurements in Table (1) described the nutrient content of powdered lentils and peas sprouts. It is clear to notice that lentils had a higher content of protein, carbohydrates, energy value, potassium, and zinc than their contents in pea sprouts while, pea sprouts had high contents of moisture, fat, ash, fiber, calcium, iron, sodium, vitamin C and vitamin A when compared to the lentil sprouts. According to **Ijarotimi and Keshinro (2013),** the germination process has been utilized to soften the kernel structure, increase its nutritional value, lessen its anti-nutritional effects, and improve the functionality of seed protein. These findings are consistent with their findings. Due to the sprout's higher concentration of nutritious elements, such as vitamins, minerals, proteins, and enzymes, compared to traditional ones, and the lack of pesticide residues, sprout can be regarded as an organic food and has health benefits **(Oates et al., 2014).** The carbohydrate content yielded a similar effect, and these findings may be explained by the fact that during germination, seeds of legumes in particular use their stored carbohydrates as an energy source to initiate germination and other processes. Growing sprouts increased ash, low-fat, and carbohydrate levels, and the highest fiber content was noted. Pea sprouts can offer the body a variety of nutrients while being low in calories. On a dry weight basis, sprouts had the highest concentrations of phosphorus, potassium, calcium, magnesium, and iron. According to previous research by **Anwar (2016),** this resulted from the sprouts' exposure to light throughout the sprouting phase and their ability to absorb nutrients from an open field growing medium. In contrast to other ready-to-eat green leafy vegetables, pea shoots have a higher concentration of potassium and phosphorus, according to **Santos et al.'s (2014)** report. Several enzyme systems become active during sprouting (germination), which significantly alters the nutritional value of pulses. After sprouting, the level of vitamin C, which was essentially nonexistent in dried legume seeds, rose **(Saha and Dunkwal, 2009)**. In contrast to other ready-to-eat green leafy vegetables, pea shoots have a higher amount of vitamins C, E, and A, according to **Santos et al. (2014).** In addition, **Márton et al. (2010)** found that the germination process results in a large decrease in Fe with a significant improvement in the availability of Fe. **Xu et al. (2019)** demonstrated that lentil has the greatest protein content and that total protein values rise after germination. On the other hand, calcium and zinc contents as well as their bioavailability were shown to rise following germination **(Luo et al., 2014).**

The dried lentil and pea sprouts' total phenol and flavonoid content was displayed in Table 2. In comparison to lentil sprouts, pea sprouts had significantly greater total phenol and total flavonoid concentrations. Pea sprouts had a greater increase in antioxidant activity than lentil sprouts due to their higher total phenol and flavonoid content. The most abundant phenols found in lentils are those with a flavone structure (i.e., monomers, oligomers, and gallate derivatives), with catechin glucoside being the predominant flavanol **(Magkos et al., 2019).** Lentil sprouts were found to be a good source of phenolic compounds, especially flavonoid derivatives. It is crucial to ascertain whether the benefits of the digesting process, such as antioxidant activity, are reflected in the bioactive chemicals' positive effects. The phenolic composition of food is significantly altered by gastrointestinal digestion, as is well-recognized **(Xu and Chang (2010); Pineda-Vadillo et al., 2016).** Due to the enrichment of the lentil sprouts with the probiotic, which significantly increased anti-oxidant activity against 2,2-diphenyl-1-picrylhydrazyl (DP-PH), they demonstrated that the lentil sprouts appeared to be a good source of buffer-extractable and potentially bio-accessible antioxidants with multidirectional activity.

According to **Santos-Silva et al. (2020),** pea sprouts have a higher total phenol and flavonoid content than fruits like pineapple, banana, lychee, and papaya, as well as their by-products, demonstrating their potential as a source of bioactive substances. A higher concentration of simple phenols, such as gallic or syringic acids, which have a stronger ability to scavenge free radicals like the DPPH, found in pea extracts, according to the suggestion of **Casas-Forero et al.'s (2020).**

The details displayed in Table 3 showed the effects of feeding a high-fat diet to produce fatty liver for 28 days either alone or in combination with tested sprouts (5 and 10%) on BWG, FER, and FI. When compared to the results in the treated groups and the negative control group, feeding on a high-fat diet alone significantly (p 0.05) recorded the greatest value of BWG, FER, and FI.

Both of the tested sprouts showed substantial variations between levels 5 and 10%, and at the same time, pea sprout levels recorded higher values than those of lentil levels, although the differences were not statistically significant. The collected data are in line with the findings of **Han et al. (2019),** who discovered that the high-fat diet group's body weight was significantly higher than that of the normal control animals. According to **Moraes et al. (2009)**, high-fat diets (HFD) can lead to a number of metabolic changes, including hyperphagia in humans, decreased lipolytic activity in fat tissue, particularly liver tissue, decreased leptin secretion and/or sensitivity, hypothalamic neuron apoptosis, impaired mitochondrial metabolism, insulin resistance, and obesity. Sprouts are a good source of dietary fiber and plant-based protein. They contribute to the daily protein requirement, which results in weight loss, and they aid to increase satiety. Pea sprouts are nutrient-rich sprouts that provide high supplies of a number of minerals, including potassium, magnesium, phosphorus, vitamin B, and an increase in protein **(Martins,**

2010). According to **Khazaei et al. (2019),** lentils have a high protein content, a low-calorie value, and high quantities of vital nutrients like folate, vitamin C, fiber, and total phenols, which are associated with reduced body weight, body fat, and antihypertensive function.

The effect of a given fatty diet alone or combined with different levels (5 and 10%) of tested sprouts (lentil and pea) on liver and brain weights is presented in Table (4). Given rats' fatty diet alone significantly ($p \leq 0.05$) increased both organ weights while significantly decreased organ weight when given fatty liver rats combined with tested sprouts. Moreover, no remarkable difference was noticed between the same level of different sprouts and it was significant between the different levels of the same sprouts. Both tested sprouts recorded significant changes with both of the control groups. According to research by **Malnick and Knobler (2006),** eating a high-fat diet leads to a detrimental deposit of fat in the liver, which can harden scar tissue and increase liver weight. They proposed that eating a high-fat diet is similarly linked to cognitive impairment. The effects of short- and long-term HFD feeding on biochemical and behavioral changes have been shown in a number of preclinical experiments. Sprouts have a high omega-3 fatty acid content, which supports brain function and lowers the risk of heart attack and stroke. Sprouts are rich in calcium and magnesium, which promote the health of the bones and muscles. Magnesium is crucial for the health of the brain and blood vessels. Additionally, sprouts provide higher levels of detoxifying enzymes and liver protection. Low-fat legumes are rich in fiber, vitamins (B and C), and protein, such as pea and lentil sprouts, are good for the health of the liver. Additionally, a subclass of vitamin B vitamins is essential for maintaining brain function **(Martins, 2010; Khazaei et al., 2019).**

Table 5 summarizes the average values for total protein, albumin, globulin, and albumin/globulin ratio (g/dl) in rats with fatty livers that consumed sprouts of lentils and peas at levels of 5 and 10%. It is evident that the negative control group's mean total protein (TP) (g/dl) level was higher than that of the other test groups. When globulin and the ratio of albumin to globulin were measured, the 10% of examined sprouts did not differ significantly from the negative control group. The mean values for pea sprouts were greater than those for lentil sprouts. Numerous illnesses and ailments, including fatty liver and inflammation or inflammatory disorders, are associated with high blood protein levels. The "A/G ratio," which compares the amounts of albumin and globulin, is used to calculate total serum protein, which represents all the proteins in the blood. Albumin predominates somewhat over globulin in healthy individuals. According to **Jang et al. (2012),** low levels of albumin and globulin could be an indication of liver issues. Consuming sprouts can increase overall protein levels, which will aid in liver detoxification. Low-fat legumes like pea and lentil sprouts are rich in protein and vitamins (B and C), vitamins, which help to maintain normal liver functions **(Martins, 2010; Khazaeiet al., 2019).**

According to the data in Table (6), rats that were fed a fatty diet to cause fatty livers without receiving therapy had high levels of liver enzymes; however, this rise was not statistically different from the other groups. Additionally, it was shown that consuming the pea and lentil sprouts caused the liver enzymes to drop significantly in relation to the positive control sample. The pea sprout levels had a high effect as compared with the lentil sprouts but there is no significance between the same levels and is significant between different levels. The amount of 10% was the best treatment for liver enzyme values. With increased plasma activity of liver enzymes, evaluated high-fat / high-cholesterol diets caused increased liver weight, fat deposition, inflammation, and degeneration **(Panchal et al., 2011).** To increase the nutritional content of legumes, germination is used. Sprouts are beneficial for the liver because they contain antioxidants and phytochemicals that prevent hepatic steatosis and apoptosis. It improves protein digestibility and changes the dietary fiber fractions in lentils. Additionally, germination increases the concentration of bioactive antioxidant substances, such as melatonin. According to **Daz and others (2019) and Khazaei et al. (2019),** pea sprouts have a lot of fiber, B vitamins, protein, and low levels of fat, all of which are excellent for liver functions. In Table (7), the impact of sprouts tested at 5% and 10% on several renal function measures in rats with fatty livers is summarized. It was shown that rats with fatty livers suffered from reduced kidney function as well as higher urea, uric acid, and creatinine levels. The levels of these parameters significantly decreased after the addition of the pea and lentil sprouts. The impact of sprouts on the evaluated parameters considerably increased as their concentration increased. Long-term consumption of a high-fat diet (HFD) causes the kidneys to accumulate more lipids. The risk of kidney disease increases as a result of the kidneys having to work faster and filter impurities over the normal level **(Panchal et al., 2011).** Kidney disease manifests as an abnormality in the levels of urea, uric acid, and creatinine. Sprouts are on the alkaline side, reducing the acidity of the diet and relieving renal stress. Potassium-rich peas and lentil sprouts reduce calcium loss and prevent kidney stones from developing. Additionally, these foods have anti-oxidant properties that guard against kidney cancer **(Daz et al., 2019; Khazaei and others 2019).**

The information in Table (8) shows how rats with fatty livers were affected by pea and lentil sprouts at 5 and 10% in terms of their blood glucose levels (mg/dl) and insulin hormones. The positive control group was found to have significantly higher blood sugar levels and lower insulin levels. The mean value of glucose and insulin hormones improved when rats with fatty livers were fed sprouts, and the effect of 10% sprouts was substantially bigger than that of 5% sprouts. The negative control group and the 10% level of pea sprouts are not statistically different. A meal high in fat can slow down digestion and make it a challenge for insulin to work as it should. A high-fat diet increases fasting glucose levels, increasing hepatic glucose production and leading to the emergence of insulin resistance **(Belfort et al., 2005)**. Sprouts contain a high antioxidant content, including vitamins C and K, are a rich source of dietary fiber, and can help lower blood sugar levels. Pea sprouts are a good substitute for those who have diabetes because they include fiber and protein, which can help to slow digestion and stabilize the body's blood sugar levels. Pea sprouts also have a low GI. In addition, lentil sprouts are rich in phytochemicals. Protein, fiber, B vitamins, iron, potassium, zinc, phosphorus, magnesium, manganese, copper, and phosphorus, these essential elements are also present in sprouted lentils. They help manage blood sugar and enhance the effects of insulin since they are low on the GI, with a GI value ranging from 18 to 52 **(Benincasa et al., 2019).**

The mean values of the lipid profile (total cholesterol, triglycerides, HDL-c, LDL-c, and VLDL-c (mg/dl) of rats with fatty livers fed on 5 and 10% pea and lentil sprouts are shown in Table (9) for comparison. Rats with fatty livers have higher lipid profile readings than normal rats. When fatty liver rats were fed on the tested amounts of pea and lentil sprouts, the collected data showed a much lower lipid profile and a significantly higher level of HDL-c. There were relation-ships between the lipid profile measurements and the quantity of further tested sprouts. Lentil sprouts performed better on lipid fractions than pea sprouts, but there was little variation in amounts amongst the various tested sprout types**.** Low-density lipoproteins (LDL-c) and triglycerides are elevated in fatty liver, while high-density lipoproteins (HDL-c) are lowered, both of which increase the risk of developing cardiovascular disease (CVD). According to **Papandreou et al., (2017),** fatty liver disease increases the risk of having high cholesterol and may also be a sign of high triglyceride levels. During the germination process, lentils produce more protein and fiber so rats that received lentil sprouts had considerably higher levels of HDL-c, which helped to reduce their risk of cardiovascular disease **(Benincasa et al., 2019).** Treatments with peas showed a substantial fall in serum lipid profile with a greater dose; TC and LDL levels did drop, and the HDL level increased with plentiful phenolic compounds, particularly for a large number of polyphenols **(Magalhaes et al.2017).**

The data in Table (10) demonstrated the inhibition of butyrylcholinesterase and lactate dehydrogenase activity in the serum of rats when compared to the control value by a high-fat meal alone. With the continual increase in the concentration of the examined sprouts mixed with a high-fat meal, the inhabitation of enzyme activity is reduced. The other finding was seen in serum malondialdehyde content (MDA), which showed that levels of examined sprouts significantly reduced their concentration after being added to a high-fat meal alone. On the other the same direction, it was discovered that a high-fat diet paired with the studied sprouts had a beneficial effect on enzyme function. A high-fat diet has the ability to cause fatty liver, which affects the blood serum enzyme cholinesterase and the liver's ability to hydrolyze acetylcholine. In order to transport impulses from the neuron to the muscle fiber, a substance called acetylcholine is synthesized at the nerve ends **(Papandreou et al., 2017).** According to research by **Feillet et al., (2009),** the consumption of pea sprouts suppressed MDA and prevented the activity of enzymes involved in the glucose metabolic pathway, such as hexokinase and LDH, from increasing.

As indicated in Table (11), fatty liver rats that received no therapy had lower serum levels of glutathione-S-transferase and glutathione peroxidase activity. Feeding a high-fat meal with lentil and pea sprouts at levels 5 and 10 was found to have a positive impact on serum glutathione-S-transferase and serum glutathione peroxidase, though the activity has remained lower than the control value. Lentil and pea sprouts can be added to the diet to protect the liver tissues, and a higher dosage of the tested sprouts can restore them to normal levels. Reactive oxygen species (ROS) may be produced as a result of a high-fat diet **(Wang et al., 2015).** In vivo, antioxidant enzyme defense mechanisms were used to control ROS. Sprouting can improve the lipid oxidation caused by HFD and can dramatically increase the activity of the key antioxidant enzymes in the serum of rats with fatty livers. These results mirrored those of **Feillet et al. (2009**). Rats with fatty livers have higher levels of oxidative stress, according to Patel et al. (2007). As indications of oxidative stress, the serum's GSHPx, CAT, and SOD activity were examined. The liver's antioxidant state can be improved by consuming lentil and pea sprouts on a daily basis, as demonstrated by the elevated levels of GSH-Px, CAT, and glutathione-S-transferase.

CONCLUSION

The buildup of fat in the liver is a frequent disorder known as "fatty liver," which can lead to liver damage. Sprouts supply great essential vitamins, minerals, fiber, and source antioxidants, they improved the digestion of carbohydrates, proteins, and aid in gut health, and reduce intestinal gas. The study concluded that pea and lentil sprouts could improve the liver enzymes, renal functions, lipid profile, and oxidative stress indicators of fatty liver rats as compared to the positive control group.

REFERENCES

Abdallah MMF (2008): Seed sprouts, a pharaoh's heritage to improve food quality. Arab Univ. *J. Agric. Sci.*, 16(2): 469-478.

Abdallah MMF and Abo El-Naga M (2013): Use of seed sprout flour to improve cake quality. *J. Biol. Chem. and Environ. Sci.*, 8(1): 279- 298.

Anwar DA (2016): Effect of a number of harvests on the production and nutritive value of mushroom fruits, sprouted vegetables, and their residues. Ph.D. *Thesis of Fac. Agric. Ain Shams Univ., Cairo, Egypt*, 93-106.

AOAC (2012): Official Methods of Analysis of AOAC International.19th ed. Ducnes Method. No. 968.06. Chapter 4, 9-56.

Asrani SK; Devarbhavi H; Eaton J and Kamath PS (2019): The burden of liver diseases in the world. *Journal of hepatology*, 70:151-171.

Baraham D and Trinder P (1972): Quantitative enigmatic colorimetric determination of uric acid in serum, plasma, or urine. *Analyst.*, 97:142.

Bedossa P (2013): Current histological classification of NAFLD: Strength and limitations. *Hepatol. Int.*, 7 (2):765-770.

Belfort R; Mandarino L; Kashyap S; Wirfel K; Pratipanawatr T; Berria R; DeFronzo RA and Cusi K (2005):
Dose-response effect of elevated plasma free fatty acid on insulin signaling. *Diabetes*, 54:1640–1648.

Benincasa P; Falcinelli B; Lutts S; Stagnari F and Galieni A (2019):
Sprouted grains: A comprehensive review. *Nutrients*, 11: 421.

Blois MS (1958):
Antioxidant determinations by the use of a stable free radical. *Nature*, 181: 1199 – 1200.

Casas-Forero N; Orellana-Palma P and Petzold G (2020):
Influence of block freeze concentration and evaporation on physicochemical properties, bioactive compounds, and antioxidant activity in blueberry juice. *Food Science and Technology*. In press. http://dx.doi. Org / 10. 1590 /fst.29819.

Chapman DG; Castillo R and Campbell JA (1959):
Evaluation of protein in foods:1. A method for the determination of protein efficiency ratio. *Canadian Journal of Bio-chemistry and Physiology*, 37 (5): 679 - 686.

Cousin R (1997):
Peas (Pisum sativum L.). *Field Crop Res.*, 53: 111-130.

Díaz MF; Martínez M; Savón LL; Torres V and Coto G (2019):
Legumes. *Royal Society of Chemistry*; London, UK: 2019. CHAPTER 8. Obtaining, Chemically Characterizing and Nutritionally Evaluating Seasonal Legume Sprouts as a Feed Alternative, 177–195.

Diego S (2011):
Oxiselect TM Catalase Activity Assay Colo-

trimetric. *Cell Biolabs, Inc*., 1-9.

Doumas BT and Biggs HG (1971): Albumin standard and measurement of serum albumin with bromo-cresol green. *Clin. Chem.,* 31:78.

Ellman GL; Courtney KD and Andres V (1961): A new and rapid colorimetric determination of acetyl-cholinesterase activity. *Biochem. Pharmacol.,* 7: 88 –95.

Friedman SL; Neuschwander-Tetri BA; Rinella M and Sanyal AJ (2018): Mechanisms of NAFLD development and therapeutic strategies. *Nature Medicine*, 24: 908-922.

Friedwaid WT (1972): Determination of HDL. *Clin. Chem.,* 18: 499. (Chemical Kits).

Han J; Plummer J; Liu L; Byrd A; Aschner M and Erikson KM (2019): The impact of obesity on brain iron levels and alpha-synuclein expression is regionally dependent. *Nutr. Neurosci*., 22: 335–43.

Hegested DM; Mills RC; Elvehjem, CA and Hart EB (1941): Choline in the nutrition of chicks. *J. Biol. Chem.,* 138: 459.

Henry RJ (1974): Clinical Chemist: *Principles and Techniques*. 2nd, Edition, Hagerstown (MD), Harcer, ROW, P. 882.

Hoover R and Zhou Y (2003): In vitro and in vivo hydrolysis of legume starches by α-amylase and resistant starch formation in legumes: A review. *Carbohydr. Polymer*., 54:401–417.

Huang DQ; El-Serag HB and Loomba R (2021): Global epidemiology of NAFLD-related HCC: Trends, predictions, risk factors, and prevention. *Nature*

Reviews Gastroenterology and Hepatology, 18:223-238.

I.F.C.C. (International Federation of Clinical Chemistry) (1983): Methods for the measurement of catalytic concentration of enzymes - Part 5: IFCC, methods for alkaline phosphatase. *J. Clin. Chem. Clin. Biochem.*, 21:731-748.

Ijarotimi SO and Keshinro OO (2013): Determination of nutrient composition and protein quality of potential complementary foods formulated from the combination of fermented popcorn, African locust, and Bambara groundnut seed flour. *Polish J. Food Nutr. Sci.*, 63(3): 155-166.

Jang HH; Park MY; Kim HW; Lee YM; Hwang KA; Park JH; Park DS and Kwon O (2012): Black rice (*Oryza sativa L.*) extract attenuates hepatic steatosis in C57BL/6 mice fed a high-fat diet via fatty acid oxidation. *J. Nutr. Metab.*,9:27.

Kaukovirta - Norja A; Wilhemson A and Poutanen K (2004): Germination: A means to improve the functionality of oat. *Agric. Food Sci.*, 13: 100-112.

Khazaei H; Subedi M; Nickerson M; Martínez-Villaluega C; Frias J and Vandenberg A (2019): Seed protein of lentils: Current status, progress, and food applications. *Foods*, 8: 391.

Klein BP and Perry AK (1982): Ascorbic acid and Vitamin A activity in selected vegetables from different geographical areas of the United States. *J. Food Sci.*, 47:941-948.

Koracevic DC (2001): Determination of glutathione s – trans-ferases (GSTs), *J. Cli. Pathol.*, 54:356-361.

Le MH; Devaki P; Ha NB; Jun DW; Te HS; Cheung RC and Nguyen MH (2017): Prevalence of non-alcoholic fatty liver disease and risk factors for advanced fibrosis and mortality in the United States. *PLoS One*, 12: e0173499.

Lee R and Nieman D (1996): Nutrition Assessment. 2nd Ed., Mosby, Missouri, USA.

Luo Y; Xie W; Jin X; Wang Q; He YE (2014): Effects of germination on iron, zinc, calcium, manganese, and copper availability from cereals and legumes. *CyTA J. Food*, 12: 22–26.

Magalhaes SCQ; Taveira M; Cabrita ARJ; Fonseca AJM; Valentao P and Andrade PB (2017): European marketable grain legume seeds: Further insight into phenolic compounds profiles. *Food Chemistry*, 215: 177–184.

Magkos F; Tetens I; Bugel SG; Felby C; Schacht SR; Hill JO; Ravussin E and Astrup AA (2019): Perspective on the transition to plant-based diets: A diet change may attenuate climate change, but can it also attenuate obesity and chronic disease risk? *Adv. Nutr.*,11:1–9.

Malnick SD and Knobler H (2006): The medical complic-ations of obesity. *Q JM.*, 99:565–79.

Martins I (2010): Tabela da Composição de Alimentos. Lisboa, Port-ugal: Instituto Nacion de Saúde Ricardo Jorge.

Márton M; Mándoki Z; Csapó-Kiss Z and Csapó J (2010): The role of sprouts in human nutrition. A review. Acta. Univ. Sapientiae, *Aliment*., 3: 81–117.

Matthews DR; Hosker JP; Rudenski AS; Naylor BA; Treacher DF and Turner RC (1985): Homeostasis model asse-ssment: insulin resistance and beta-cell function from fasting plasma glucose and insulin concentrations in man. *Diabetology*, 28: 412–419.

Moraes JC; Coope A; Morari J; Cintra DE and Roman EA (2009): High-fat diet induces apoptosis of hypo-thalamic neurons. *PLo S One*, 4: e5045.

Nzikou IM; Matos L; Moussounga JE; Ndangu CB and Kimbonguila A (2009): Characterization of Moringa oleifera seed oil variety Congo Brazzaville. *J. Food Technol.*, 7 (3): 59- 65.

Oates L; Cohen M; Braun L; Schembri A and Taskova R (2014): Reduction in urinary organophosphate pesticide metabolites in adults after a week-long organic diet. *Environ. Res*., 132: 105–111.

Ohkawa H; Ohishi W and Yagi K A (1979): Determination of MDA. *Biochem*., 95-351.

Panchal SK; Poudyal H; Iyer A; Nazer R; Alam MA; Diwan V; Kauter K; Sernia C; Campbell F; Ward L; Gobe G; Fenning A and Brown L (2011): High-carbohydrate, high-fat diet-induced metabolic syndrome and cardiovascular remodeling in rats. *J. Cardiovasc. Pharmacol*., 57 (5): 611-624.

Papandreou C; Bullò M; Tinahones FJ; Martínez-González MÁ; Corella D; Fragkiadakis GA; López-Miranda J; Estruch R; Fitó M and Salas-Salvadó J (2017): Serum metabolites in non-alcoholic fatty-liver disease development or reversion; A targeted metabolomic approach within the PREDIMED trial. *Nutrition and Metabolism*, 14(1):58.

Park YK; Koo MH; Ikegaki M and Contado JL (1997): Comparison of the flavonoid aglycone con-tents of *Apismellifera* propolis from various regions of Brazil. *Arquivos de Biologia e Tecnologia*.,40:97-106.

Patel C; Ghanim H; Ravishankar S; Sia CL; Viswanathan P; Mohanty P and Dandona P (2007): Prolonged reactive oxygen species generation and nuclear factor-κB activation after a high-fat, high-carbohydrate meal in the obese. *Journal of Clinical Endocrinology and Metabolism*, 92(11): 4476–4479.

Patton CJ and Crouch SR (1977): Spectrophotometric and kinetics investigation of the Berthelot reaction for determination of ammonia. *Anal. Chem.*, (49):464-469.

Pineda-Vadillo C; Nau F; Dubiard CG; Cheynier V; Meudec E; Sanz-Buenhombre M; Guadarrama A; Tóth T; Csavajda É and Hingyi H (2016): In vitro digestion of dairy and egg products enriched with grape extracts: Effect of the food matrix on polyphenol bioaccessibility and antioxidant activity. *Food Res. Int*., 88: 284–292.

Reitman S and Frankel S (1957): Colorimetric method for the determination of serum glutamic oxaloacetic and glutamic pyruvic trans-aminases. *Am. J. Clin. Pathology*., 28: 56.

Reeves PG; Nielson FH and Fahey GC (1993): 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. *J. Nutr*., 123: 1939-1951.

Snedecor GW and Cochran WG (1980): Statistical methods 7th ed., Iowa State Univ. Press, Ames Iowa, USA, Hard Cover: 507 p.

Saha R and Dunkwal V (2009): Development and nutria-national analysis of value-added spread instant mix. *J. Human Ecol*., 28(3): 187-190.

Santos J; Herrero M; Mendiola JA; Oliva-Teles MT; Ibannez E; Delerue-Matos C and Oliveira MBPP (2014): Assessment of nutritional and metabolic profiles of pea shoots: The new read to eat baby leaf vegetable. *Food Res. Int*., 58: 105-111.

Santos-Silva J; Ortiz-Weyrich D; García LGC; Ramíez-Asquieri E; Salamoni-Becker F and Damian C (2020): Effect of drying on nutritional compo-sition, antioxidant capacity and bioactive compounds of fruits co-products. *Food Science and Technology*. In press. http: // dx. doi. org /10.1590/fst.21419.

Schermer S (1967): The Blood Morphology of Laboratory Animal. Long-mans, Printed in Great Britain, Green and Co. Ltd., pp.350.

Shanmugam V; Wang YW; Tsednee M; Karunakaran K and Yeh KC (2015): Glutathione plays an essential role in nitric oxide-mediated iron-deficiency signaling and iron-deficiency tolerance in Arabi-dopsis. *Plant J.,* 84: 464–477.

Singleton VL and Rossi JA (1965): Colorimetry of total phenolics with phosphor-molybdic-phospho-tungstic acid reagents. *Am. J. Ecol. Viticult*., 16:144-158.

Sun VI; Larry W; Oberely A and Ving V (1988): A simple method for clinical assay of superoxide dism-utase. *Clin. Chem*., 34 (3):497-500.

Thavarajah D; Thavarajah P; Wejesuriya A; Rutzke M; Glahn RP; Combs GF and Vandenberg A (2011): The potential of lentil *(Lens culinaris L.)* as a whole food for increased selenium, iron, and zinc intake: Preliminary results from a 3-year study. *Euphytica*.,180 :123–128.

Troszynska A and Ciska E (2002): Phenolic compounds of seed coats of white and colored varieties of pea (Pisum sativum L.) and their total antioxidant activity. *Czech J. Food Sci*.,20:15–22.

Thomas L (1992): Labor and diagnose, 4 th Ed. Marburg: Die Medizinischi Verlag-sgesells chat.

Tietz NW (1995): Clinical Guide to Laboratory Tests, 3rd Ed. Philadelphia; W.B. Saunders

Trinder P (1969): Glucose. *Ann. Clin. Biochem*., (62):24-33.

Troszynska A; Estrella I; Lamparski G; Hernndez T; Amarowicz R; Pegg RB; Troszyńska A; Estrella I; Lamparski G and Hernández T (2011): Relationship between the sensory quality of lentil (*Lens culinaris*) sprouts and their phenolic constituents. *Food Res. Int*.,44:3195–3201.

Wang J; Shimada M; Kato Y; Kusada M and Nagaoka S (2015): Cholesterol-lowering effect of rice bran protein containing bile acid-binding proteins. *Bioscience, Biotechnology, and Bio-chemistry* 79(3): 456 – 461.

Weichsel-Baum CTE (1964): An accurate and rapid method for the determination of protein in small amounts of blood serum and plasma. *Amer. J. Clin. Path.*, 16:40.

Wieca M and Dziki D (2015): Improvement in sprouted wheat flour functionality: Effect of time, temperature and elicitation. Int. J. Food Sci. Technol.,50:2135–2142.

Xu B and Chang SK (2010): Phenolic substance characterization and chemical and cell-based antioxidant activities of 11 lentils grown in the Northern United States. *J. Agric. Food Chem.*,58:1509–1517.

Xu M; Jin Z; Simsek S; Hall C; Rao J; Chen BE (2019): Effect of germination on the chemical composition, thermal, pasting, and moisture sorption properties of flours from chickpea, lentil, and yellow pea. Food Chem.,295: 579–587.

Xu ZJ; Fan JG; Ding XD; Qiao L and Wang GL (2010): Characterization of high-fat, diet-induced, non-alcoholic steatohepatitis with fibrosis in rats. Dig. Dis. Sci. 2010; 5:931–940.

Young D (1975): Effects of drugs on clinical laboratory tests. *Pestaner, L. Clin. Chem.,* 21: 5, 1D-432D.

Zhao Y (2001): Antioxid Redox Signal. In WWW. Cell Technology. Com., 3-375.

Table (1): Nutrient contents per 100g of pea and lentil sprouts powder

Constituents	Pea sprouts	Lentil sprouts
Moisture (g)	10.09±2.34 [a]	**9.34±0.34 [b]**
Protein (g)	25.77±4.23 [b]	**27.71±3.57 [a]**
Fat (g)	3.91±0.26 [a]	**0.64±0.02[b]**
Ash (g)	6.95±0.94 [a]	**2.68±0.44[b]**
Fiber (g)	7.86±0.63 [a]	**5.27±0.31 [b]**
Carbohydrates (g)	45.42±3.96 [b]	**54.64±7.92 [a]**
Energy value (Kcal /100 g)	319.95±9.34 [b]	**335.16±10.82 [a]**
Calcium (Ca) (mg)	150.56±6.75[a]	**21.98±6.01[b]**
Iron (Fe) (mg)	3.76±0.54[a]	**2.34±0.34[b]**
Potassium (K) (mg)	234.56±10.43[b]	**244.76±11.05[a]**
Sodium (Na) (mg)	19.78±1.23[a]	**8.5±1.22[b]**
Zinc (Zn) (mg)	1.11±0.08[b]	**1.23±0.54[a]**
Vitamin C (mg)	30.85±3.42[a]	**23.54±1.44[b]**
Provitamin A (mcg)	**178.54±9.76[a]**	**19.78±2.41[b]**

Values are means ± SD (n = 3). Values bearing superscripts at the same row are significantly different at $p \leq 0.05$.

Table (2): Total phenolic, flavonoid contents and antioxidant activity (DPPH) of pea and lentil sprouts powder

Content	Lentil sprouts	Pea sprouts
Total phenols (mg/kg)	107.5±13.05 [b]	646.88±14.16[a]
Total flavonoid (mg/kg)	45.9±6.93 [b]	83.9±4.23 [a]
Antioxidant activity DPPH mg TE/100 g dry matter	38.92±8.45 [b]	74.58±5.99 [a]

Values are means ± SD (n = 3). Values bearing superscripts at the same row are significantly different at $p \leq 0.05$.

Table (3): Body weight gain, feed efficiency ratio, and feed intake of fatty liver rats were affected by 5 and 10 % from lentil and pea sprouts (Mean ± SD).

Parameters	Negative control	Positive control	Fatty liver rats with 5% lentil sprouts	Fatty liver rats with 10% lentil sprouts	Fatty liver rats with 5% pea sprouts	Fatty liver rats with 10% pea sprouts	LSD
Body weight gain (BWG) /28d	35.24^{d}± 3.11	60.18^{a}± 4.21	52.21^{b}±3.43	42.40^{c}± 4.34	50.18^{b}±6.29	40.08^{c} ±8.77	**7.34**
Feed intake/day	13.22^{d}±2.33	19.12^{a}±3.21	18.15^{b} ± 2.39	15.90^{c} ± 4.16	17.80^{b}± 2.74	15.01^{c} ±2.98	**0.96**
Feed efficiency ratio (FER)	**0.095^{c}±0.00**	**0.112 ±0.04**	**0.103^{b} ±0.01**	**0.095^{c} ±0.03**	**0.101^{b}±0.02**	**0.095^{c} ±0.06**	**0.002**

Values are means ± SD (n = 6). Values bearing superscripts at the same row are significantly different at $p \leq 0.05$.

Table (4): Liver and brain weights of fatty liver rats were affected by 5 and 10 % from lentil and pea sprouts (Mean ± SD).

Parameters	Negative control	Positive control	Fatty liver rats with 5% lentil sprouts	Fatty liver rats with 10% lentil sprouts	Fatty liver rats with 5% pea sprouts	Fatty liver rats with 10% pea sprouts	LSD
Brain (g)	0.73^{d}±0.004	1.09^{a}±0.17	0.99^{b}±0.048	0.89^{c} ±0.02	0.95^{b}±0.08	0.83^{c}±0.07	**0.07**
Liver(g)	**4.96^{c}±0.71**	**6.87^{a}±0.58**	**6.12^{b}±0.42**	**5.44^{c}±0.52**	**6.07^{b}±0.32**	**5.11^{c}±0.72**	**0.62**

Values are means ± SD (n = 6). Values bearing superscripts at the same row are significantly different at $p \leq 0.05$.

Table (5): Total protein, albumin, globulin, and albumin/globulin ratio of fatty liver rats were affected by 5 and 10 % from lentil and pea sprouts (Mean ± SD).

Parameters	Negative control	Positive control	Fatty liver rats with 5% lentil sprouts	Fatty liver rats with 10% lentil sprouts	Fatty liver rats with 5% pea sprouts	Fatty liver rats with 10% pea sprouts	LSD
Total protein(g/dl)	8.50 ^{a}±0.06	5.27^{e}±0.06	6.32^{d}±0.04	7.47^{c}±0.05	7.07 ^{c} ±0.06	8.02 ^{b} ±0.06	**0.40**
Albumin (g/dl)	5.29^{a}±0.43	3.70^{e}±0.16	4.11^{d}±0.26	4.60^{c}±0.15	4.45^{c}±0.26	4.93^{b}±0.15	**0.28**
Globulin(g/dl)	3.21^{a}±0.55	1.57^{c}±0.12	2.21^{b}±0.31	2.87^{a}±0.05	2.62^{b}±0.66	3.09^{a}±0.49	**0.45**
Albumin /globulin	**1.65 ^{c}±0.12**	**2.36 ^{a}±0.12**	**1.86 ^{b}±0.12**	**1.60 ^{c}±0.12**	**1.70 ^{b} ±0.12**	**1.60 ^{c} ±0.12**	**0.17**

Values are means ± SD (n = 6). Values bearing superscripts at the same row are significantly different at $p \leq 0.05$.

Table (6): Liver enzymes of fatty liver rats were affected **by 5 and 10 % from lentil and pea sprouts (Mean ± SD).**

Parameters	Negative control	Positive control	Fatty liver rats with 5% lentil sprouts	Fatty liver rats with 10% lentil sprouts	Fatty liver rats with 5% pea sprouts	Fatty liver rats with 10% pea sprouts	LSD
AST (U/L)	37.76^{d}±2.23	77.32^{a}±4.97	67.76^{b}±3.33	56.31^{c}±2.84	62.19^{b}±4.31	53.89^{c}±4.17	**5.99**
ALT (U/L)	35.89^{d}±4.12	64.10^{a}±5.49	58.90^{b}±1.5	49.05^{c}±1.78	54.95^{b}±2.03	48.04^{c}±3.04	**6.21**
AST/ALT	1.05^{d}±0.01	1.21^{a}±0.01	1.15^{b}±0.01	1.14^{b}±0.01	1.13^{c}±0.01	1.12^{c}±0.01	**0.01**
ALP (U/L)	**184.11^{e}±4.12**	**226.77^{a}±3.09**	**219.43^{b}±3.45**	**206.06^{c}±4.20**	**214.39^{b}±2.37**	**199.19^{d}±4.80**	**6.54**

Values are means ± SD (n = 6). Values bearing superscripts at the same row are significantly different at $p \leq 0.05$.

Table (7): Renal functions of fatty liver rats were affected **by 5 and 10 % from lentil and pea sprouts** (**Mean ± SD).**

Parameters	Negative control	Positive control	Fatty liver rats with 5% lentil sprouts	Fatty liver rats with 10% lentil sprouts	Fatty liver rats with 5% pea sprouts	Fatty liver rats with 10% pea sprouts	LSD
Uric acid (mg/dl)	3.69^{d}±0.12	5.50^{a}±0.58	4.90^{b}±0.74	4.19^{c}±0.03	4.74^{b}±0.34	4.03^{c}±0.78	**0.34**
Urea (mg/dl)	25.61^{d}±2.43	44.23^{a}±2.42	38.42^{b}±2.12	32.04^{c}±1.00	38.01^{b}±2.05	31.01^{c}±1.07	**3.22**
Creatinine (mg/dl)	**0.64^{d}±0.02**	**1.30^{a}±0.13**	**1.19^{b}±0.14**	**0.98^{c}±0.05**	**1.11^{b}±0.04**	**0.91^{c}±0.25**	**0.09**

Values are means ± SD (n = 6). Values bearing superscripts at the same row are significantly different at $p \leq 0.05$.

Table (8): Blood glucose and insulin hormone of fatty liver rats were affected by **5 and 10 % from lentil and pea sprouts** (**Mean ± SD).**

Parameters	Negative control	Positive control	Fatty liver rats with 5% lentil sprouts	Fatty liver rats with 10% lentil sprouts	Fatty liver rats with 5% pea sprouts	Fatty liver rats with 10% pea sprouts	LSD
Blood glucose (mg/dl)	80.00^{e}±2.00	137.00^{a}±2.00	115.00^{b}±2.00	89.20^{d}±2.00	107.00^{c}±2.00	82.01^{e}±2.00	**6.63**
Insulin hormones (IU/ml)	**19.03^{a}±2.00**	**7.11^{d}±2.00**	**13.22^{c}±2.00**	**17.27^{b}±2.00**	**14.21^{c}±2.00**	**18.53^{a}±2.00**	**1.01**

Values are means ± SD (n = 6). Values bearing superscripts at the same row are significantly different at $p \leq 0.05$.

Table (9): The serum lipid profile of fatty liver rats was affected **by 5 and 10 % from lentil and pea sprouts** (**Mean ± SD).**

Parameters	**Negative control**	**Positive control**	**Fatty liver rats with 5% lentil sprouts**	**Fatty liver rats with 10% lentil sprouts**	**Fatty liver rats with 5% pea sprouts**	**Fatty liver rats with 10% pea sprouts**	**LSD**
Total cholesterol (mg/dl)	$118.56^{d}\pm2.54$	$214.33^{a}\pm1.09$	$204.45^{b}\pm1.17$	$195.87^{c}\pm2.59$	$200.12^{b}\pm1.38$	$189.54^{c}\pm2.11$	**7.88**
Triglycerides (mg/dl)	$115.23^{d}\pm2.58$	$177.54^{a}\pm1.05$	$170.09^{b}\pm2.83$	$161.67^{c}\pm3.06$	$167.43^{b}\pm$4,.61	$158.54^{c}\pm4.29$	**5.34**
HDL-c (mg/dl)	$55.11^{a}\pm2.00$	$40.61^{d}\pm1.00$	$45.69^{c}\pm1.00$	$50.06^{b}\pm2.00$	$48.03^{b}\pm1.00$	$53.44^{a}\pm2.00$	**2.21**
VLDL-c (mg/dl)	$23.05^{d}\pm0.46$	$35.51^{a}\pm0.28$	$34.02^{a}\pm0.86$	$32.33^{c}\pm0.43$	$33.49^{b}\pm2.04$	$31.71^{c}\pm1.92$	**1.86**
LDL-c (mg/dl)	**$40.40^{d}\pm0.49$**	**$138.21^{a}\pm5.99$**	**$124.74^{b}\pm2.45$**	**$113.48^{c}\pm3.31$**	**$118.6^{b}\pm4.38$**	**$104.39^{c}\pm3.56$**	**9.32**

Values are means ± SD (n = 6). Values bearing superscripts at the same row are significantly different at $p \leq 0.05$.

Table (10): Butyrylcholinesterase; lactate dehydrogenase activity and malondialdehyde of fatty liver rats were affected **by 5 and 10 % from lentil and pea sprouts (Mean ± SD).**

Parameters	**Negative control**	**Positive control**	**Fatty liver rats with 5% lentil sprouts**	**Fatty liver rats with 10% lentil sprouts**	**Fatty liver rats with 5% pea sprouts**	**Fatty liver rats with 10% pea sprouts**	**LSD**
Butyryl Cholinesterase U/mL	$18.45^{a}\pm1.09$	$8.93^{e}\pm0.43$	$11.73^{d}\pm1.54$	$14.53^{c}\pm3.43$	$12.53^{d}\pm2.69$	$16.32^{b}\pm1.09$	**1.34**
Lactate dehydrogenase (IU/L)	$107.54^{f}\pm5.76$	$197.43^{a}\pm5.85$	$177.08^{b}\pm7.07$	$152.43^{d}\pm7.57$	$165.54^{c}\pm8.44$	$139.43^{e}\pm5.85$	**8.67**
Malondialdehyde (µmol)	**$0.93^{f}\pm1.170$**	**$9.33^{a}\pm1.170$**	**$7.34^{b}\pm0.93$**	**5.16. $^{d}\pm0.08$**	**$6.26^{c}\pm0.080$**	**$4.05^{e}\pm1.170$**	**1.07**

Values are means ± SD (n = 6). Values bearing superscripts at the same row are significantly different at $p \leq 0.05$.

Table (11): Serum glutathione- S-transferase, glutathione peroxidase, superoxide dismutase, and catalase of fatty liver rats were affected **by 5 and 10 % from lentil and pea sprouts** (**Mean ± SD).**

Parameters	Negative control	Positive control	Fatty liver rats with 5% lentil sprouts	Fatty liver rats with 10% lentil sprouts	Fatty liver rats with 5% pea sprouts	Fatty liver rats with 10% pea sprouts	LSD
glutathion-S-transferase (U/L)	$112.67^{a} \pm 3.88$	$60.36^{e} \pm 3.49$	$73.38^{d} \pm 7.26$	$84.68^{c} \pm 8.31$	$81.81^{c} \pm 4.93$	$94.81^{b} \pm 4.93$	**6.47**
Glutathion peroxydase (U/ml)	$1.19^{a} \pm 0.65$	$0.77^{d} \pm 0.07$	$0.82^{c} \pm 0.01$	$0.97^{b} \pm 0.11$	$0.90^{c} \pm 0.33$	$1.01^{b} \pm 0.14$	**0.08**
Superoxide dismutase (U/ml)	$109.50^{a} \pm 1.33$	$81.65^{d} \pm 2.13$	$89.65^{c} \pm 5.72$	$97.67^{b} \pm 3.98$	$94.65^{b} \pm 5.05$	$104.65^{a} \pm 5.05$	**6.98**
Catalase (U/ml)	$\mathbf{157.87^{a} \pm 6.82}$	$\mathbf{101.93^{e} \pm 7.58}$	$\mathbf{110.62^{d} \pm 8.66}$	$\mathbf{120.05^{c} \pm 6.94}$	$\mathbf{115.85^{c} \pm 9.36}$	$\mathbf{128.85^{b} \pm 9.36}$	**7.82**

Values are means ± SD (n = 6). Values bearing superscripts at the same row are significantly different at $p \leq 0.05$.

التأثير البيولوجي والكيميائي الحيوي لبراعم البازلاء الخضراء والعدس على الجرذان المصابة بالكبد الدهني

عبد الناصر عبد العاطي جاد الله 1،عليه عاطف فتح الله عطيه2، ميمونه عبد الواحد الخليفه2 وعادل عبدالرسول عبدالوهاب بدر3
1- استاذ الطب الباطني- كلية الطب – جامعة المنوفية
2- زميل مدرس التغذيه العلاجيه معهد الكبد القومي- جامعة المنوفية
3-زميل مدرس التغذيه مستشفى جامعة المنوفيه

الملخص العربي

يعد الكبد الدهني أحد أكثر أمراض الكبد المزمنة انتشارًا ، وغالبًا ما يكون مصحوبًا باضطرابات أيضية أخرى مثل السمنة ومقاومة الأنسولين وارتفاع ضغط الدم وخلل الدهون في الدم وضعف التمثيل الغذائي للدهون وارتفاع مخاطر الإصابة بأمراض القلب والأوعية الدموية. تعتبر البراعم مصدرًا رائعًا لمضادات الأكسدة والأحماض الأمينية الضرورية ومجموعة متنوعة من الفيتامينات والمعادن. في هذه الدراسة ، تم توظيف 30 جرذًا ألبينو. تم تقسيمهم إلى 6 مجموعات ؛ المجموعة الأولى كانت بمثابة مجموعة ضابطة سلبية وتم تغذيتها على نظام غذائي قياسي ، بينما تم تزويد المجموعات الأخرى بنظام غذائي عالي الدهون لتحفيز الكبد الدهني. قسمت الجرذان المتبقية إلى أربع مجموعات وتغذيت على 5 و 10٪ من العدس والبازلاء لمدة 28 يوم. كان أحدهم لا يزال يعاني من الكبد الدهني وكان يتبع نظامًا غذائيًا أساسيًا كمجموعة ضابطة إيجابية. التركيب الكيميائي ومحتوى الفينول والفلافونويد الكلي لبراعم البازلاء والعدس. بالإضافة إلى ذلك ، تم إجراء تقديرات لزيادة وزن الجسم (BWG) ، وتناول العلف (FI) ، ونسبة كفاءة التغذية (FER) ، ووظائف الكلى والكبد ، ومستويات السكر في الدم ، وهرمونات الأنسولين ، ومستويات بيروكسيد الدهون (MDA) ، و إنزيمات مضادات الأكسدة. أظهرت النتائج أنه بالمقارنة مع براعم العدس ، كان لبراعم البازلاء تأثير إيجابي أكبر على المعايير التي تم فحصها. كان مستوى 10٪ أعلى بشكل ملحوظ من قيمة 5٪. لذلك ، فإن براعم البازلاء والعدس هي أكثر العوامل الموصوفة على نطاق واسع والأكثر فاعلية لتحسين الكبد الدهني.

الكلمات المفتاحية: *البراعم-الكبد عالى الدهون-انزيمات الكبد- المالونالدهيد*