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ABSTRACT

Obesity is a problem of energy balance that is primarily regarded as a lipid metabolism disorder. The purpose of this study was to determine the effect of intermittent fasting and matcha powder at different levels on obese male albino rats. Fifty male white albino rats were divided into 10 groups. Each group had five rats; male intermittent fasting was done and matcha powder powdered blends were given to the main diet; One was kept as a control group, while the other nine were fed a high-fat (20% fat in the form of animal fat) to produce obese rats. Obesity occurred after 21 days, and samples were tested for biochemical markers 28 days after the experiment was finished, glucose, lipid, liver and kidney functions, were determined. The effect of intermittent fasting and matcha powder on obesity. The study found that intermittent fasting and matcha powder significantly improve health and treat obesity. The group8 (intermittent fasting for 24 hours followed by a 24 hour diner and matcha (5%) had the highest treatment of lipid profile, but the best group of serum glucose, liver and kidney functions, (intermittent fasting for 24 hours followed by a 1-hour diner and matcha 5%).This study found that intermittent fasting and matcha powder could be a promising treatment for obesity.

Key words: obesity, matcha, glucose, lipid, liver, kidney functions

INTRODUCTION

Obesity is a rapidly growing global public health concern. Obesity is considered a nationwide pandemic, affecting one in every three adults and one in every six children in the United States of America. **(Finucane *et al.*, 2011).** Several countries throughout the world have seen a twofold or triple increase in the prevalence of obesity over the previous three decades , most likely as a result of urbanisation, sedentary lifestyles, and increased intake of high-calorie processed foods **(Flegal *et al.*, 2009).**Obesity is a global health issue that affects individuals of all ages, genders, and socioeconomic backgrounds. It is associated with various health risks and can increase the likelihood of developing several chronic conditions (**Xihua and Hong, 2021).** Type 2 Diabetes: Obesity is strongly linked to insulin resistance, a condition where the body's cells become less responsive to insulin, leading to high blood sugar levels and an increased risk of developing diabetes. **(Yohannes, 2020).** Cardiovascular Diseases: Excessive body weight puts strain on the heart, leading to an increased risk of hypertension (high blood pressure), coronary artery disease, heart attacks, and strokes. Respiratory Problems: Obesity can cause respiratory issues such as sleep apnea, which is characterized by interrupted breathing during sleep. It can also lead to asthma and other respiratory conditions **(Ota , 2014).** Joint Problems: Excess weight puts stress on the joints, especially in the knees and hips, leading to conditions such as osteoarthritis and joint pain **(Keramat *et al.*, 2021).** Certain Cancers: Obesity has been linked to an increased risk of developing various types of cancer, including breast, colon, pancreatic, and kidney cancers **(Sukanya *et al.*, 2023).** The primary causes of obesity are an imbalance between calorie intake and expenditure, influenced by factors such as genetics, environment, lifestyle choices, and socioeconomic status. Poor dietary habits, a lack of physical activity, sedentary lifestyles, and consuming high-calorie processed foods contribute to weight gain **(Al Kibria, 2019).** Intermittent fasting (IF) is indeed a nutritional intervention that focuses on the timing of meals rather than specific food restrictions. It involves cycling between periods of fasting and eating, which can vary in duration and frequency depending on the specific fasting protocol followed **(Kristin *et al*., 2021).** Intermittent fasting is practised in many common ways. One such strategy is the 16/8 method, which involves cutting meals to an 8-hour window each day after 16 hours of fasting, alternate-day fasting (alternating between fasting days and normal eating days), and the 5:2 method (eating normally for five days of the week and restricting calorie intake on two non-consecutive days) **(Dong *et al*., 2020).** The main principle behind intermittent fasting is to extend the period of time between meals, which can lead to various physiological changes in the body. During the fasting period, the body depletes its glycogen stores and starts utilizing stored fat for energy. This may result in decreased body weight and improved blood lipid profiles and insulin sensitivity, two metabolic health indicators **Razzak and Naz, 2017.** The same authors reported that intermittent fasting is not a magic solution for weight loss or overall health. It should be approached with caution and personalized to individual needs and preferences. It may not be suitable for everyone, particularly those with certain medical conditions or those who have a history of disordered eating. As with any dietary intervention, it's advisable to consult with a healthcare professional or registered dietitian before starting intermittent fasting to ensure it is appropriate for you and to receive guidance on how to implement it effectively and safely. Matcha is a powdered form of the Tencha cultivar of Japanese green tea (Camellia sinensis**) (Horie *et al*., 2017)**

and (Schroder *et al.*, 2019), The popularity of the beverage has grown all over the world **(Schroder *et al.*, 2019).** As a result of its unique production process, it is particularly high in antioxidant chemicals **(Sano *et al.*, 2018)**. The traditional approach involves covering the tea bushes with bamboo mats for the majority of the growth time to protect the leaves from direct sunlight **(Farooq and Sehga, 2018).** During this process, plants can produce additional amino acids and healthy compounds like theanine and chlorophyll, which give matcha its unique, non-bitter flavour and vibrant colour. As a result, matcha is regarded as the most aromatic green tea and is well acknowledged for its extraordinary quality **(Horie *et al.*, 2017).** Matcha tea contains almost all of the components of tea leaves, both their water-soluble and water-insoluble elements. The most noticeable way that matcha and other green teas differ from one another is this. Matcha is thought to have more potential health benefits than other green teas these days. However, to date, little is known regarding the functions of matcha's water-insoluble constituents. **(Cabrera *et al.*, 2005)**. Green tea's health benefits are believed to be attributed to natural antioxidants such polyphenols, a broad family of chemicals that can account for up to 30% of the dry weight of green tea. **(Komes *et al.*, 2010).** Antioxidant qualities of polyphenols are similar to those of carotene, tocopherol, and vitamins C and E. The amount of health-promoting active compounds in tea beverages varies depending on the type of tea, the amount of tea leaves per serving, the brewing temperature, and the brewing time. **(Koch *et al.*, 2017).** Matcha, a powdered green tea from Japan, is strong in antioxidant and anti-inflammatory chemicals.Because of its high catechin concentration, it offers promising potential health benefits. If ingested on a regular basis, it may improve the body's efforts to maintain health and avoid illness **(Kochman *et al.*, 2021).** EGCG

(Epigallocatechin-3-gallate) is a major catechin in green tea. Its high antioxidant content could be a factor in the health advantages of drinking tea. Additionally, EGCG is utilised as a chemopreventive medication to treat obesity, cardiovascular disease, and cancer **(Zheng *et al.*, 2004).** It has been shown that green tea and its catechins, particularly EGCG, lower blood lipid levels, adipose tissue, and body weight. **(Wolfram *et al.*, 2005).** Among EGCG's methods of action are modifications to the function of intestinal, muscle, liver, and adipose cells. **(WHO, 2001)**. A reduction in calorie intake, **(Henao *et al.*, 2012)** an increase in energy expenditure, and **(Singla *et al.*, 2010)** alterations in fat, liver, muscle, and intestinal cell activity **(Liao *et al.*, 2001).** The aim of this study is to assess the impact of matcha powder dietary supplements and intermittent fasting on obesity in male albino rats.

Materials and Methods

Materials

Matcha tea (Camellia sinensis) was obtained from Shibin El Kom City, Menoufia Governorate, Egypt.Casein, cellulose, choline chloride powder, and DL- methionine powder were purchased from Morgan Co. in Cairo, Egypt. Fifty "50" normal Sprague Dawley rats (males) weighing 150±10 g were purchased from the Helwan farm, Ministry of Health's, Cairo, Egypt.

Methods

Chemical Composition

Total nitrogen and crude protein: According to **A.O.A.C. (2010)**, total nitrogen was evaluated using Marco Kjeldahl techniques, and crude protein was calculated as as T.N. X 6.25.

Fat content: The fat content was determined using the **A.O.A.C. (2010)** technique. The Soxhlet device was employed. The extraction was carried out for a total of 16 hours using n-hexane as the extraction solvent.

After charring, the ash content was determined using the method provided by the **A.O.A.C. (2010).** In a muffle furnace, the samples were heated to 525°C until they turned white or light grey ash. Crude fibre: Crude fibre was determined using **(Holst and Assoc 1982)** technique. The sample was subjected to 45 minutes of digestion in boiling 0.128 M sulfuric acid, followed by three rinses with distilled water and another digestion in boiling 0.223 M sulfuric acid.

Characterization of phenolic acid and antioxidants from matcha powder by HPLC:

Matcha was prepared for infusion. A conical flask containing 1.75 g of plant material was filled with 100.0 mL of distilled water at one of the following temperatures: 25 °C, 70 °C, 80 °C, or 90 °C, which are the most common for making plant infusions. The infusion-containing flask was sealed and spun for 30 minutes at 180 revolutions per minute (Brunswick model EXCELLA E24). The reduction potential of an infusion was determined using the Ferric Ion Reducing Antioxidant Power (FRAP) Method. Total reduction potential is determined by the FRAP method, which is dependent on the test sample's capacity to convert Fe3+ ions into Fe2+ ions. The FRAP unit is used to calculate the ability to reduce 1 mole of Fe3+ to Fe2+ **(Rehman *et al*., 2002 and Damiani *et al*., 2014).** The Agilent 8453UV was used to measure the absorbance at 593 nm. The values expressed as M Fe(II)/dm3 were computed. Every assay was performed three times. Calculating the Total Polyphenol Content (TPC) in an Infusion.To calculate the total polyphenol content (TPC), ISO 14502-1 and the Singleton **(Song *et al*., 2012)**. The Agilent 8453UV was used to measure the absorbance at 765 nm. All assays were carried out in triplicate. The outcomes. Total Flavonoids Content (TFC) Determination.

The total flavonoids content was determined using the procedures described by **(Horie *et al.*, 2017)**. The standard calibration curve was plotted using various rutin concentrations. TFC was computed as milligrammes of equivalent rutin per 1litre of freshly brewed Matcha tea. The Agilent 8453UV was used to measure the absorbance at 510 nm. Every assay was run in triplicate.

Determination of Vitamin C Content

was employed to measure the ascorbic acid concentration of the infusions quantitatively. The ascorbic acid solution's colour change in response to the 2.6-dichloroindophenol solution is used to determine the titration process.

Experimental design

Fifty males Sprague-Dawley rats weighed 150±10g were used in this experiment. The rats were kept in the Experimental Animals Department of the Physiology Laboratory at Menoufia University's Faculty of Home Economics Rats fed on basal diet for one week for adaptation. Obese rats were induced by being fed a high-fat diet (20% animal lipid) for four weeks **(AIn, 1993) .** Rats were divided into 10 groups based on basal diet, with Group 1 being a healthy, healthy male group fed a basal diet and represented (a control –ve group). Group (2) Obese animals fed on a basal diet only as a positive control group. Group (3): Obese models They fasted intermittently for 16 hours.Group (4): Obese models fasted intermittently for 16 hours and fed on a casein diet containing (5%) matcha tea Group (5): Obese models alternate-day fasting and the 5:2 method (eating normally for five days of the week and restricting calorie intake on two non-consecutive days). Group (6): Obese models alternate-day fasting and the 5:2 method (eating normally for five days of the week and restricting calorie intake on two non-consecutive days)and fed on a casein diet containing (5%) Matcha tea . Group (7): Obese models the sub-group can be made up of exciting 24 hours followed by a 24 hour dinner period by substituting daily fasting. Group (8): Obese models the sub-group can be made up of exciting 24 hours followed by a 24 hour dinner period by substituting daily fasting and fed on a casein diet containing (5%) Matcha tea.Then, Group (9) Obese models the sub-group can be made up of exciting 24 hours followed by a 1 hour dinner period by substituting daily fasting Group (10) Obese models the sub-group can be made up of exciting 24 hours followed by a 1 hour dinner period by substituting daily fasting and fed on a casein diet containing (5%) Matcha tea after 28 days of the diet used in each group, **Tietz (1995)** evaluated analyzes .

Blood was collected from the retroorbital vein after a 12-hour fast. The serum was extracted correctly from the blood samples and stored in a deep freezer until analysis. Blood samples were collected in dry, clean centrifuge glass tubes and allowed to coagulate in a 37°C water bath for 30 minutes. **Schermer (1967)** proposed a method for doing so.

Biochemical Analysis

The serum total cholesterol level was determined using the method proposed by **Thomas (1992)**, and the serum triglyceride level was determined using an enzymatic approach described by **(Young, 1975)** and (**Fossati and Prencipe, 1982)**. HDL-c (high-density lipoprotein cholesterol) was measured. **Friedewaid (1972), Grodon and Amer (1977), and Lee and Nieman (1996)** calculated very low-density lipoprotein cholesterol VLDL-c in milligrammes per deciliter using the following formula: VLDL-c(mg/dl) = Triglycerides / 5, whereas LDL-c (low-density lipoprotein cholesterol) was computed in mg/dl as follows by **Lee and Nieman (1996):** LDL-c (mg/dl) = Total cholesterol - (HDL-c + VLDL-c), Alanine aminotransferase (ALT) and Aspartate aminotransferase (AST), were measured using the **Reitman and Frankel (1957)** method. Enzymatic approaches, According to **Henry (1974)**, enzymatic methods were employed to quantify serum urea, uric acid, and creatinine. Enzymatic determination of plasma glucose was carried out calorimetrically according to **(Trinder, 1969).**

Statistical analysis

The SPSS programme was used to analyze the results that were collected. Results from the ANOVA test were compared between groups, and a significance level of $P<0.05$ was considered **(Sendcor and cochron, 1979).**

RESULTS AND DISCUSSION

Identification and Quantification of chemical composition of compounds in Matcha powder.

Data given in Table (1a) result showed that matcha contained Amino acid and Soluble saccharide (3.52 and 6.54%) with Polyphenol and Soluble protein was (9.70 and 0.03) in addition to Fiber and Ash (39.50 and 8.60%) whereas, fat, moisture and Total carbohydrates (0.86 ,6.95 and 24.3%) respectively, these results are agreement with those reported by **Ranjitha *et al.,(* 2018)**

Table (1a): Identification and Quantification of chemical composition compounds in Matcha powder .

Parameters	Quantity (%)
Amino acid	3.52
Soluble saccharide	6.54
Polyphenol	9.70
Soluble protein	0.03
Fiber	39.50
Ash	8.60
fat	0.86
moisture	6.95
Total carbohydrates	24.3

Identification and quantification of phenolic compounds in Matcha powder by HPLC.

Data given in Table (1b) indicate Using high-performance liquid chromatography, the active phenolic components of the generated Matcha powder were characterised. In this study, matcha powder contains a high concentration of phenolic chemicals. Chlorogenic acid and gallic acid were isolated from matcha.Gallic acid, ellagic acid, p-hydroxy benzoic acid, and caffeic acid **(Wang *et al.*, 2019)**.The highest quantities of phenolic compounds reported for chlorogenic acid and gallic acid were 4730 g/g and 421g/g, respectively, followed by p-hydroxybenzoic acid and caffeic acid at 245 g/g and gallic acid at 229g/g. 2005 (Thippeswamy and Naidu). Matcha extract also includes ellagic acid (377 g/g). The presence of phenolic acids like chlorogenic acid and gallic acid. **(Unno, *et al.*, 2018)** confirmed the presence of gallic acid, ellagic acid, p-hydroxybenzoic acid, and caffeic acid in Matcha. These acids have a greater antioxidant capacity than others.

Table (1b): Identification and quantification of Phenolic composition compounds in Matcha powder .

Parameters	Quantity µg/g
chlorogenic acid	4730
gallic acid	421
ellagic acid	377
p-hydroxybenzoic acid	245
caffeic acid	229

Data given in Table (1c) show the polyphenols, flavonoids, vitamin C, and antioxidant activity of matcha gathered at various times and utilised in infusions at various temperatures in this study. Polyphenol molecules are known to be extraordinarily potent antioxidants. They contain carotene and tocopherol, and they have a higher antioxidant impact than vitamins C and E, both of which can lower oxidative stress **(Białecka *et al.*, 2018)**. These substances were detected at high concentrations during this investigation. Matcha brewed at 90 °C for 10 minutes had the highest rutin content, while chlorophyll content was the lowest at 6.46 mg/L. These findings were consistent with those of previous researchers who discovered that, during a comparatively brief brewing period (5–10 minutes), the highest concentration of bioactive chemicals in Match infusions occurred at 80 °C. According to these findings, the optimum outcomes for extracting Matcha components are obtained while brewing for a short time at a high water temperature. **(Weng, 2012).** looked at the polyphenol content of several Matcha preparations. One of the highest polyphenol concentrations was found in matcha brewed at the highest temperature (100 °C) **(Unno *et al.*, 2018)**.

Table (1) c: Identification and quantification of Antioxidants in Matcha powder

Antioxidants	µg/g
rutin	**19614**
Quercetin	**19.2**
vitamin C	**1.99**
Caffeine	**55.4**
PolyphenolicAcids	**9.44**
Theanine	**9.55**
Catechins	**55.65**
Chlorophyll	**6.46**

Effect of intermittent fasting and matcha of Glucose level on obese male albino rats.

Table (2) shows the effect of different quantities of intermittent fasting and Matcha tea on the glucose levels of obese rats. The collected data suggested that the positive control group had a higher glucose level than the negative control group. Comparing all treated groups to the positive control group, serum glucose levels decreased significantly ($p \leq 0.05$ in all treated groups). The best results in serum glucose levels were obtained with intermittent fasting for 24 hours followed by a 1-hour dinner and matcha (5%); these treatments resulted in a considerable drop in these parameter when compared to the other treated groups. The results are consistent with those of **(Xu *et al.* 2015).** According to their findings, coronary artery disease (CAD) was detected in 63.2% of fasted individuals and 75.0% of fed patients. The meta-analysis found only minor changes in fasting and non-fasting glucose concentrations (108 vs. 115 mg/dl) and BMI (27.9 vs. 29.0, kg/m2). In conclusion, a prospective hypothesis test revealed that routine intermittent fasting was associated with a lower prevalence of Obesity in coronary angiography patients. A previously observed connection between fasting and lower CAD risk was also validated, as was an Association between fasting and hypoglycemia and BMI **(Horne *et al.*, 2012).**

Table (2) Effect of intermittent fasting and matcha on Glucose level on obese male albino rats.

Groups	Glucose level (mg/dl)
Control (-ve)	$99^{g} \pm 2.21$
Control (+ve)	$233^{a} \pm 2.65$
intermittent fasting for 16 hours	$228^{b} \pm 2.60$
intermittent fasting for 16 hours and matcha (5%)	$227.6^{b} \pm 2.68$
intermittent fasting for 2 days	$226^{b} \pm 2.16$
intermittent fasting for 2 days and matcha (5%)	$204.33^{c} \pm 2.52$
intermittent fasting for 24 hours followed by a 24-hour diner	$119^{d} \pm 1.58$
intermittent fasting for 24 hours followed by a 24 hour diner and matcha (5%)	$114^{e} \pm 1.34$
intermittent fasting for 24 hours followed by a 1 hour diner	$104.6^{f} \pm 2.65$
intermittent fasting for 24 hours followed by a 1-hour diner and matcha (5%)	$100^{g} \pm 2.64$
LSD (P≤ 0.05)	3.74

Each value is shown as as mean ± standard deviation, Mean in the same column with different superscript letters differ significantly (P≤ 0.05).

Table (3) illustrate effect of intermittent fasting and matcha on lipid profile level of obese male albino rats. Low-density lipoprotein cholesterol was highest in the positive control group, whereas the lowest were found in the negative control group, with significant differences (P≤0.05). Conversely, the highest levels of LDL-c were found in obese groups following a 16-hour intermittent fast and matcha (5%), whereas intermittent fasting for 24 hours followed by a 1 hour diner and (5%) matcha had the lowest, with significant differences (P≤0.05). Very low-density lipoprotein cholesterol (VLDL-c) levels can be said to be highest in the positive control group, whereas the group under negative control had the lowest, with significant differences (P≤0.05). Conversely, the obese groups with the highest VLDL-c levels were those with a 16-hour intermittent fast and 5% matcha tea. whereas 24 hours followed by a 1 hour diner and (5%) matcha had the lowest, with significant differences (P≤0.05). for the atherogenic index (AI), data indicated that The greatest VLDL-c values were found in the positive control group, while The group under negative control exhibited the lowest, with significant differences (P≤0.05). However, the highest AI levels were seen in obese groups after intermittent fasting (16 hours) and matcha tea (5%), 24 hours followed by a 1 hour diner and (5%) matcha. These findings correspond with that of **(Xu *et al.*, 2015)** They found that in both normal weight and overweight/obese individuals, green and intermittent fasting lowers LDL-cholesterol and TC but not HDL-cholesterol or triglycerides; nonetheless, more well planned research are required. Longer-term research with a wider range of populations is necessary. Green tea catechins have been found in both in vitro and animal studies to dramatically lower plasma triglycerides, total cholesterol (TC), and low-density lipoprotein (LDL) cholesterol **(Xing *et al.*, 2019)**.

There have been a few randomised controlled trials (RCTs) and meta-analyses. These results are analogous to those and to serum thiobarbituric acid-reactive compounds. Additionally, match supplementation decreased the expression of N(6)- (carboxylmethyl) lysine (CML), N(6)- (carboxylethyl) lysine (CEL), and RAGE in the kidneys while raising the expression of SREBP-2 in the liver but not SREBP-1. Matcha appears to protect against hepatic and renal damage by reducing the accumulation of AGE in the kidneys, lowering hepatic glucose, triglyceride, and total cholesterol levels, and functioning as an antioxidant According to research, green tea may be useful as a nephroprotective agent against diethyl nitrosamine (DEN) and ferric nitrilotriacetate (Fe-NTA)-induced nephrotoxicity in Wistar rats **(El-Desouky *et al.* 2019)**.The administration of 5% matcha led to a significant decrease in elevated cholesterol and triglyceride (TG) levels in the bloodstream. Matcha exhibited the most effective reduction and brought all other affected parameters back to nearly normal values. Matcha,is a high-grade green tea ground into a fine powder, contains catechins such as epicatechin, epicatechin gallate, epigallocatechin, and epigallocatechin gallate **(Huanget *et al.* 2017).** Previous findings reported that matcha, in its powdered form, reduced hyperlipidemia and fat accumulation in the blood of rats subjected to a matcha-based diet. This effect was attributed to matcha's ability to impede or decrease fat absorption. The results from our study align with previous research by **(Grgic Jozo *et al.*, 2018)** demonstrating an inverse correlation between matcha consumption and plasma cholesterol levels. Consequently, it is conceivable that matcha has the potential to modulate lipid metabolism, potentially by regulating lipid absorption.

Table (3): Effect of intermittent fasting and matcha on serum triglycerides , serum total cholesterol and lipid profile level on obese male albino rats

Groups mg/dl	Total cholesterol	Triglycerides	(HDL_{-C})	(LDL_{-C})	($VLDL_{-C}$)
Control (-ve)	61.33^{h} ±2.08	60.61^{i}± 2.02	58.00^{a}±1. 00	2.8^{f} ± 2.83	12.13^{i} ± 0.42
Control (+ve)	108^{c} ± 2.65	182.33^{a}±2.03	22.67^{g}±1.52	48.87^{a} ± 1.94	36.66^{a} ± 0.40
intermittent fasting for 16 hours	98^{e} ± 2.63	92.33^{f}±2.02	31.33^{f} ±1.15	48.2^{a} ± 2.91	18.47^{f} ± 0.33
intermittent fasting for 16 hours and matcha (5%)	75^{g} ± 1.00	77.0^{g}±1.00	36.0^{e} ±1.53	23.6^{a} ±5.44	15.4^{g} ±0.36
intermittent fasting for 2 days	88^{f} ± 1.03	90.33^{f}±1.50	41.0^{d} ±2.58	29.07^{cd} ±2.50	18.07^{f}±0.33
intermittent fasting for 2 days and matcha (5%)	111^{b}±2.20	162^{d}±2.00	45.0^{c}±2.60	33.6^{c}±3.22	32.4^{c}±0.44
intermittent fasting for 24 hours followed by a 24-hour diner	114^{a}. 0±1.00	102.33^{e}±1.53	51.67^{b}±1.50	41.78^{b}±2.47	20.42^{d}±0.53
intermittent fasting for 24 hours followed by a 24 hour diner and matcha (5%)	98^{h}±1.10	70.0^{h}±1.09	56.33^{a} ±1.67	2.33^{f} ±2.48	15.4^{g} ±0.36
intermittent fasting for 24 hours followed by a 1 hour diner	99.33^{e}±1.12	113^{d}±2.63	57.0^{a}±2.22	19.4^{e} ±3.42	22.6^{d}±0.53
intermittent fasting for 24 hours followed by a 1-hour diner and matcha (5%)	103.0^{d}±1.08	168^{b}±2.56	61.0^{a}±2.64	8.4^{f} ±3.33	33.6^{b}±0.55
LSD (P≤ 0.05)	2.99	3.26	2.843	3.54	0.652

Each value is shown as as mean ± standard deviation, Mean in the same column with different superscript letters differ significantly (P≤ 0.05).

Table (4) shows the effect of intermittent fasting and (5%) matcha tea powders on the levels of liver functions (AST and ALT enzymes) in obese rats. The positive control group clearly had the highest levels of AST liver enzyme, whereas the group under negative control had the lowest, with significant differences(P≤0.05) Conversely, with statistically significant differences (P≤05), the treatment groups (obesity groups) with the highest AST liver enzyme were identified following 16 hours of intermittent fasting and 5% matcha tea, whereas the 24-hour period had the lowest value, which was followed by a one-hour dinner and 5% respectively. The positive control group had the highest values of the ALP liver enzyme, while the negative control group had the lowest, with significant differences (P≤0.05), The treatment groups (obesity groups) with intermittent fasting for 16 hours and matcha tea (5%) tea had the highest ALP liver enzyme levels, while the lowest value was observed for 24 hours followed by a 1 hour diner and (5%) tea, (LFTs) are frequently used in clinical practise to assess the effects of potentially hepatotoxic medications, test for liver disease, and track the progression of known diseases. Supplementing with matcha tea dramatically lowered the risk of dyslipidemia, hepatic and visceral lipid buildup, high blood sugar, hepatitis steatosis, and impaired liver function. RNA sequencing analysis of genes that are differently expressed in the liver Administration of matcha increased the activity of cytidine dehydrogenase and decreased the activity of proteins linked to lipid droplets. **(Zhou *et al.*, 2021)** .

Table (4): Effect of intermittent fasting and matcha on liver functions level of obese male albino rats

Groups	AST (U/L)	ALT (U/L)
Control (-ve)	46.00^{h} ±2.74	56.67^{h}±2.08
Control (+ve)	99.33^{a} ±1.50	106^{a} ±4.36
intermittent fasting for 16 hours	97.33^{a}±2.08	104.00^{a} ±1.09
intermittent fasting for 16 hours and matcha (5%)	93.00^{b}±2.65	98.00^{b} ±1.00
intermittent fasting for 2 days	86.67^{c}±2.09	91.67^{c}±1.57
intermittent fasting for 2 days and matcha (5%)	78.0^{d} ±1. 00	83.00^{d} ±2.11
intermittent fasting for 24 hours followed by a 24-hour diner	70.67^{e} ±3.06	77.33^{e}±2.00
intermittent fasting for 24 hours followed by a 24 hour diner and matcha (5%)	60.0^{f}±2.00	72.67^{f}±2.52
intermittent fasting for 24 hours followed by a 1 hour diner	53.0^{g} ±2.00	67.33^{g} ±2.09
intermittent fasting for 24 hours	47.00^{h}±2.65	60.00^{h}±2.64

followed by a 1-hour diner and matcha (5%)		
LSD (P≤ 0.05)	**3.85**	**3.60**

Each value is shown as as mean ± standard deviation, Mean in the same column with different superscript letters differ significantly (P≤ 0.05).

Effect of intermittent fasting and matcha on kidney functions of obese male albino rats.

Table (5) shows the effects of intermittent fasting and (5%) matcha tea on renal functions including (serum urea, serum uric acid, and serum creatinine mg/dl) in obese rats. The data gathered revealed that with significant differences (P<0.05) in average measurements, the negative control group had the lowest serum urea level, whereas the positive control group had the highest. The group that had 16 hours of fasting and 5% matcha tea treatment had the highest serum urea value reported. with significant differences (P<0.05) as compared to the other treated groups, whereas the 24-hour period had the lowest value, which was followed by a one-hour lunch and 5% tea, respectively. According to the obtained data, The serum uric acid levels of the negative control group were the lowest, whereas those of the positive control group were the highest, with significant differences (P<0.05) treating obese groups with fasting for 16 hours, followed by fasting for 16 hours and 5% matcha tea had the highest blood uric acid levels in obese groups, whereas fasting for 24 hours followed by a 1 hour diner and 5% tea had the lowest, with significant differences (P<0.05). The gathered data demonstrated that the positive control group had the highest serum creatinine levels, while the negative control group had the lowest, with significant differences (P<0.05). Serum creatinine levels were highest in obese groups after a 16-hour fast and 5% matcha tea consumption, while a 24-hour fast, a one-hour meal, and 5% matcha tea had the lowest, with significant differences (P<0.05). These findings are in line with **(Yamabe *et al.*, 2009)** discovered that Matcha tea therapy led to a considerable reduction in serum thiobarbituric acid-reactive chemicals and kidney AGE levels. In addition, match supplementation increased hepatic SREBP-2 expression but not SREBP-1, while decreasing renal N (6)- (carboxylmethyl) lysine (CML), N(6)-(carboxylethyl) lysine (CEL), and RAGE expression. By reducing hepatic glucose, triglyceride, and total cholesterol levels and functioning as an antioxidant, matcha appears to offer protection against hepatic and renal damage. Additionally, green tea shows promise in protecting wistar rats against nephrotoxicity caused by ferric nitrilotriacetate (Fe-NTA) and diethyl nitrosamine (DEN), according to **(El-Desouky *et al.*, 2019)**. Consuming foods high in green tea is strongly advised to prevent kidney toxicity, particularly for people who work in factories, laboratories, or other environments where pollution and drug intoxication are common. **(Yamabe *et al.*, 2009).**

Table (5): Effect of intermittent fasting and matcha on kidney functions of obese male albino rats.

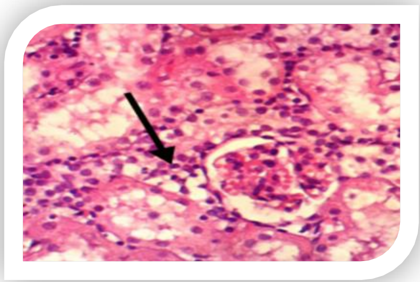
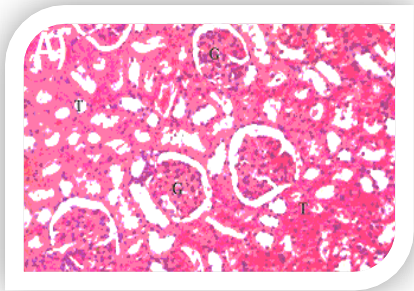
Groups	Creatinine (mg/dl)	Urea (mg/dl)	Uric acid (mg/dl)
Control (-ve)	0.63 [j] ±.026	60.33 [f] ±2.51	1.05[h] ±0.025
Control (+ve)	2.25 [a] ±0.28	106.67[a] ±2. 58	4.08 [a]±0.022
intermittent fasting for 16 hours	2.16 [b]±0.21	96.00 [b]±2.53	4.05 [a] ±0.026
intermittent fasting for 16 hours and matcha (5%)	2.04 [a] ±0.27	103.33 [c]±2.66	3.96[b]±0.24
intermittent fasting for 2 days	1.91[d] ±0.19	87.33[c]±2.65	3.69 [c]±0.03
intermittent fasting for 2 days and matcha (5%)	1.89 [e]±0.20	81.33 [d]±2.10	3.56 [d] ±0.022
intermittent fasting for 24 hours followed by a 24-hour diner	1.14[f]±0.33	63.00[f]±1.00	3.09[f]±0.02
intermittent fasting for 24 hours followed by a 24 hour diner and matcha (5%)	0.83 [h] ±0.18	73.0 [e]±2.73	3.24[e]±0.033

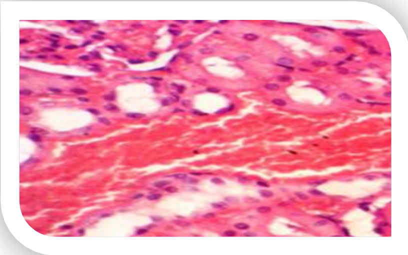
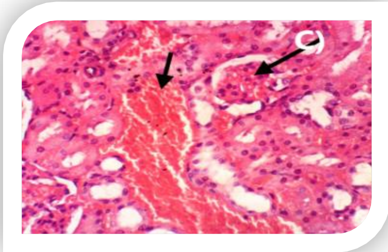
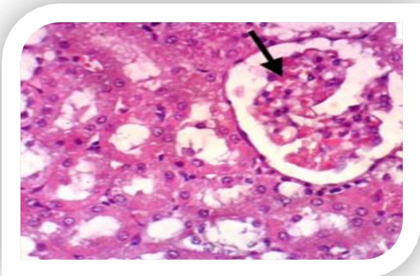
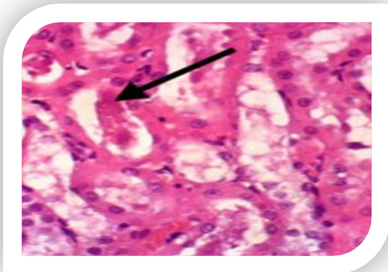
intermittent fasting for 24 hours followed by a 1 hour diner	**0.92^{g} ±0.31**	**70.67^{e} ±2.09**	**1.20^{g}±0.19**
intermittent fasting for 24 hours followed by a 1-hour diner and matcha (5%)	**0.7^{i} ±0.22**	**58.00^{g} ±1.55**	**$1.0 1^{i}$ ±0.01**
LSD (P≤ 0.05)	**0.037**	**0. 033**	**0.033**

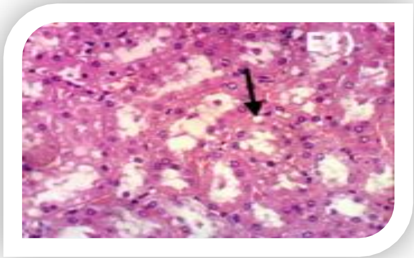
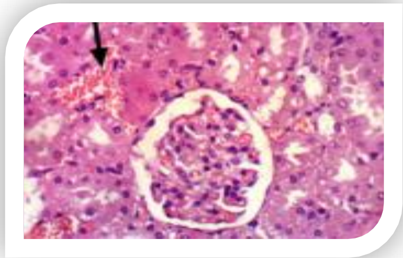
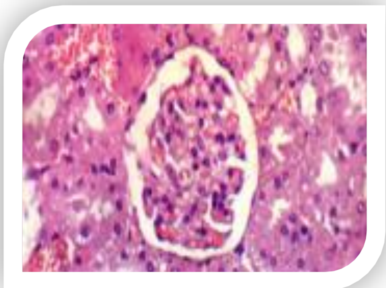
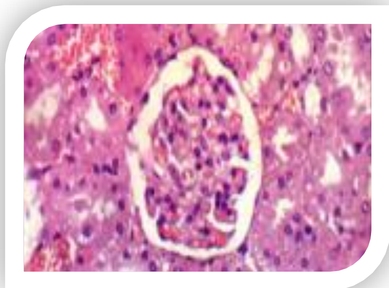
Each value is shown as as mean ± standard deviation, Mean in the same column with different superscript letters differ significantly (P≤ 0.05).

Histopathological Examinations of Kidneys:

Examination of kidney of normal group rats showing, the normal histological structure of renal parenchyma **Pho.(1).** Obese rats showed revealing proteinaceous aggregates in the lumen of renal tubules and infiltration of interstitial inflammatory cells **Pho.(2).** Meanwhile, group of rats which treated with intermittent fasting for 16 hours showing congestion of renal blood vessels and glomerular tuft **Pho.(3).** Kidneys of obese rats which treated with intermittent fasting for 16 hours (5%) and matcha showing the normal histological structure of renal parenchyma **Pho.(4).** Kidneys of obese rats which treated with intermittent fasting for 2 days showed congestion of renal blood vessel **Pho.(5).** Kidneys of obese rats which treated with intermittent fasting for 2 days and 5% matcha tea show swelling with mild denegation and necrosis of the renal tubular epithelium as well as few detached cells **Pho.(6).** Kidneys of obese rats which treated with intermittent fasting for 24 hours followed by a 24 hour diner showed vacuolation of epithelial lining renal tubules and congestion of glomerular Tuft . **Pho.(7).** Kidneys of obese rats which treated with intermittent fasting for 24 hours followed by a 24 hour diner and (5%) matcha showing vacuolization of renal tubule epithelial lining, thickening of Bowman's capsule, and cystic dilatation of renal tubules vessel **Pho.(8).** Kidneys of obese rats which treated with intermittent fasting for 24 hours followed by a 1 hour diner showed vacuolation of epithelial lining renal tubules and congestion of glomerular tuft **Pho.(9).** Kidneys of obese rats which treated with intermittent fasting for 24 hours followed by a 1 hour diner and (5%) matcha shown in the kidneys of the normal group rats **Pho.(10).**

 **Photo (2): Kidney of rat from group 2 showing revealing proteinaceous aggregates in the lumen of renal tubules and infiltration of interstitial inflammatory cells (H & E X400).**	 **Photo (1): Kidney of rat from group 1 demonstrating normal renal parenchyma histological structure (H & E X 400).**

 **Photo (4): Kidney of rat from group 4 showing showing the normal histologicalstructure of renal parenchyma (H & E X 400).**	 **Photo (3): Kidney of rat from group 3 showing congestion of renal blood vessels and glomerular tuft(H & E X 400).**
 **Photo (6): Kidney of rat from group 6 show swelling with mild denegation and necrosis of the renal tubular epithelium as well as few detached cells (H&EX400).**	 **Photo (5): Kidney of rat from group 5 showing showed congestion of renal blood vessel (H & E X 400)**

 **Photo (8): Kidney of rat from group 8 showing vacuolization of renal tubuleepithelial lining, thickening of Bowman's capsule, and cystic dilatation of renal tubules (H & E X 400).**	 **Photo (7): Kidney of rat from group 7 showing showed vacuolation of epithelial lining renal tubules and congestion of glomerular tuft (H & E X 400).**
 **Photo (10): Kidney of rat from group 7 showing shown in the kidneys of the normal group rats (H & E X 400).**	 **Photo (9): Kidney of rat from group 9 showing showed vacuolation of epithelial lining renal tubules and congestion of glomerular tuft (H & E X 400).**

CONCLUSION

The study reveals that intermittent fasting and matcha powder can effectively protect against obesity by lowering lipid profiles and glucose levels, and improving overall health by enhancing liver and kidney functions.

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دراسة تأثير الصيام المتقطع ومسحوق الماتشا على ذكور الفئران البيضاء المصابة بالسمنة

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الملخص العربى

السمنة هي مشكلة توازن الطاقة التي تعتبر في المقام الأول اضطراب التمثيل الغذائي للدهون. الغرض من هذه الدراسة هو تحديد تأثير الصيام المتقطع ومسحوق الماتشا بجرعات مختلفة على ذكور الفئران البيضاء المصابة بالسمنة. تم تقسيم 50 من ذكور الفئران البيضاء إلى 10 مجموعات (كان لكل مجموعة خمسة فئران ، ذكور تم إجراء الصيام المتقطع وتم إعطاء خلطات مسحوق ماتشا إلى النظام الغذائي الرئيسي ؛ تم الاحتفاظ بواحدة كمجموعة ضابطة ، بينما تم تغذية المجموعات التسعة الأخرى بمسحوق الماتشا. علينظام غذائي عالي الدهون (20٪ دهن على شكل دهن حيواني) لاحداث السمنه . تمت الاصابة بعد واحد وعشرين يومًا وتم اختبار العينات للعلامات البيوكيميائية بعد 28 يومًا من انتهاء التجربة ، الجلوكوز ، الدهون ، وظائف الكبد و تم تحديد وظائف الكلى وتأثير الصيام المتقطع ومسحوق الماتشا على السمنة وأظهرت النتائج أداء معنوي للصيام المتقطع ومسحوق الماتشا كعلاج للسمنة وكذلك تحسين الصحة . المجموعة 8 (الصيام المتقطع لمدة 24 ساعة تليها وجبة عشاء لمدة 24 ساعة وماتشا (5٪) لديها أعلى علاج لدهون الدم ، ولكن أفضل مجموعة في وظائف الكبد والكلى وجلوكوز الدم (صيام متقطع لمدة 24 ساعة تليها مجموعة عشاء لمدة ساعة وماتشا 5٪).، ووجدت هذه الدراسة أن الصيام المتقطع ومسحوق الماتشا يمكن أن يكون علاجًا واعدًا للسمنة.

الكلمات المفتاحية: ،السمنة، ماتشا ، الجلوكوز ، الدهون ، الكبد ، وظائف الكلى