

## Application of Specific Dynamic Action and Its Expected Impact on Weight Reduction in Rats

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### ABSTRACT

The effect of eating different levels of gelatin (5%, 10%, 15% and 20%) on the human weight using of white experiment animals (Sprague Dawley). Twenty five white male albino rats were divided into 5 groups (5 rats each group), all groups were fed for 28 days on experimental diet as follows. Control group was fed on standard diet. Other groups were fed experimental basal diet with different supplementation levels with gelatin (5%, 10%, 15%, and 20%), respectively. At the end of the experiment (4 weeks), blood samples were collected for determined the following biochemical parameters: liver functions [GOT and GPT], Kidney functions [creatinine, uric acid, and urea], CBC: hemoglobin, RBC, PLT, and WBC. The results showed that the body weight gain for control group increased levels of gelatin increased (5%, 10%, 15%) which recorded weight loss however, (20%) gelatin recorded the highest weight loss. Food efficiency ratio of control group recorded the least while, gelatin 10% recorded the highest. The liver function showed, regarding GPT recorded with highest value for group 20% gelatin and the lowest value was for control group. S.GOT the 20% gelatin was the highest value, while, lowest value was for control group. K kidney function showed that S. creatinine, recorded the highest value with group 20% gelatin while, the lowest value for group control S. urea recorded the highest value was for group 20% gelatin and, the lowest value was for control group u. acid which recorded the highest value recorded for group 20% gelatin and, the lowest value for control group (CBC), regarding Hb, recorded the highest value for group 20% and, the lowest value was for control group with ( $p \leq 0.01$ ). As for RBC, recorded the highest value for group 20% gelatin and the lowest value for control group with high significant differences at ( $p \leq 0.001$ ) for levels of gelatin (5%, 15% and 20%) with ( $p \leq 0.01$ ) for 5%. WBC recorded the highest value for group 20% gelatin and the lowest value for control group significant differences ( $p \leq 0.1$ ).

**Key words:** Specific dynamic action, weight reduction, Rats

### Introduction

Gelatin is one of the most widely used food ingredients and is one of the most a fat substitute that can be used to reduce the energy content of food without negative effects on the taste (Riaz and Chaudry, 2004 and Paddon-Jones *et al.*, 2008). Besides for the food industry, gelatin is also useful in medicine, pharmaceutical and photographic industries. Gelatin is a valuable protein derived from animal by-products which obtained through partial hydrolysis of collagen originated from cartilages, bones, tendons and skins of animals. It is a translucent brittle solid substance, colourless or slightly yellow, nearly tasteless and odourless (Gormez and Montero, 2005). Today, gelatin is usually available in granular powder form, although in Europe countries, sheet gelatin is still available (Choi and Regenstejn, 2000). Gelatin have efficiency of increasing energy expenditure for that is used for weight loss so it was used in this study as a tool for the treatment of obesity problem which obesity is increasing globally, with nearly half a billion of the World's population now considered to be overweight or obese (Rossner, 2002). The prevalence of obesity increases the likelihood of various diseases, particularly heart disease, type 2 diabetes, obstructive sleep apnea, certain types of cancer, and osteoarthritis was increasing globally, (Sanchez-Garcia, 2007). WHO standards reported that about 22 million children aged under 5 years are overweight globally. Obesity affects almost 10% of schoolchildren in industrialized countries and high rates are also emerging in some of the developing ones. About 30% of obese children become obese adults (IOTF, 2007). The increasing prevalence of childhood obesity throughout the past two decades has been emphasized with from 10 to 20% for men, and 10 to 25% for women (Kopelman, 2000). suggests that obesity was now so common within the world's population. Obesity was relatively common estimated in 1987, that 8% of men and 12% of women were obese, while 37% of men and 24% of women were overweight. In 1992, 42% of men and 28% of women were overweight, while 11% of men and 12% of women were obese. In 1992 self-reported prevalence of obesity (depending on age) was estimated at 2% to 6% for men and 4% to 15% for women (WHO, 2000).

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## Material and Methods

### Materials:

Casein, corn oil, vitamins mixture and minerals, were obtained from Morgan Co. Cairo, Egypt. Gelatin powder was purchased from local market at shebin El-kom Governorate.

### Methods:

#### Experimental design:

Twenty-five male albino rats, Sprague Dawley Strain, age 6 months and weight  $150 \pm 2g$ . The animals were classified in to 5 groups each group consists from five rats which obtained from Research Institute Ophthalmology Medical Analysis department and Experimental the rats were applied in Laboratory of the Faculty of Home Economics Menoufia University rats were kept in cages wire. The diet was introduction in special food cups to avoid scattering of food. Also, water was provided to the rats by glass tube through the wire case.

**Group 1:** (Control): Fed on basal diet.

**Group 2:** Fed on basal diet and supplement with 5% gelatin

**Group 3:** Fed on basal diet and supplement with 10 % gelatin.

**Group 4:** Fed on basal diet and supplement with 15 % gelatin.

**Group 5:** Fed on basal diet and supplement with 20 % gelatin.

During the experimental period, all rats were weighed and the consumed diets recorded every day. At the end of the experiment rats were fasted overnight (12 hours) and anesthetized with diethyl ether. Blood samples were collected into a dry clean centrifuge glass tubes. Serum was separated by centrifugation at 4000 r.p.m for 15 minutes at room temperature. Serum was carefully aspirated and transferred into clean quiet fit plastic tubes and kept frozen at  $(-20^{\circ}C)$  until analysis. Blood sample were collected in ethylene diamine tetra acetic acid (EDTA). The important internal organs (liver, kidney and intestines) fixed in neutral buffered which removed and washed in saline solution and fixed in neutral buffered formalin. Section (5 min) prepared and investigated by the light microscope (Humanso, 1962; Drury and Wallington, 1980 and Kiernan, 1981). Biological evaluation of the experimental diets were carried out by determination of initial weight, final weight, body weight gain (g) and feed intake (g). According to (Baker, 1958) using the following formulas.  
 $BWG = \text{Final weight} - \text{initial weight}$ .

$$\text{Relative organ weight} = \frac{\text{Organ weight}}{\text{Body weight}} \times 100$$

### Biochemical analysis:

Serum glutamic pyruvic transaminase (S.GPT), and serum glutamate oxalate transaminase (S.GOT) were determined according to the methods described by Henry, (1974), Young, (1975), Tietz, (1983, 1986) .

Serum creatinine, serum urea and serum measured acid were determined according to the methods described by Sox, (1986).

Blood analysis is included WBC count, Hb, RBC count, platelet count (PLC), carried out according to Jacobs *et al.*, (2001).

### Statistical Analysis:

Statistical analysis were performed by IBM-P-C computer hardware compact 1998, under Windows Microsoft Office 2010 using statistical package program for Social Science (SPSS, 2010). And compared with each other using the suitable test. All obtained results were tabulated and suitable recommendation was given.

## Results and Discussion

### A-Biological changes:

#### Final Body weight.

Data in table (1) showed (Mean  $\pm$  SD) among control fed on basal diet with gelatin (5 %, 10 %, 15 % and 20 %), over 28 days. Final body weight decreased for all groups after 28 day loss weight when compared with control, this slimming may due to a fat substitute. Gelatin is one of the most a fat substitute that can be used to reduce the energy content of food without negative effects on the taste (Riaz and Chaudry, 2004).

BWG when compared the control group at level of (5 %, 10 %, 15 % and 20 %) gelatin The percentage of group 5% was low weight 7 times as opposite action of control, 10% was low weight 14 times as opposite action of control 15% was low weight 14.5 times as opposite action of control and, 20% was Low weight 16

times as opposite .A groups(5 %, 10 %,1 5 % and 20 %) gelatin recorded ( $p \leq 0.001$ ) very high significant differences.

**Table 1:** Body weight gain (Mean  $\pm$  SD) among control fed on basal diet with gelatin (5 %, 10 %,1 5 % and 20 %) ,over 28 days.

Groups Statistical	Control	Gelatin5%	Gelatin10%	Gelatin15%	Gelatin20%
BWG/28 days					
Mean $\pm$ SD	2.89 0.97	-19.68 4.24	-40.92 10.21	-42.59 9.78	-46.80 7.82
T.test	6.67	10.36***	8.97***	9.70***	13.37***

\*\*\* Very high significant differences ( $p \leq 0.001$ .)

Data in table (2) showed (Mean  $\pm$  SD) of among control fed on basal diet with gelatin (5 %, 10 %, 15 % and 20 %), over 28 days. The result indicated that groups 5 %, 10%, 15 %and 20 gelatin recorded very high significant differences ( $p \leq 0.001$ ).

**Table 2:** Feed intake among control fed on basal diet with gelatin (5 %, 10 %, 15 % and 20 %) ,over 28 days.

Groups Statistical	Control	Gelatin5%	Gelatin10%	Gelatin15%	Gelatin20%
Feed intake (FI)					
Mean $\pm$ SD	353 1	355.2 1.92	351 1.58	346.68 2.71	350.8 0.84
T.test	789.33	412.91***	496.3***	286.28***	937.55***

\*\*\* Very high significant differences ( $p \leq 0.001$ ).

Data in table (3) and showed (Mean  $\pm$  SD) among control fed on basal diet with gelatin (5 %, 10 %, 15 % and 20 %), over 28 days. The result indicated that groups 5 %, 10%, 15 %and 20 gelatin recorded very high significant differences ( $p \leq 0.001$ ).

**Table 3:** Food efficiency ratio (FER) among control fed on basal diet with gelatin (5 %, 10 %, 15 % and 20 %) ,over 28 days.

Groups Statistical	Control	Gelatin5%	Gelatin10%	Gelatin15%	Gelatin20%
Feed efficiency (FER)					
Mean $\pm$ SD	0.01 0.00	-0.05 0.01	-0.09 0.01	-0.01 0.00	-0.01 0.00
T.test	7.30	13.98***	15.66***	9.79***	6.42***

\*\*\* Very high significant differences ( $p \leq 0.001$ ).

### B-Biochemical changes:

Data tabulated in table (4) shown that Serum, GPT and GOT (U/L) among control fed on basal diet with gelatin (5 %, 10 %,15 % and 20 %) ,over 28 days.

GPT recorded high significant differences ( $p \leq 0.01$ ) for group15 %gelatin and very high significant differences ( $p \leq 0.001$ ) for group 10 % and 5 % respectively. The final results show in the natural border According to (Olaisen, 1975).

GOT very high significant differences ( $p \leq 0.001$ ) for group 5%,10%,15 % and 20 %gelatin agree with (Hacker and Roberts ,1975).

**Table 4:** Serum, GPT and GOT (U/L) among control fed on basal diet with gelatin (5 %, 10 %, 15 % and 20 %) ,over 28 days.

Groups Statistical	Control	Gelatin 5%	Gelatin 10%	Gelatin 15%	Gelatin 20%
GPT					
Mean $\pm$ SD	34.67 8.14	36.33 2.52	37 1	37.67 0.72	38.67 3.51
T. test	7.37	23.56***	64.08***	7.19**	-
GOT					
Mean $\pm$ SD	113 9.79	110 3.77	112 9.79	119 3.37	167 1.15
T. test	18.72	58.67***	22.86***	32.42***	28.75***

\*\*\* Very high significant differences ( $p \leq 0.001$ ) . \*\* High significant differences ( $p \leq 0.01$ ).

Data presented in table (5), was showed the fasting serum urea, creatinine and uric acid (mg / dl) among control fed on basal diet with gelatin (5 %, 10 %, 15 % and 20 %), over 28 days.

Creatinine showed that very high significant differences ( $p \leq 0.001$ ) recorded for group 10%, 15 % while high significant differences ( $p \leq 0.01$ ) for group 5%, 20 %. Generally, a high serum creatinine level indicated that your kidneys aren't working well. Creatinine level may temporarily increase if you're dehydrated, have a low blood volume, eat a large amount of meat or take certain medications (John *et al.*, 2004). For urea very high significant differences ( $p \leq 0.001$ ) for group 5 and 20 % while high significant differences ( $p \leq 0.01$ ) for group fed on 15% and 20% gelatin.

**Table 5:** Fasting serum urea, creatinine and uric acid (mg / dl) among control fed on basal diet with gelatin (5 %, 10 %, 15 % and 20 %), over 28 days.

Groups Statistical	Control	Gelatin 5%	Gelatin 10%	Gelatin 15%	Gelatin 20%
Creatinine					
Mean± SD	0.6 0.1	0.60 0.09	0.64 0.08	0.65 0.05	0.67 0.15
T.test	-	10.87**	18.76***	31.82***	7.55**
Urea					
Mean± SD	45.33 10.02	60.33 2.32	61 11	62.33 9.50	63.33 2.08
T.test	-	45.25***	9.60***	11.35**	52.69***
Uacid					
Mean± SD	3.6 0.2	3.6 0.61	3.57 0.49	3.77 0.40	4.1 0.6
T.test	-	10.25**	12.53**	16.14***	31.17***

\*\* High significant differences ( $p \leq 0.01$ ). \*\*\*Very high significant differences ( $p \leq 0.001$ ).

Urea showed high significant differences ( $p \leq 0.01$ ) for group for 5 % gelatin while, very high significant differences ( $p \leq 0.001$ ) for groups 5%, 10% and 20 % gelatin.

According to (Johnson *et al.*, 1972) enhanced metabolism of proteins will also increase urea production, as may be seen with high protein diets, steroid urea, burns, or fevers. A low blood urea nitrogen (bun) usually has little significance, but its causes include liver problems, malnutrition (insufficient dietary protein), or excessive alcohol consumption. Overt hydration from intravenous fluids can result in a low bun. Normal changes in renal blood flow during pregnancy will also lower bun. Urea itself is not toxic.

Uric acid recorded high significant differences ( $p \leq 0.01$ ) for 5 % and 10% gelatin while very high significant differences ( $p \leq 0.001$ ) for groups 15% and 20 % gelatin.

#### Blood analyses:

Data presented in table (6) showed that hemoglobin (HGB g/dl), red blood cells, platelets count and white blood cells among control fed on basal diet with gelatin (5 %, 10 %, 15 % and 20 %), over 28 days.

HGB recorded significant differences for group 5% gelatin ( $p \leq 0.01$ ), while high significant differences ( $p \leq 0.01$ ) 10%, 15% and 20 % respectively. These results are in agreement with (Bain, 1995).

**Table 6:** Hemoglobin (HGB g/dl), red blood cells (RBC'S  $10^3/\text{mm}^3$ ), platelets count (PLT  $10^3/\text{mm}^3$ ) and white blood cells (WBC'S  $10^3/\text{mm}^3$ ) among control fed on basal diet with gelatin (5 %, 10 %, 15 % and 20 %), over 28 days.

Groups Statistical	Control	Gelatin 5%	Gelatin 10%	Gelatin 15%	Gelatin 20%
HGB					
Mean± SD	45±0.92	10.9±1.84	11.3±2.26	14.85±2.0510	15.1±1.41
T.test	-	16.7*	7.06**	10.24**	15.01**
RBC					
Mean± SD	5.92±0.4750	6.17±1.30	6.99±0.20	7.25±4.	8.12±0.28
T.test	-	6.7*	17.65***	2.2***	40.60***
WBC					
Mean± SD	6.2±	6.55±0.78	8.3±1.13	08.95±2.19	9.2±3.11
T.test	-	11.5*	3.99*	5.77*	11.9*
PLT					
Mean± SD	242±5.66	247±9.90	257±26.87	444.5±299.10	479±346.48
T.test	-	35.28**	13.25***	2.10*	1.99**

\* High significant differences ( $p \leq 0.01$ ). \*\* High significant differences ( $p \leq 0.01$ ). \*\*\* Very high significant differences ( $p \leq 0.001$ ).

RBC showed that significant differences ( $p \leq 0.1$ ) for group 5% gelatin, while very high significant differences ( $p \leq 0.001$ ) for groups 10%, 15% and 20% gelatin agree with (Anon, 2006).

PLT recorded significant differences ( $p \leq 0.1$ ) for group 15% gelatin while high significant differences ( $p \leq 0.01$ ) for groups 5% and 20% gelatin and very high significant differences ( $p \leq 0.001$ ) for 10% gelatin according to (Mark *et al.*, 2007).

WBC showed that significant differences ( $p \leq 0.1$ ) for group 5%, 10%, 15 and 20% gelatin result are agreement with (Trivedi *et al.*, 2007).

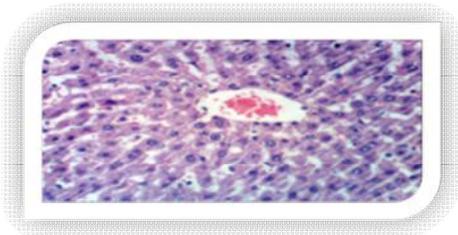
### C- Effect of gelatin on histological structure of, liver, kidney and intestine liver

Results showed that the rat's liver of control group did not show any change however, liver of rat from gelatin 5% showed that the normal histological structure of hepatic lobule and rat from group 10% gelatin showed kupffer cells activation and binucleation of hepatocytes with rat from group 15% and 20% gelatin % showed congestion of central vein and hepatic sinusoids kidney

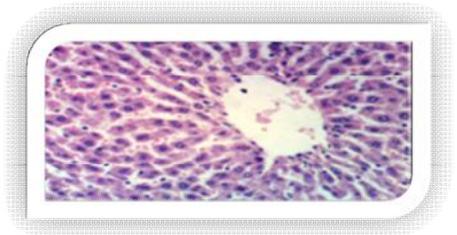
Histological examination of kidney of control group showed normal histological structure of renal parenchyma and rat's kidney of group (5 and 10)% gelatin showed no histopathological changes. However, rat's kidney of group 15% gelatin showed vacuolization of epithelial lining renal tubules and group 20% gelatin showed interstitial nephritis and protein cast in the lumen of renal tubules..

### Intestine:

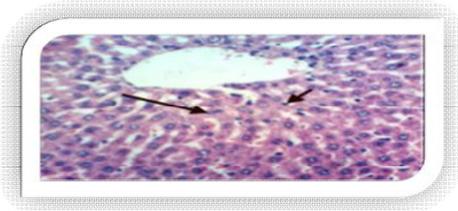
Histological examination appeared in intestine rat's of control with group 5% 10% and 15% gelatin showed that no histopathological changes while intestine rat's of 20% gelatin showed slight activation of mucus secreting cells and showed that few inflammatory cells infiltration in lamina propria.



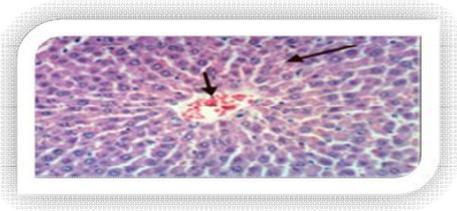
**Photo 1:** Liver of rat from group control showing the normal histological structure of hepatic lobule (H & E X 400).



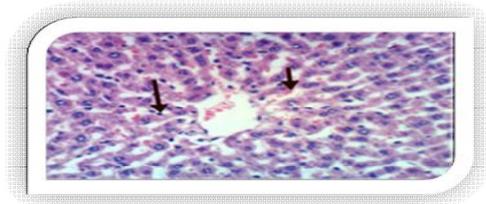
**Photo 2:** Liver of rat from group 5% gelatin showing the normal histological structure of hepatic lobule (H & E X 400).



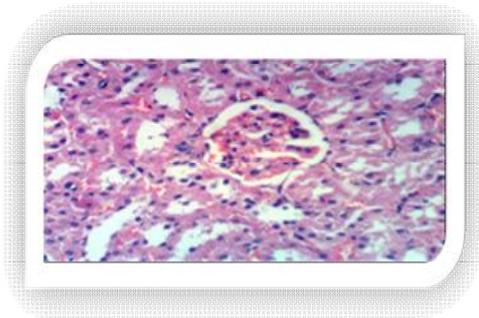
**Photo 3:** Liver of rat from group 10% gelatin showing kupffer cells activation and binucleation of hepatocytes (H & E X 400)



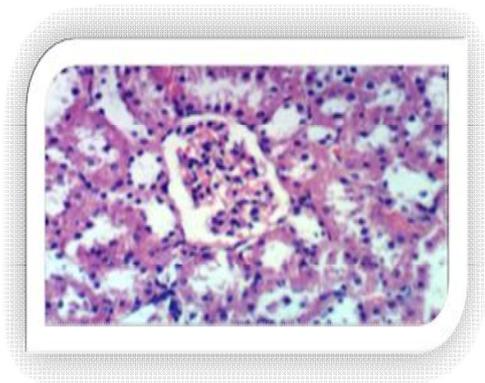
**Photo 4:** Liver of rat from group 15% gelatin showing congestion of central vein and hepatic sinusoids (H & E X 400)



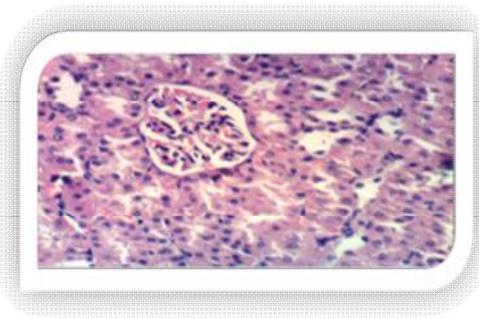
**Photo 5:** Liver of rat from group 20% gelatin showing cytoplasmic vacuolization of Centro lobular cells activation (H & E X 400).



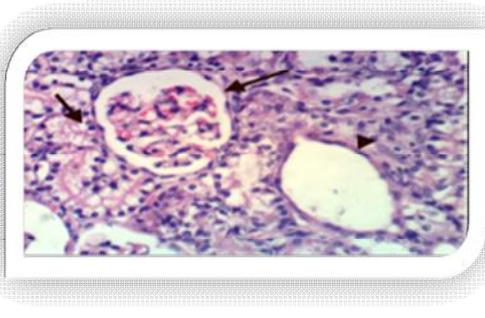
**Photo 1:** Kidney of rat from contro group showing the normal histological structure of renal parenchyma (H & E X 400).



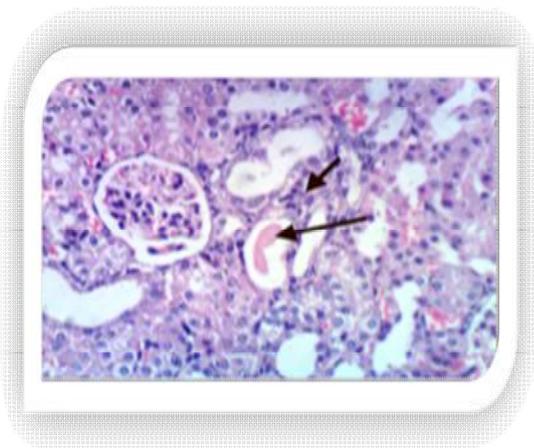
**Photo 2:** Kidney of rat from group5%gelatin showing the normal histological structure of renal parenchyma (H & E X 400).



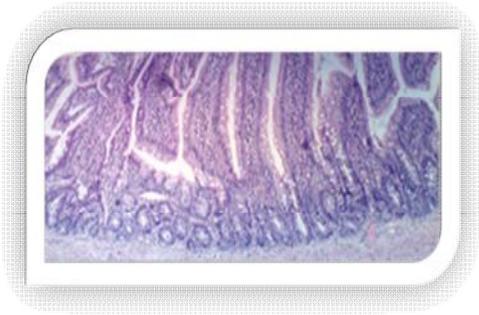
**Photo 3:** Kidney of rat from group10%gelatin showing no histopathological changes (H & E X 400).



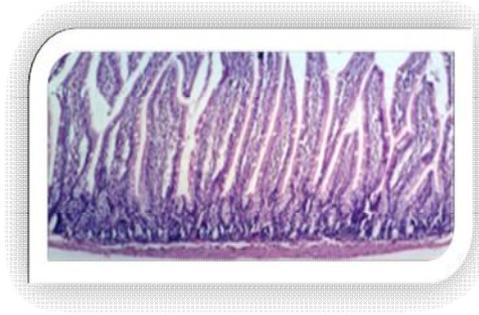
**Photo 4:** Kidney of rat from group15%gelatin showing vacuolization of epithelial lining renal tubules (H & E X 400).



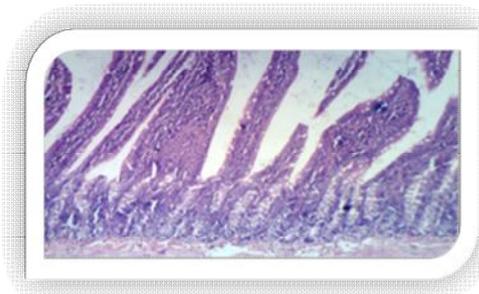
**Photo 5:** Kidney of rat from group 20% gelatin showing interstitial nephritis and protein cast in the lumen of renal tubules (H & E X 400).



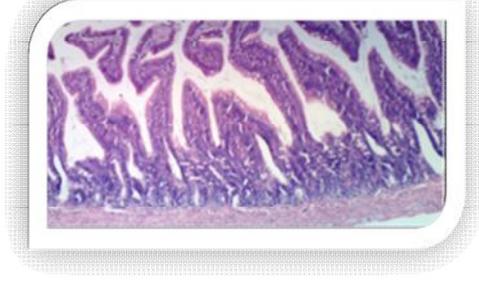
**Photo 1:** Intestine of rat from group control showing no histopathological changes (H & E X 100).



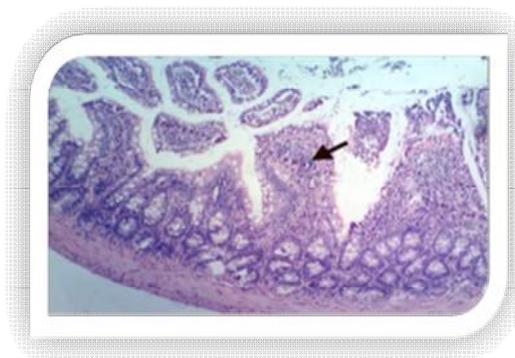
**Photo 2:** Intestine of rat from group 5%gelatin showing no histopathological changes (H & E X 100).



**Photo 3:** Intestine of rat from group 10%gelatin showing no histopathological changes (H & E X 100).



**Photo 4:** Intestine of rat, from 15%gelatin (showing no histopathological changes (H & E X 100).



**Photo 5:** Intestine of rat from group 20 % gelatin showing few inflammatory cells infiltration in lamina propria (H & E X 100).

It could be concluded (Photos 1-5) that loss weight accompanied by certain tissue changes, while the changes ameliorated considerably the biochemical changes (Tables 4-6).

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