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# Effect Of AJI-NO-MOTO On Kidney Of Adult Albino Rat: A Histopathological Evaluation

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## ABSTRACT

**Introduction:** Aji-No-Moto (MSG), the wonder flavoring agent, has been reportedly overused in all packed food products and the cuisines being served in restaurants. This salt effect almost all the organs of the body but the evidences regarding its ill effects are very limited. Thus, no guidelines are there for the safe limits of Aji-No-Moto use. In current study we planned to analyses the histopathological effects of Aji-No-Moto on kidney.

**Methods:** The study was conducted on 18 inbred adult albino rats of either sex. The rats of control group (C) received only standard diet with distilled water, low dose test group ($T_1$) rats received 0.5mg/kg of MSG dissolved in distilled water and high dose test group ($T_2$) rats received 1.5mg/kg of MSG dissolved in distilled water per orally for 28 days. After the experimental period, the rats were sacrificed to dissect out the renal tissue which was later subjected to histological processing and tissue sectioning.

**Observations:** The kidney tissue sections of the control group (C) revealed normal renal architecture consisting of cortical labyrinth and medulla. The cortical labyrinth consisted of glomeruli, PCT and DCT whereas the medulla consisted of the ascending and descending limbs of loop of henle and collecting ducts. On the other hand, renal sections of low dose group ($T_1$) showed focal shrinkage of renal glomerulus and widening of the Bowman's space. Furthermore, these changes were more pronounced in high dose group ($T_2$) along with hypercellularity of glomeruli, dilatation, hyperaemia and congestion in the intertubular cortical blood vessels and mononuclear cell infiltrate.

**Conclusion:** Aji-No-Moto is the most widely used flavoring agent whose minimal dose for use has to be evaluated. The current study was planned to access the minimal low dose limit of MSG for use. The results of aforementioned study revealed that even small dose of 0.5mg/kg/day is capable of producing histopathological effects on kidney.

**KEYWORDS:** Aji-No-Moto (MSG), Kidney, Renal, Renal Glomerulus.

## INTRODUCTION

Flavoring agents have been the boon for the cuisines since ages. Kombu and other seaweeds were added to food in Japan to enhance flavor, since thousands of years ago. In 1908, a Japanese scientist discovered that active ingredient in Kombu is Glutamic acid. Glutamate is found in wide variety of foods and as a result of its flavour enhancing effects, glutamate is often deliberately added to foods usually as purified monosodium salt called as AJI-No-Moto( MSG) or monosodium glutamate or MSG. MSG contains 78% glutamic acid, 22% of sodium and water. When present in its "free" form, not "bound" together with other amino acids in protein, glutamate has a flavour enhancing effect in foods. Bound glutamate, found naturally in foods, is less dangerous because it is slowly broken down and absorbed by gut so that it can be utilized by the tissues, especially muscle, before toxic concentrations can build up [1]. Glutamate additives are free glutamates completely unattached to any other protein which are easily and quickly absorbed and cause a spike in blood levels of glutamate. Thus, bound glutamate in diet is not dangerous while free glutamate is dangerous. This is because the body does not have to break down the free-form of glutamate [2].

Industrial food manufacturers use Aji-No-Moto (MSG) as flavour enhancer because it, balances, blends and rounds the total perception of other tastes [3]. When Aji-No-Moto (MSG) is added to food, it provides a flavoring function through stimulation of orosensory receptors and by improving palatability of meals [4]. This taste quality elicited is called "Umami" also referred to as "Xienwei" in Chinese or "Savoury", "broth-like" or "meaty taste" in English or fifth taste and this taste is not combination of primary taste qualities, namely, sweet, sour, salty, bitter. Recent evidence suggests that taste and palatability are mediated through

specific glutamate receptors located on the taste buds and in the stomach [5].

Apart from eliciting taste, Aji-No-Moto (MSG) also influences appetite positively and induces weight gain [6]. It is proposed in various types of patients with cancer, radiation therapy and organ transplantation to improve appetite [7]. It is also used intravenously as an adjunct in the treatment of encephalopathies associated with hepatic diseases [8].

Use of Aji-No-Moto (MSG) in food has grown in the last 30 years and is still growing. Aji-No-Moto (MSG) is present in canned prepared snacks and fast food. It is found in most soups, salad dressings, processed meats, ice-cream, frozen yogurt, bread and very often in "low fat" and "no fat" foods to make up for flavour lost when fat is reduced or eliminated. It is found in feeding products and even in infant formula. Aji-No-Moto (MSG) is commonly used in Chinese, Thainese and Japanese foods [9]. Their use has reached alarming proportions and humans are daily exposed to these chemical substances in their foods without defining the exact and safe limit.

The kidney is one of the major organs that functions to remove toxic metabolites and waste products from blood and regulates the amount of fluid and electrolyte balance in the body [10]. Thus, kidney plays a vital role in elimination of many metabolic waste products resulting from many xenobiotics, including mono sodium glutamate. MSG causes kidney dysfunction, renal oxidative stress [11] and histopathological alterations in the kidney tissues. In supplementation of effects on kidney, Aji-No-Moto (MSG) bears a broad spectrum of side effects ranging from Chinese restaurant syndrome to number of pathological conditions like addiction, stroke, epilepsy, brain trauma, neuropathic pain, schizophrenia, anxiety, depression, Parkinson's disease, Alzheimer's disease, Huntington's disease and Amyotrophic lateral sclerosis [12].

Despite evidence of negative consumer response to MSG, reputable international organizations and nutritionist have continued to endorse MSG, and reiterate that MSG has no adverse reactions in humans. The safe concentration of MSG in foods and its toxicity in humans is still controversial issue [13]. Henceforth, we planned to evaluate the effects of low dose Aji-No-Moto (MSG) on micro anatomy of kidney so that the inadvertent use of this flavoring agent can be brought to a notice.

## METHODS

Healthy Wistar Albino rats, 18 in number of either sex, weighing between 125 – 160 gm were taken for the study. The rats were procured from the Central Animal House of Government Medical College, Jammu. The animals were left for acclimatization to the laboratory conditions for a week and were provided standard rodent chow/feed and water ad-libitum during the period of experimentation. Later, the rats were randomly divided into three groups according to block permuted randomization plan and an identification number was given to rats of each group. The rats of control group (C) received only standard diet with distilled water, low dose test group ($T_1$) rats received 0.5mg/kg of Aji-No-Moto (MSG) dissolved in distilled water and high dose test group ($T_2$) rats received 1.5mg/kg of Aji-No-Moto (MSG) dissolved in distilled water per orally for 28 days.

The animals were housed in polypropylene cages (4 animals per cage) with dust free rice husk as a bedding material under laboratory conditions with control environment of temperature 18 to 29ºC, humidity (30% to 70%) and 12h light/dark cycle (16.00-18.00) as per Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA), India, guidelines which are in accordance with the internationally accepted principles for laboratory animal use and care. The animals were fasted overnight and were weighed before the initiation of the experiment; using electronic weighing scale.

After the experimental period of Twenty-eight days, all the rats were sacrificed by giving injection Thiopentone sodium, as per the guide lines laid down by the "Committee for Purpose of Control and Supervision of Experiment on Animals" (CPCSEA). After sacrificing the rats, the renal tissue was dissected out and subjected to further processing and examination of tissue sections.

## OBSERVATIONS

### CONTROL GROUP (C)

The light microscopic examination of sections revealed normal architectural pattern of renal tissue organized into cortical labyrinth and medullary rays. The cortical labyrinth consisted of glomeruli, PCT and DCT along with the interlobular blood vessels. The renal corpuscles were normal in structure; with the glomeruli invaginating the Bowman's capsules Figure 1 The medullary rays were seen as elongated regions or projections of medullary tissue into the cortex. In the medulla, descending and ascending segments of loop of Henle and collecting ducts were seen **Figure 2.**

[Figure 1 about here.]

[Figure 2 about here.]

### GROUP $T_1$

Cut sections of kidneys of Group $T_1$ rats revealed that the basic architecture of cortex and medulla was preserved, however few histopathological changes were observed. In the cortex of the kidneys, renal corpuscles showed shrinkage of renal glomerulus and widening of the Bowman's space, which was focal i.e., appeared in some glomeruli and some were normal. The renal tubules appeared normal with normal lining epithelium and empty lumina **Figure 3.**

[Figure 3 about here.]

### GROUP $T_2$

Cut sections of kidneys of Group $T_2$ revealed variable pathological changes consisting of shrinkage of renal glomerulus and widening of the Bowman's spaceFigure 4 which was focal i.e. appeared in some glomeruli and some were normal. However, more glomeruli were involved as compared to Group $T_1$.

Few glomeruli showed hypercellularity, that is cellular proliferation of mesengial or endothelial cells and infiltration of inflammatory cells suggestive of increase in lobulation of glomerular tuft Figure 5. Dilatation, hyperaemia and congestion in the intertubular cortical blood vessels were seenFigures 5 and 6 .Mononuclear inflammatory cells infiltrated in the interstitial tissues in few areas **Figure 6.** The medulla showed normal cytoarchitecture.

[Figure 4 about here.]

[Figure 5 about here.]

[Figure 6 about here.]

## DISCUSSION

Aji-No-Moto (MSG) being the most widely used flavoring agent; balances, blends and rounds the total perception of other tastes. It provides a flavoring function through stimulation of orosensory receptors and by improving palatability of meals. Recent evidences suggest that taste and palatability are mediated through specific glutamate receptors located on the taste buds and in the stomach. In view of taste enhancing capability, the use of Aji-No-Moto (MSG) has increased dramatically over past 30 years without realizing the safety profile of the salt. So, the current study was planned to drag the attention of general population regarding the histopathological effects of Aji-No-Moto (MSG) on one of the vital organs i.e., kidney which is responsible for excretion of all the toxins from our body.

Histopathological changes of kidney revealed in current study that there was shrinkage of glomerulus and widening of bowman's space which was focal and was present in both Group $T_1$ and Group $T_2$ rats with frequency more in Group $T_2$ rats. This finding was in concordance with the findings obtained in various studies in past [13–16], though the dose given in past studies was higher than current study. Renal tissues of Group $T_2$ rats also showed focal mononuclear inflammatory cell infiltration in the interstitial tissues which was positively supported by evidence derived from [4, 15, 17].

Degeneration of renal cell nuclei observed by [14] and necrotic lesions in the epithelial lining of renal tubules observed by [4, 17] were not evidenced in the current study. These dissimilarities can be attributed to the higher dose of Aji- No-Moto used in those studies of the past. Furthermore, the cause of the renal toxicity can be associated with the oxidative stress caused by Aji-No-Moto (MSG). [18]

## CONCLUSION

Flavoring agents like Aji-No-Moto (MSG) have been inadvertently used in various cuisines, packed food, baby food and other types of food. The manufacturers even sometimes do not indicate it on the label and just describe it as "Flavoring Agent" or "hydrolysed vegetable protein." Thus, resulting into no check on the quantity of the salt being used. Although several international organizations and government institutions have declared MSG safe for consumption, yet certain studies on experimental animals have confirmed toxic effect of MSG in different organs. The present study was designed to elucidate the histopathological effects of Aji-No-Moto (MSG) on renal tissue of adult albino rats in a dose dependent manner so that we are able to conclude the minimal safe limits of Aji-No-Moto to be consumed daily.

The results of our study concluded that daily consumption of Aji-No-Moto even at low doses is capable of producing histopathological changes in kidney. These changes, though, focal can become generalized on high dose exposure to Aji-No-Moto. These changes occurred in kidney as kidney is the man organ for detoxification and excretion of such kind of xenobiotics resulting into oxidative stress. In view of above mentioned observations of current study, it is advised that the safe limits for the ingestion of this substance by humans should be reviewed.

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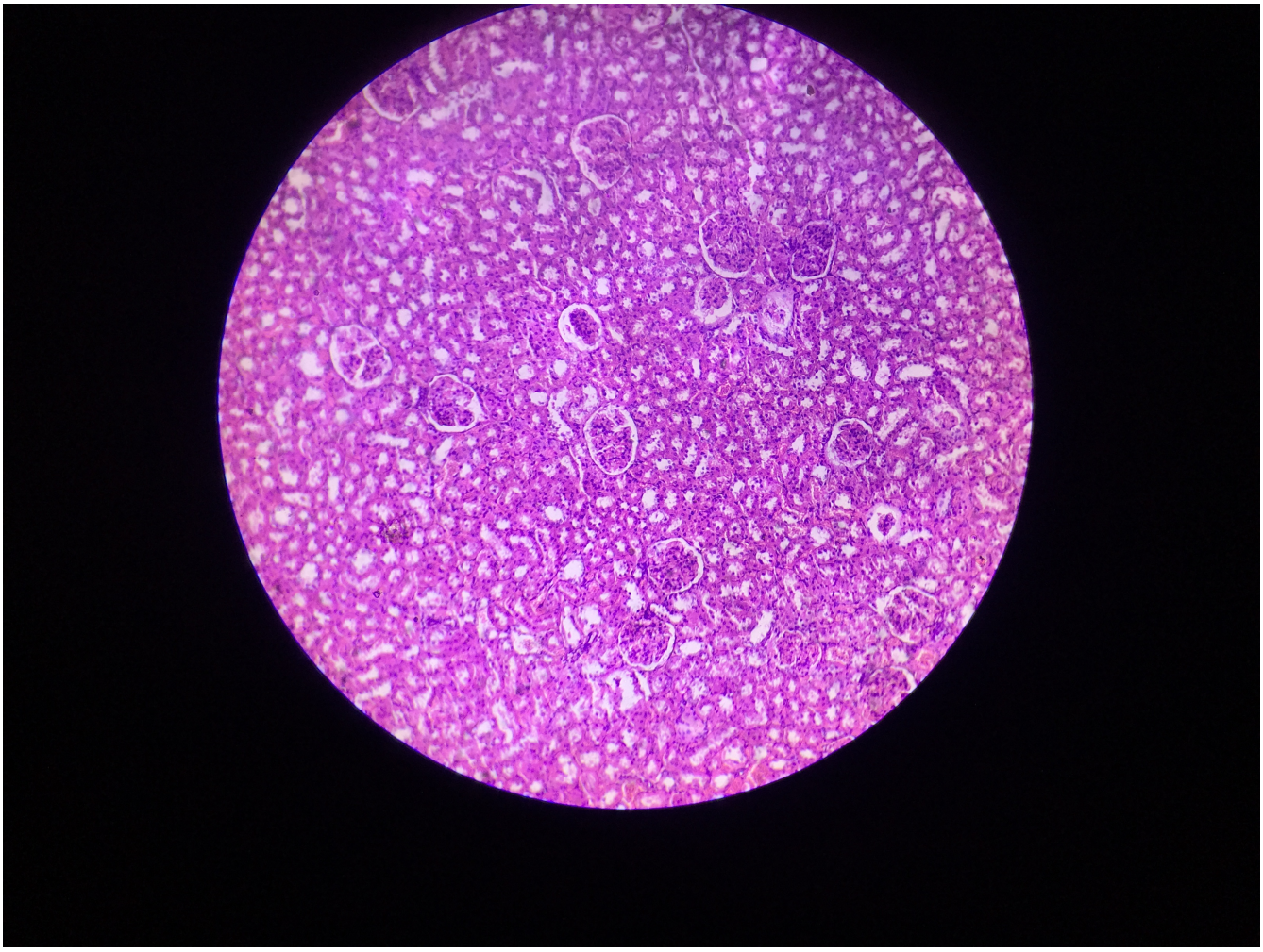

**Figure 1: Photomicrograph of section of kidney of control group C showing renal cortex with renal corpuscle (A) and renal tubules (B). (H&E stain 100X)**

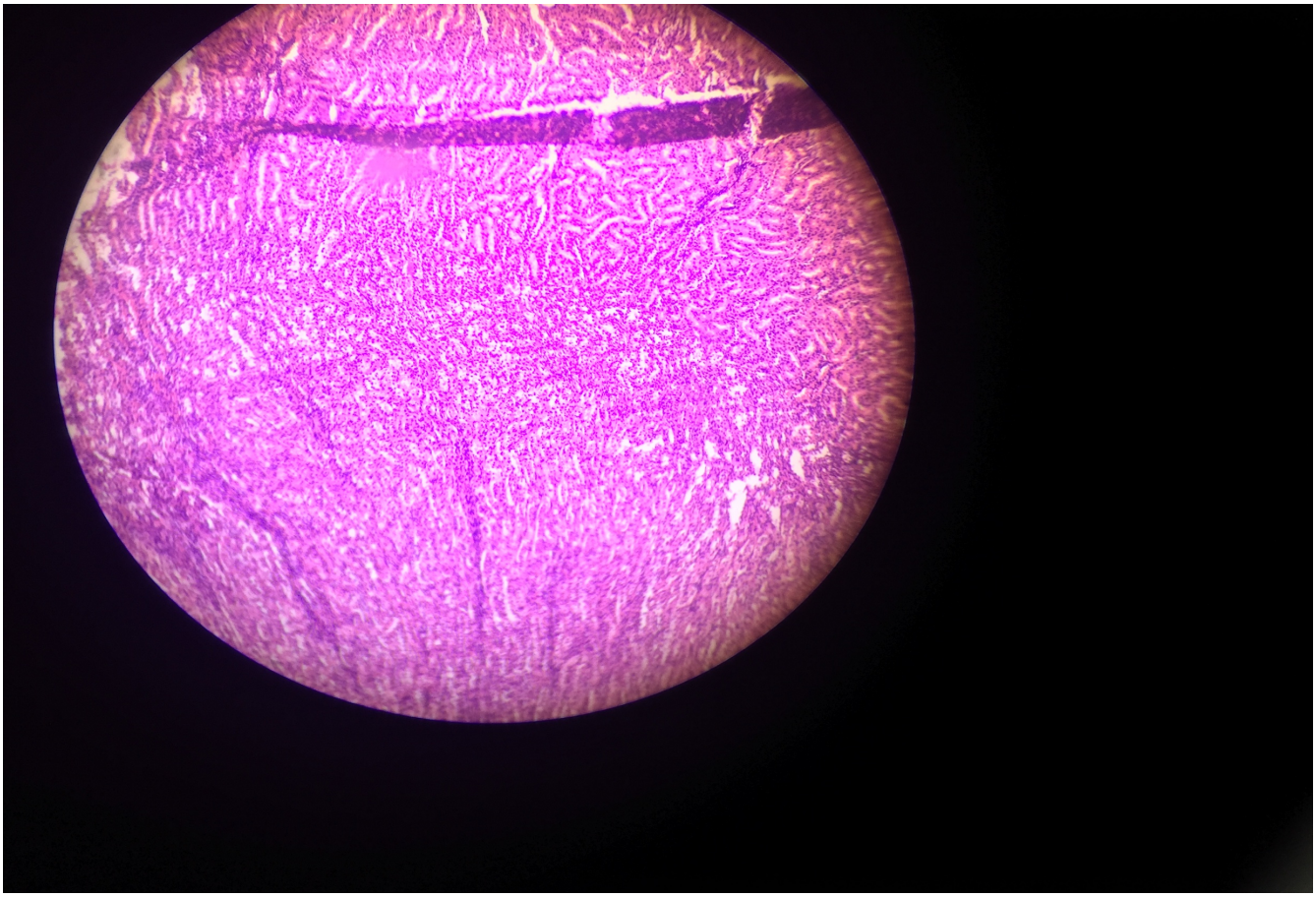

**Figure 2: Photomicrograph of section of kidney of control group C showing renal medulla with renal tubules(A) (H&E stain 100X).**

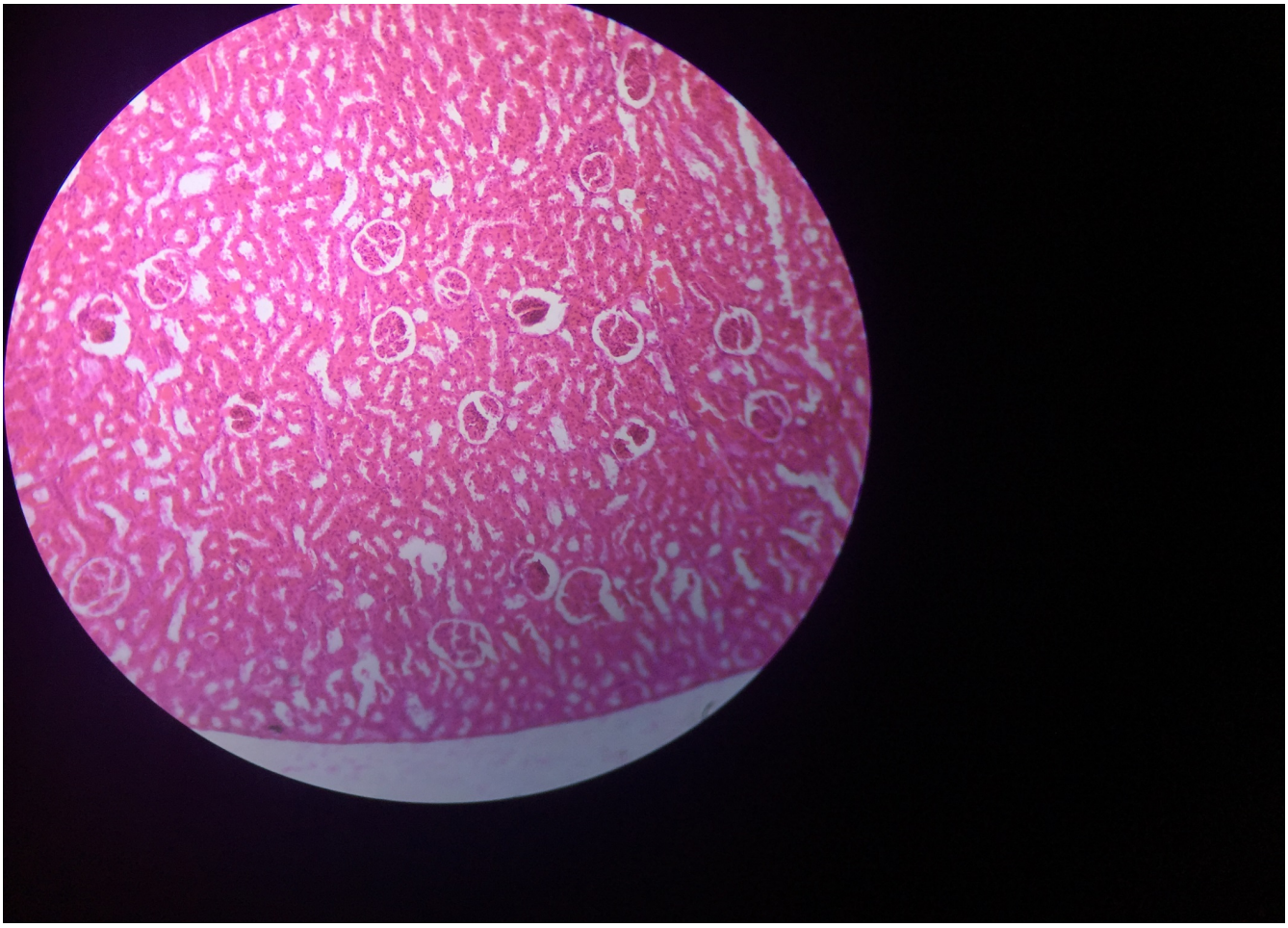

**Figure 3: Photomicrograph of section of kidney of experimental group $T_1$ showing shrunken glomerulus (A), increased Bowman's space (B) and normal renal tubules with empty lumen (C) (H&E stain 100X).**

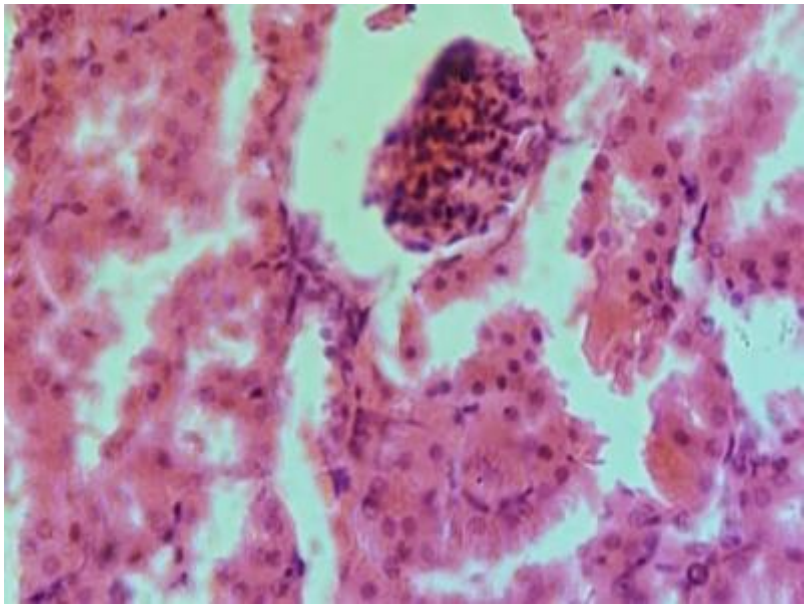

**Figure 4: Photomicrograph of section of kidney of experimental group $T_2$ showing shrunken glomerulus(A), increased bowman's space (B) and tubular atrophy (C).(H&E stain 400X)**

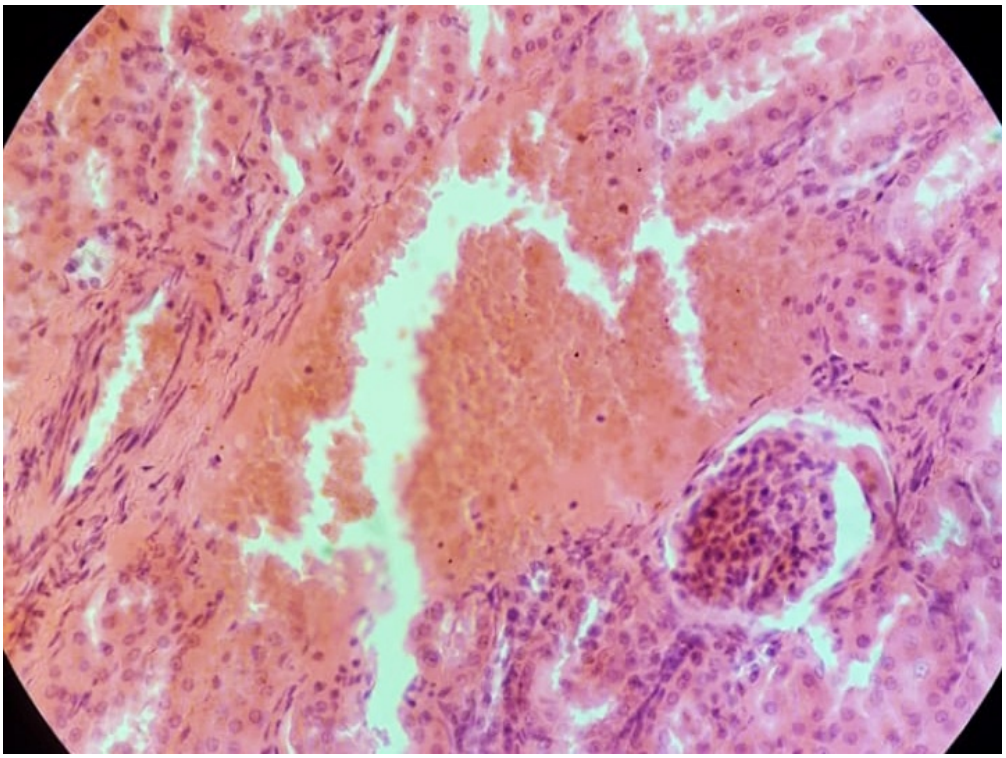

**Figure 5: Photomicrograph of kidney of experimental group $T_2$ showing vascular dilatation and congestion (A) and lobular accentuation (B). (H&E stain 400X)**

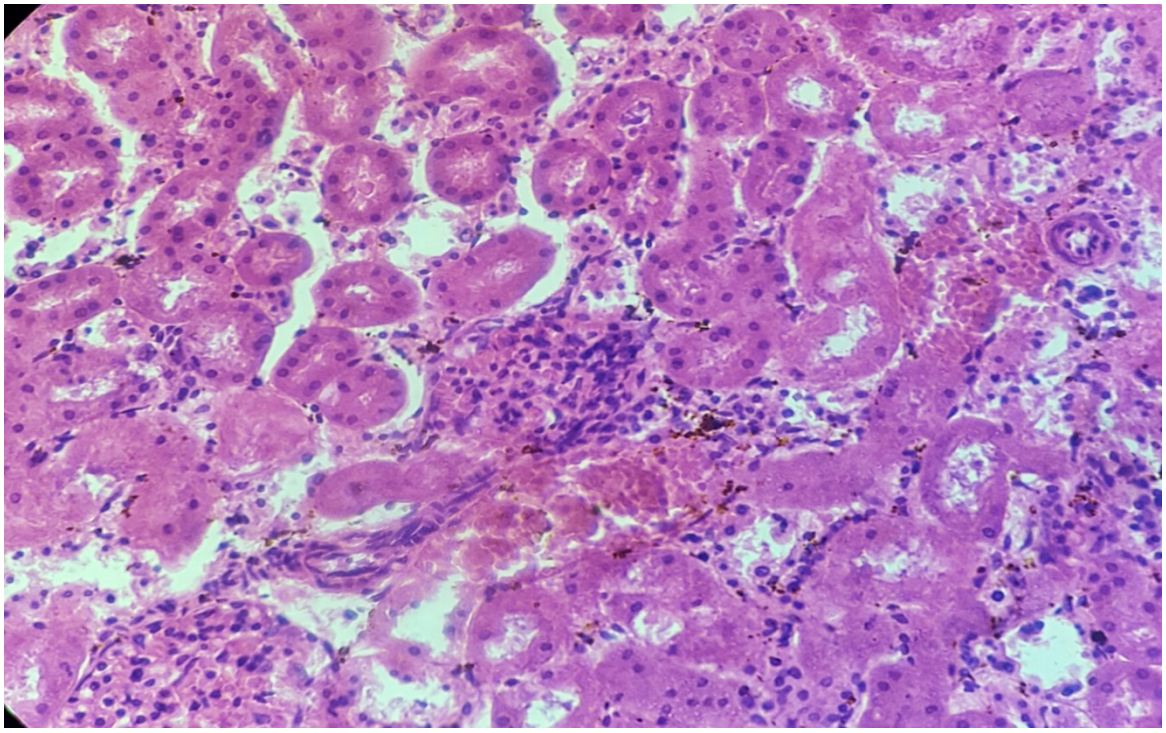

**Figure 6: Photomicrograph of section of kidney of experimental group $T_2$ showing mononuclear infiltrate (A) and vascular dilatation and congestion (B). (H&E stain 400X)**