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## The Histological Examination of *Mus musculus*' Stomach Which Was Exposed to Hunger and Thirst Stress: A Study with Light Microscope

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**Abstract:** In this study, the histological changes observed in *Mus musculus*' stomach mucosa which was exposed to hunger and thirst were examined. Pieces from chest and stomach cavities were taken in the 1st, 2nd, 3rd, 4th and 5th days following last feeding. These tissue specimens were fixed by using 10% neutral formalin which was compressed. After routine tissue checks, the tissue pieces were sunk into paraffin and some blocs were prepared. With the aim to examine histological structures of the pieces taken, they were colored with Hematoxylin and Eosin (H and E). An increase in the number of blood cells taken part in stomach tissue was observed in the first twenty four hours. A widening in glandular epithelium lumen was seen after two days. A tendency to slim was observed in mucosa layer of the surface and glandular lumen during hunger. In the stomach mucosa, structural changes were caused by hunger and thirst. It was found that these changes were in direct proportion with hunger and thirst duration.

**Key words:** Stress, starvation, stomach, *Mus musculus*, light microscope, histology

### INTRODUCTION

Long-term hunger is a problem that all living species in the nature often have to cope with. It is a known fact that hunger has a considerable impact on many systems metabolically and structurally. In hungry living species, the speed of basal metabolism decreases rapidly and the amount of azoth in urine increases as an indicator of protein destruction. During hunger, first priority is given to the central nerve system and erythrocytes that can use pure glucose as energy source. At the same period, the level of serum insulin decreases but the amount of glucagons increases and thus gluconeogenesis i.e., the process of producing glucose from some amino acids and glycerol speeds up in the liver. Since the level of insulin decreases, blood cells begin to absorb less glucose. Yet, fatty acids can enter into these cells and they are used as energy source. All of these occur during the first 48-72 h of hunger. The process of gluconeogenesis reaches at maximum level during the 3rd day of hunger (Ganong, 2002; Sönmez and Ozan, 2005). During hunger, the process of cell mitosis slows down and cell cycles prolong with some cells staying at the G1 stage. In parallel to this, epithelium cells rate of renewing decreases (Çolakoğlu *et al.*, 1999). Blood pressure and glucose levels and body weight lower down depending upon the intensity level of hunger. The gastric pH of stomach

decreases, i.e., the amount of gastric acid increases. Depending upon the duration of hunger, the lumens of intra-cell canals narrow and microvillus groups become shorter (Colakoglu *et al.*, 1999). When hunger begins, in the first instance glycogen storages mobilize and they become emptied in 24 h. There are various studies focusing on the histological and histo-chemical changes occurred in stomach mucosa in different phases of hunger. In the study, the effects of hunger and thirst stress on stomach mucosa were examined.

### MATERIALS AND METHODS

This study was fulfilled in the Zoological Research Laboratory of the Marmara University in January 2006. In this histological study, 18 mice from *Mus musculus* family were used. During the experiment, each subject group was kept in separate cages and in night-day periods with 12 h. Following last feeding, pieces were taken from chest and stomach cavities of the subjects after applying ether anesthesia at the end of the 24th h and 2nd, 3rd, 4th and 5th days. These pieces were fixed by using 10% Neutral Formalin which was compressed. After washing and routine checking procedures, the pieces were sunk into paraffin and then, blocs were prepared. The sections being 6-7  $\mu$  in thickness and having been taken from paraffin blocs were colored with Hematoxylin and Eosin to examine general histological structure. These preparations

were examined under the Olympus light microscope and their photographs were taken.

### RESULTS

At the end of the first 24 h following last feeding, some flattening and degeneration were observed in the surface epithelium and gland epithelium. An increase was seen in the amount of blood cells taken part in stomach tissue. Muscular layer had normal histological appearance (Fig. 1-3). In the 48th h, these changes became more

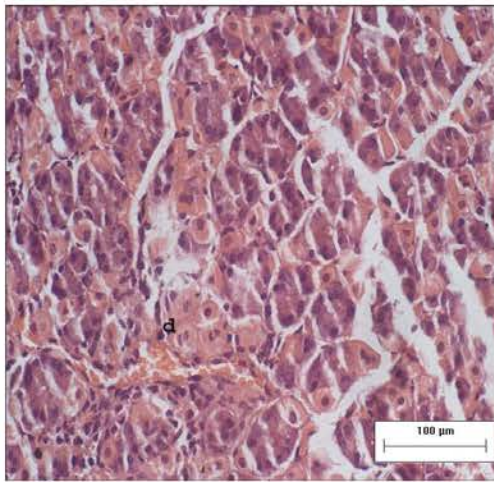


Fig. 1: The section taken in the 1st day of hunger. It is observed that there was a clustering tendency in the blood vessel areas of stomach tissue--Blood vessel areas. H&E X 10

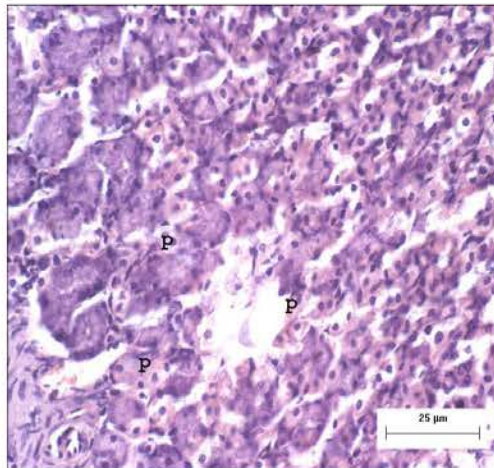


Fig. 2: Coloring of the parietal cell pertaining to the 1st day of hunger is observed. Parietal cell. H&E X 40

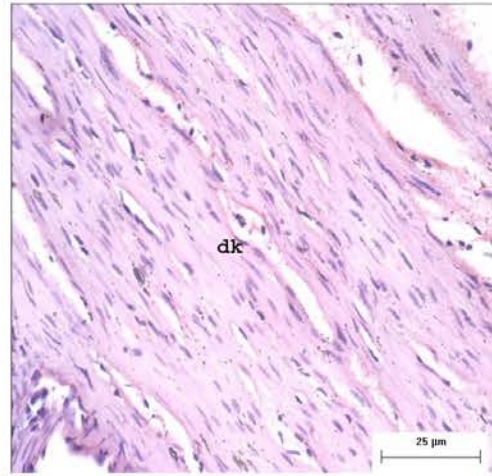


Fig. 3: Stomach muscular tissue pertaining to the 1st day of hunger. A flat muscle. H&E X 40

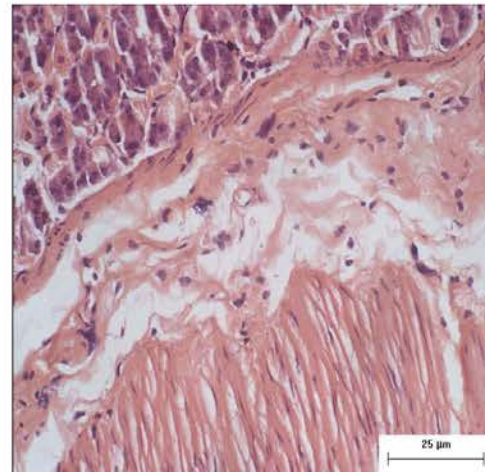
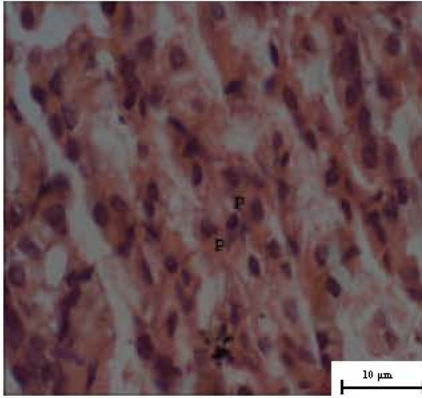
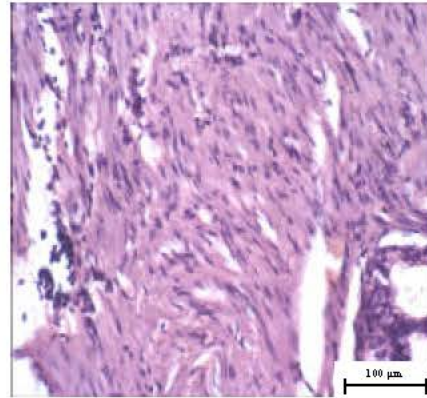


Fig. 4: The section of surface epithelium pertaining to the 2nd day of hunger. Partial destructions are observed in the surface epithelium. H&E X 40

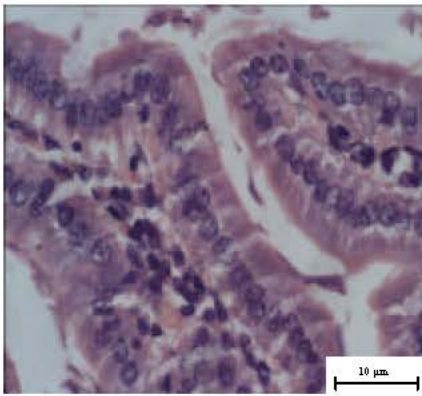
obvious. In addition to this, a partial destruction was observed in the surface epithelium. There was also degeneration in parietal cells morphologically (Fig. 4 and 5). At the end of the 3rd day of hunger, it was seen that stomach glands of the subjects had widened. It was observed that there were disintegration in mucus cells and shrinkages in parietal cells. It was seen that there was widening around blood vessel areas (Fig. 6 and 7). At the end of the 5th day of hunger, it was detected that the muscular structure was degenerated, parietal cells were suffered from structural destruction and there was a rise in the number of cells (Fig. 8 and 9). Stomach mucosa of the control groups were in normal histological



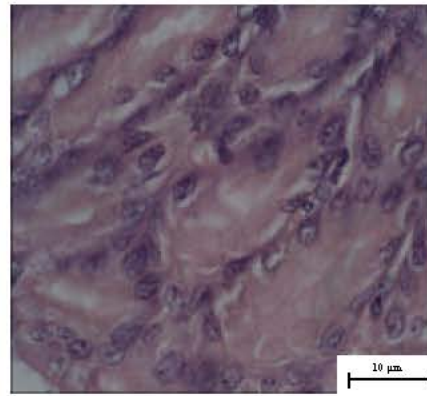
**Fig. 5:** Coloring of the parietal cell pertaining to the 2nd day of hunger. The degeneration level of parietal cells is obvious. H&E X 100



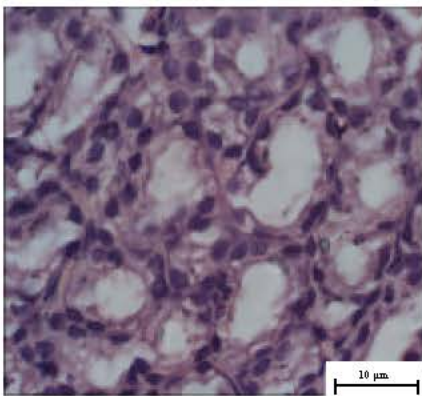
**Fig. 8:** There is degeneration in the muscular layer in the 5th day of hunger. H&E X 10



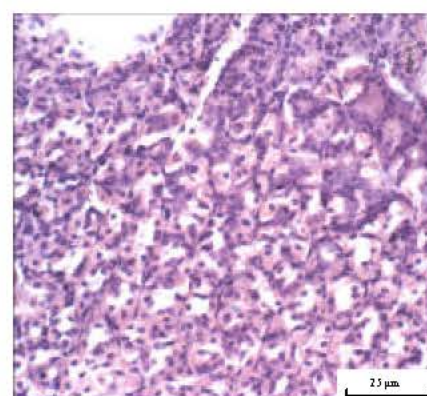
**Fig. 6:** The section taken in the 3rd day of hunger. Coloring and destruction in the surface mucous cells. H&E X 100



**Fig. 9:** There is an increase in the number of parietal cells and their structures are being degenerated in the 5th day of hunger. H&E X 100



**Fig. 7:** There is obviously too much widening in gland lumen in the 3rd day of hunger. H&E X 100



**Fig. 10:** Control group. General overview of the stomach mucosa. H&E X 40

appearance. Tubular stomach glands under the surface epithelium were observed. Parietal cells were seen in gland epithelium (Fig. 10).

### DISCUSSION

Hunger is a situation affecting living organisms metabolically and structurally. Secretions of the cells located in stomach glands enable the nutrients in the stomach to be decomposed and the digestion process to be started. There are studies which focus on the changes in various cells of the stomach mucosa due to short-term and long-term hunger and examine these changes under the light and electron microscopes. In these studies, histological findings varied upon the genus, age and hunger level of the selected animal were obtained (Sönmez and Ozan, 2005; Colakoglu *et al.*, 1999; Uçar *et al.*, 2004; Zaviacic *et al.*, 1977). Blood pressure and gastrin levels and body weight lower down significantly depending upon the intensity level of hunger (Sönmez and Ozan, 2005; Colakoglu *et al.*, 1999; Uçar *et al.*, 2004). In the study, the changes in stomach mucosa occurring during hunger were examined. It was assumed that hunger causes thinning in the mucus layer of stomach epithelium surface. The first changes in the stomach mucosa resulting from hunger were detected at the end of the first 24 h following last feeding. In this period, it was observed that the lumen of stomach glands widened. The surface epithelium became flattened and degenerated. Colakoglu *et al.* (1999) observed the widening in gland lumen after 3 days of hunger. Alvares *et al.* (1992) detected no change in stomach mucosa of the mice after 18 h of hunger. Zaviacic *et al.* (1977) observed that there were some pouring in the surface mucus cells and shrinkages in the parietal and main cells after the 72 h of hunger. Matsumoto *et al.* (1989) observed that stomach ulcers occur in mice due to hunger. Jacobs and Sturtevent (1982) found that there are more multi-vesicular elements in normally and limitedly feeding animals than the case in hungry animals. Furthermore, they detected that some irregularities take place in the granular endoplasmic reticulum of parietal cells during hunger. In that study, some degeneration was observed in stomach mucosa of the mice which were kept hungry in five days, but no sign of ulcer was observed. In this study, it was seen that the surface mucus cells get poured and some cells became

shrunk after 3 days of hunger. It was found that the microvillus structures of parietal cells in the stomach were affected from hunger. In the 4th and 5th days of hunger, the tendency of shortening and becoming sparse was observed. Another change occurred in the stomach mucosa due to hunger is the degeneration and pouring in the surface epithelium. It was seen that there was some pouring in the surface mucus cells during the 3rd day of hunger. In this study, it was noticed that hunger causes an obvious reduction in the mucus mucosa of stomach epithelium surface. Considering this study and other related studies, we reach the conclusion that stomach mucosa is affected and some histo-pathological changes occur under hunger stress depending upon the duration of hunger.

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