شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم

بسم الله الرحمن الرحيم

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جامعة عين شمس
شبكة المعلومات الجامعية
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قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

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INTRODUCTION

Monosodium glutamate (MSG), the sodium salt of glutamic acid, is a worldwide used flavor enhancer. The consumption of this compound has increased 3 times between 1979 and 2001 in human ***(Hermanussen et al., 2006)***.

Some animal studies have reported that MSG is able to induce overweight and/or obesity but mechanisms which would be responsible for such an effect remain unclear. Different physiological effects of glutamate on the gastrointestinal tract and on the endocrine and exocrine pancreas have been reported. Some of them are believed to occur through binding to receptors which are present in numerous cell types. Glutamate is well known to represent the predominant excitatory neurotransmitter in the central nervous system and appears to also act as a peripheral neurotransmitter ***(Boutry et al., 2011)***.

In addition, some adverse effects of MSG are Chinese restaurant syndrome, neuroexcitotoxicity and impaired vision. Chronic administration of MSG induced oxidative stress in experimental animals ***(Singh et al., 2003)***.

Although MSG has some toxic effects, yet people are still using it possibly due to its cheapness and affordability. Many use MSG as a seasoning in food in place of meat as they cannot afford the meat ***(Martins, 2004)***.

Regards all of the above it appears mandatory to document the consequences of MSG consumption in terms of beneficial over deleterious effects of this compound ***(Boutry et al., 2011)***.

Antioxidants such as Vitamin E and selenium (Se) prevent the production of free radicals or suppress the cellular damage ***(Noaman et al., 2002)***.

Vitamin E is an essential fat-soluble micronutrient whose effects on human health can be attributed to both antioxidant and non-antioxidant properties ***(Reboul, 2017)***.

Also, Vitamin E is found in various foods and oils. Nuts, seeds and vegetable oils contain high amounts of alpha-tocopherol, and significant amounts are also available in green leafy vegetables and fortified cereals ***(Rizvi et al., 2014)***.

Vitamin E has been found to be very effective in the prevention and reversal of various disease complications as cardiovascular diseases, cancer, HIV, cataract and Alzheimer's disease. This is due to its function as an antioxidant, its role in anti-inflammatory processes, its inhibition of platelet aggregation and its immune-enhancing activity ***(Rizvi et al., 2014)***.

Although some information is available on the MSG-induced oxidative stress and toxicity, yet the studies on the effect of antioxidants, especially those consumed in food, on MSG-induced toxicity and oxidative stress are lacking. Moreover, most of the studies, so far on MSG, have been carried out on very high doses (4 mg/g and above) ***(Onyema et al., 2006)***.

Aim of the Work

The present work aimed to investigate the effect of monosodium glutamate on the histology of the ileum of the adult male albino rats and evaluate the potential protective effect of vitamin E.

Chapter 1

Review of Literature

Anatomy of the small intestine in humans

The small intestine consists of the duodenum, jejunum and ileum. It extends from the distal end of the pyloric canal to the ileocecal junction and has a mean length of 5 meters (3–8.5 meters) when measured intraoperatively in the living adult ***(Teitelbaum et al., 2013)***.

The adult duodenum is approximately 25 cm long and is the shortest, widest and most predictably placed part of the small intestine. The proximal 2.5 cm is intraperitoneal, and the remainder is retroperitoneal. The duodenum forms an elongated 'C' that lies between the level of the first and third lumbar vertebrae in the supine position. The lower 'limb' of the C extends further to the left of the midline than the upper limb. The head and uncinate process of the pancreas lie within the concavity of the duodenum. The duodenum lies entirely above the level of the umbilicus and the main vessels supplying it are the superior and inferior pancreaticoduodenal arteries ***(Stranding and Adams, 2016)***.

The mucous membrane of the duodenum is thick. In the first part of the duodenum, it is smooth. In the remainder of the duodenum, it is thrown into numerous circular folds called the plicae circulares which make the rest of the duodenal wall thicker than the first part ***(Snell, 2012)***.

The jejunum and ileum together measure about 5 m long; the upper two fifths of this length makes up the jejunum and the lower three fifths makes up the ileum. The coils of jejunum and ileum are freely mobile and are attached to the posterior abdominal wall by a fan-shaped fold of peritoneum known as the mesentery of the small intestine ***(Snell, 2012)***.

The jejunum, the second part of the small intestine begins at the duodenojejunal junction. It has an external diameter of about 4 cm and an internal diameter of about 3 cm. It has a thick wall and a rich arterial blood supply. The coils of jejunum occupy the upper left part of the abdominal cavity. The plicae circulares are most pronounced in the proximal part of jejunum, where they are more numerous and deeper than elsewhere in the small bowel. They frequently 'branch' around the lumen and may appear to be stacked on top of each other, giving the jejunum a characteristic appearance during single contrast radiography, computed tomographic (CT) enterography or magnetic resonance (MR) entography ***(Stranding and Adams, 2016)***.

The ileum is the final section of the small intestine, following the duodenum and jejunum ***(Coico et al., 2003)***.

The ileum tends to occupy the lower right part of the abdominal cavity and the pelvic cavity. In the supine position, the ileum lies mainly in the hypogastric region and right iliac fossa. The terminal ileum frequently lies in the pelvis, from where it ascends over the right psoas major and right iliac vessels, to end by opening at the ileocaecal junction in the right iliac fossa and become separated from cecum by ileoceacal valve ***(Stranding and Adams, 2016)***. Its main function is to absorb vitamin B12 and bile salts ***(Saladin, 2004)***.

The ileum has an external diameter of about 3 cm, an internal diameter of about 2.5 cm and tends to have a thin wall. The plicae circulares become progressively less obvious in the distal ileum; they tend to be single and flat ***(Stranding and Adams, 2016)***.

The mucosa of the terminal ileum immediately proximal to the ileocaecal junction may appear almost flat at endoscopy, although the villi can be seen when viewed close up ***(Stranding and Adams, 2016)***.

Solitary lymphoid follicles are scattered throughout the small intestine but are most numerous in the distal ileum. Numerous and palpable aggregations of lymphoid tissue (Peyer's patches) are present in the mucous membrane of the lower ileum along the antimesenteric border. On the other hand these aggregations are rarely present in the duodenum and regarding the distal jejunum they are small, circular, few in number and impalpable ***(Van Kruiningen et al., 2002; Snell, 2012)***.

While there is no clear boundary between the jejunum and the ileum, there are general anatomical differences between these regions. The wall of the jejunum is thicker, wider, more vascular and redder than the ileum. It has a greater number of more prominent plicae circulares, and contains less lymphoid tissue than the ileum ***(Stranding and Adams, 2016)***.

In addition the jejunal mesentery is attached to the posterior abdominal wall above and to the left of the aorta, whereas the ileal mesentery is attached below and to the right of the aorta. The jejunal mesentery, measured from the superior mesenteric artery to the mesenteric border of the bowel, is shorter than the ileal mesentery ***(Stranding and Adams, 2016)***. At the jejunal end of the mesentery, the fat is deposited near the root and is scanty near the intestinal wall. At the ileal end of the mesentery, the fat is deposited throughout so that it extends from the root to the intestinal wall ***(Snell, 2012).***

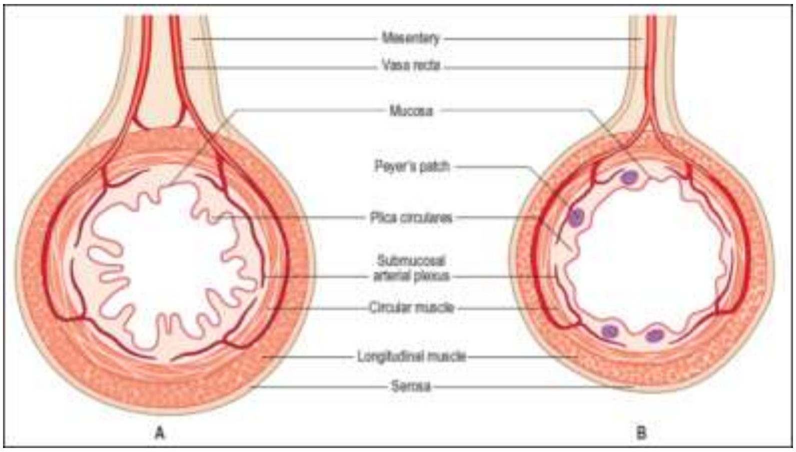

Fig. a: cross sections through the proximal jejunum (A) and terminal ileum (B). The mesenteric attachment is wider in the jejunum, and two leaves of vessels enter the bowel wall. The bowel wall is thicker in the jejunum ***(Stranding and Adams, 2016)***.

There are also differences between the mesenteric vessels of the jejunum and ileum ***(Conley et al., 2010)***. The jejunal arteries are slightly larger than their ileal counterparts. There are usually 4–6 jejunal branches, which arise from the left side of the upper portion of the superior mesenteric artery. They are distributed to the jejunum via 1–3 tiers of arterial arcades. On the other hand ileal branches are more numerous (around 8–12) and slightly smaller in calibre than the jejunal branches. They arise from the left and anterior aspects of the superior mesenteric artery and distributed to the ileum via 2-6 tiers of arcades ***(Stranding and Adams, 2016)***.

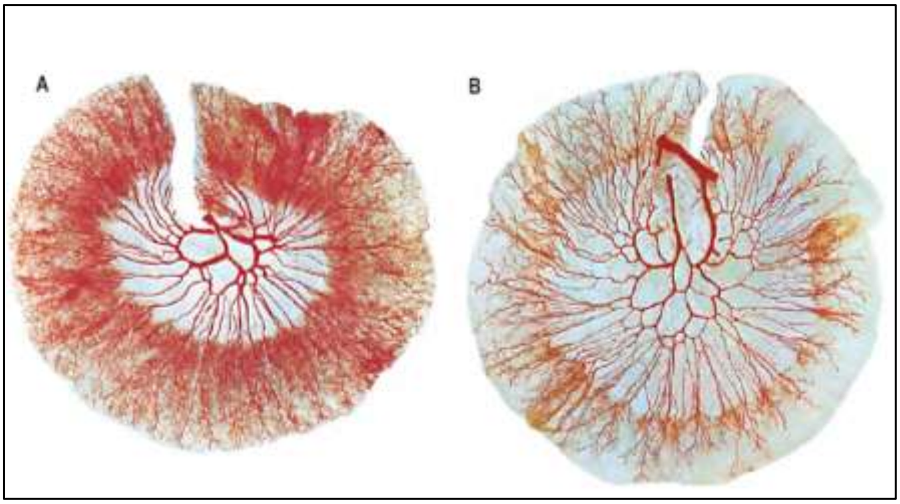

Fig. b: Specimens of the jejunum (**A**) and ileum (**B**) from a cadaver showing the difference in the distribution of superior mesenteric artery ***(Stranding and Adams, 2016)***.

Development of the ileum

The ileum is developed from the gut tube especially the midgut. The midgut develops by forming a loop in the fifth week with cranial and caudal limbs. The cephalic limb of the loop develops into the distal part of the duodenum, the jejunum, and part of the ileum. The caudal limb becomes the lower portion of the ileum, the cecum, the appendix, the ascending colon, and the proximal two-thirds of the transverse colon. The apex of the loop is connected to the definitive yolk sac by the vitello- intestinal duct. It is also suspended from the posterior abdominal wall by a dorsal mesentery which contains the superior mesenteric artery ***(Sadler, 2012).***

The loop undergoes elongation and coiling in the relative small abdominal cavity that result in physiological herniation through the umbilicus. Then rotation of the loop occurs during herniation (about 90 degree) bringing the cranial limb to the right and the caudal limb to the left. Reduction of the hernia occurs in the tenth week with a second rotation (180 degree) ***(Sadler, 2012).***

The vitello intestinal duct undergo obliteration followed by absorption during the sixth week and the dorsal mesentery will remain as the intestinal mesentery ***(Sadler, 2012).***

Anatomy of the Small intestine in rats

The functional anatomy of the intestine in the rat has been considered similar to humans ***(Vdoviaková et al., 2016)***. However there are some anatomical differences between them, which includes:

1. The small intestine is the longest part of the gastrointestinal (GI) tract, approximately 170 cm in rats and (500-700) cm in humans ***(Hugenholtz and De Vos, 2018)***. In rats the duodenum length is approximately 10 cm, jejunum measures 100 cm and the length of the ileum is 3 cm ***(Vdoviaková et al., 2016)***.
2. The average small Intestine: colon length ratio is 2.5 in rats versus 7 in humans ***(Treuting and Dintzis, 2012),*** and the surface ratio of small intestine: colon is only 18 in mice compared to 400 in humans ***(Casteleyn et al., 2010)***.

3. Rats' intestinal villi are taller than those of human. This morphological difference increases the surface area of the rats' small intestine and has been suggested as a compensation mechanism for the lack of mucosal folds in the rat's intestine ***(Treuting et al., 2018)***.
4. In rodents, raised oval foci may be noted along the serosal antimesentric border. These collections of lymphoid cells are known as gut assosciated lymphoid tissue (GALT) and include lymphoid aggregates and Peyer's patches. In humans GALT is more prominent in the ileum ***(Treuting et al., 2018)***.
5. The anatomical nomenclature of the intestinal blood supply in humans and rats is different. The rats' small intestine is supplied by cranial mesenteric artery and by superior mesenteric artery in human ***(Vdoviaková et al., 2016)***. In humans some authors described that there is anastomosis between ileocolic artery and right colic artery. In 5% of cases this anastomosis was absent and the second anastomosis was between superior supra duodenal artery and inferior pancreatico duodenal artery ***(Skandalakis, 2004)***. In rats anastomosis was described between cranial pancreatic duodenal artery and caudal pancreatico duodenal artery ***(Vdoviaková et al., 2016)***.

Microscopic structure of the small intestine in humans

There are minor microscopic differences between the duodenum, jejunum and ileum ***(Eroschenko, 2008)***.

The small intestine is composed of four layers: mucosa, submucosa, muscularis externa and adventitia (serosa) ***(Gerson and Lightdale, 2017)***.

Mucosa

The mucosa is the innermost layer of the digestive tube, made up of three components: the simple columnar epithelium, a supporting lamina propria and a thin smooth muscle layer called muscularis mucosa. Muscularis mucosa consists of an inner circular and outer longitudinal layer of smooth muscle which produce local movement and folding of the mucosa ***(Yong et al., 2006)***.

The mucosa of the small intestine contains specialized structural modifications that help to increase the surface area for absorption of fluids and nutrients. These modifications exhibit the villi, microvilli and plicae circulares ***(Eroschenko, 2008)***.

In contrast to the stomach rugae, the plicae circulares are permanent elevations or spiral folds of the mucosa with a submucosal core that extend into the lumen of the intestine. In the proximal portion of the small intestine the plicae circulares are most prominent where most absorption takes place and toward the ileum they decrease in prominence ***(Eroschenko, 2008)***.

Villi are finger like projections in the lamina propria of the mucosa that extend into the lumen of the intestine. These villi are covered by simple columnar epithelium and also, they