The Influence of Row Soy Diet on Gastrointestinal Tract in Animal Model

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Background: Soybean is the vegetal product of soy, *Glycine max* fam. *Fabaceae*. It is well known that short-term ingestion of raw soy and plant trypsin inhibitors by mice greatly stimulates the exocrine pancreas, leading to increased enzyme production, organ enlargement and cellular hyperplasia.
The **aim** of this study is to examine changes that occur in the liver, an organ from the gastrointestinal tract less studied on this topic when row soy is administrated. Short time nutritional studies were conducted on C57BL/6J mice of four weeks.
Results showed a decrees in mice body mass after administration of row soybean. Histological analyze revealed an alteration of the pancreas showing the presence of inflammatory cell infiltrate, the phenomen of vascular congestion and edema of the parenchymal cells and of the liver highlighting fibrosis of the vascular wall, the presence of the intravascular infiltrate represented by fibrin and figurative elements (erythrocytes and leukocytes), of the Kupffer cells phagocyte active, and granulocytes with diapedez trend.
Conclusions: The main conclusion of this study is that row soybean diet has a negative action on the gastrointestinal tract in animal model affecting mostly the pancreas and the liver translated by decreasing body weight in mice.

Keywords: raw soy, pancreas, liver, mouse body weight

Introduction

Soybean, the vegetal product of soy, Glycine max fam. Fabaceae is an abundant source of proteins that have long been recognized for high nutritional value. Soybean also contains isoflavones, phytosterols, phytic acid and saponins [1,2]. Due to it's chemical composition , it is recommended for woman as an alternative to hormonal replacement therapy and/or as preventive agent against breast cancer and osteoporosis [3].

It is well known that short-term ingestion of raw soy and plant trypsin inhibitors by rats, mice, chicks and other species greatly stimulates the exocrine pancreas, leading to increased enzyme production, organ enlargement and cellular hyperplasia [4,5]. Long-term feeding of raw soy preparations results in the development of hyperplastic and neoplastic nodules of the pancreas, including carcinoma. It is also known that raw soybean causes a hypertrophy, and an increase in small intestinal weight, duodenal mucosa weight and smooth muscle layer thickness [6,7].

Liver is a primary site where the biotransformation of the products of digestion takes place through the degradation and detoxification of xenobiotic compounds received from the intestines or from the general circulation. The aim of our study is to examine changes that occur in the liver, an organ from the gastrointestinal tract less studied on this topic when row soy is administrated.

Material and methods

Short time nutritional studies were conducted on C57BL/6J mice of four weeks. Mice were purchased from Charles River (Germany). The work protocol followed all NIAH-National Institute of Animal Health rules: animals were maintained during the experiment in standard conditions: 12h light-dark cycle, food and water ad libidum, temperature 24 ºC, humidity above 55%. The number of mice taken into study was ten. The control group was formed by five mice which received 2 g/day row soybean prepared by grinding while in the other group five mice were fed on a standard laboratory chow.

Soy was acquired from the University of Agricultural Sciences and Veterinary Medicine of Banat, USAMVB, Timisoara. Soy was received with the next analyze report: Glycine semen contains 35–40% protein, 15–20% lipid (lecithin), 15–35% carbohydrates, isoflavones 1,2–3 g/kg, and saponozide with tritherpenic genin. Mice were maintained on this diet four weeks[8] and afterwards they were weighted and sacrificed. Pancreas and liver were excised, trimmed free of adherent fat, washed with PBS, blotted dry, examined for any visual macroscopic abnormalities, weighted and fixed in 10% formalin solution. Samples were stained with H&E (hematoxylin-eosin) and microscopically analysed.

Results

Mice body weight – 19.34 g in average was smaller in case of animals fed with row soy than 22.17 g in average in case of mice feed with standard food (Figure 1). Liver's weight ranged from 1.332 g in average (standard food) to 1.514 g in average (row soy) while pancreas weight ranged from 0,145 g in average (standard food) to 0.211 g in average (row soy).

The microscopic analysis of the pancreas showed the presence of inflammatory cell infiltrates, the phenomen of

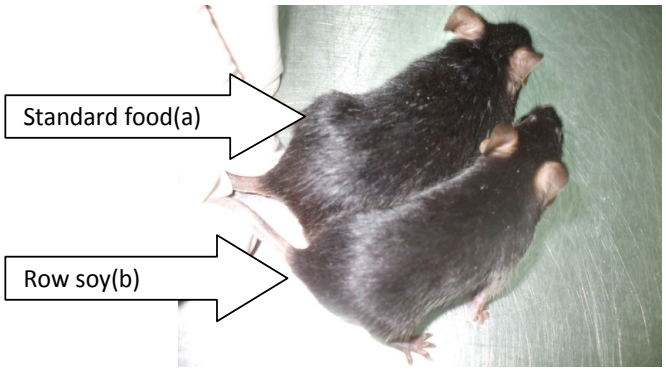

Fig. 1. (a) Mouse fed for four weeks with standard food, (b) Mouse fed for four weeks with raw soy

vascular congestion and edema of the parenchymal cells (Figure 2).

Following microscopic examination of the liver fibrosis of the vascular wall was evidenced, the presence of the intravascular infiltrate represented by fibrin and figurative elements (erythrocytes and leukocytes) was highlighted, of the Kupffer cells phagocyte active, and granulocytes with diapedezis trend (Figure 3). Hepatocytes exhibited nuclear heterocromatinisation, cariorexis and cariolise. These phenomena may indicate a reduction of the functional activity of the hepatocytes in question, due to malfunction of genes and failure of transcription of genetic information. At cytoplasmic level, there can be observed balloon dystrophy of hepatocytes (Figure 4).

Discussions

As Barac and coworkers observed [1], this paper confirms the fact that trypsin inhibitors in raw soybean cause growth inhibition, pancreatic hypertrophy and hyperplasia in experimental animals. Results in mice weight showed that there is in fact an inverse relationship between the trypsin inhibitor activity and the protein efficiency ratio. Not eliminated trypsin inhibitors in raw soybean were capable of inhibiting the growth in mice.

Another element about row soybean mentioned in literature is the fact that it caused an enlargement of the pancreas that can be described histologically as hypertrophy (an increase in the size of the acinar cells of the pancreas) as well as hyperplasia (an increase in the number of the acinar cells) [9,10].This paper also shows an alteration at pancreatic level by the presence of inflammatory cell infiltrate, the phenomen of vascular congestion and edema of the parenchymal cells.

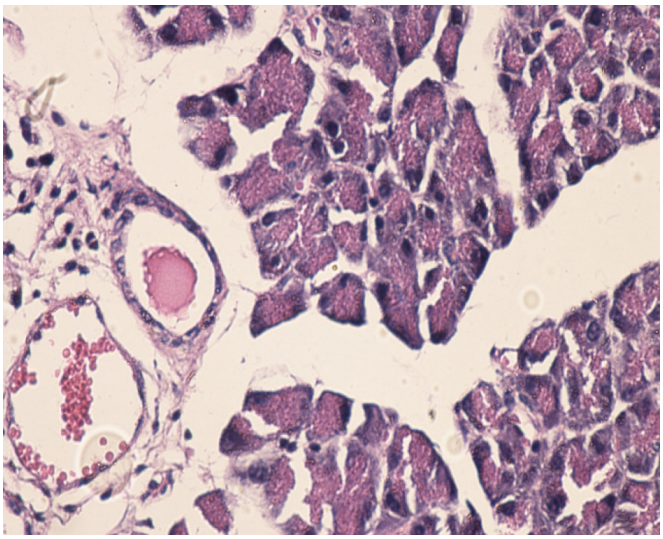

Fig. 2. Microscopic aspect of the pancreas – coloration HE x 400

Less studies were made on the liver and the purpose of present work was to observe the changes on this level. It can be observed that mice's liver fed with row soybean has an increased weight – 1,514 g versus mice fed with standard food – 1,332 g. Microscopic examination of the liver and the histological analysis by hematoxylin-eozyn staining confirm an alteration of the liver : fibrosis of the vascular wall, the presence of the intravascular infiltrate represented by fibrin and figurative elements (erythrocytes and leukocytes),of the Kupffer cells phagocyte active, and granulocytes with diapedesis trend.

Conclusions

The purpose of the study was to examine the influence of row soy diet on gastrointestinal tract in animal model. The

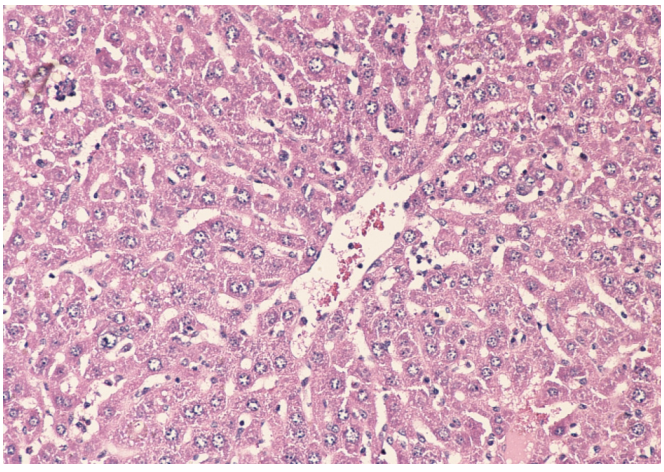

Fig. 3. Microscopic aspect of the liver – coloration HE x 400

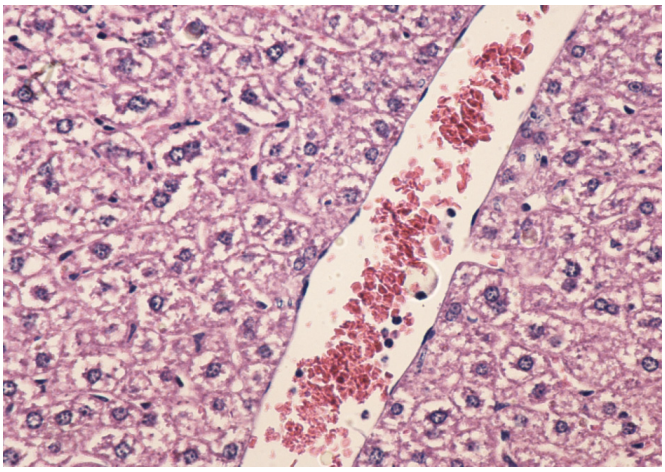

Fig. 4. Microscopic aspect of the liver – coloration HE x 400

main conclusion is that row soybean diet has a negative action on the gastrointestinal tract in animal model affecting mostly the pancreas and the liver translated by decreasing body weight in mice. Heat treatment of row soybean could be attributed to the destruction of these inhibitors. Further studies on the action of thermic prepared soy diet in animal model will be made.

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