

The Influence of Different Concentrations of Fats in Protein-Fat Substrates on the Proteolytic Activity of Pancreatic and Gastric Juices

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The effect of various concentrations of fat hydrolysis products on the total proteolytic activity of pancreatic and gastric juices was studied using a casein-fat emulsion (casein + tributyrin, casein + sunflower oil). It was concluded that sunflower oil hydrolysis products contribute to a significant decrease in pancreatic juice total proteolytic activity, which is not observed under the influence of tributyrin hydrolysis products. Hydrolysis products of both sunflower oil and tributyrin do not affect the gastric juice total proteolytic activity in an acidic environment. Increasing the concentration of both sunflower oil and tributyrin in the composition of the casein emulsion contributes to a significant decrease in the total proteolytic activity of pancreatic juice. At the same time, the effects of tributyrin are less pronounced than when using sunflower oil. At the same time, an increase in the concentration of both tributyrin and sunflower oil does not significantly affect the total proteolytic activity of gastric juice.

Keywords: pancreatic juice, gastric juice, proteolytic activity, protein-fat emulsion, casein, gelatin, tributyrin, sunflower oil.

Introduction

Information about the mechanisms of digestion can be obtained from the study of purified substrates (proteins, fats, carbohydrates), however, such data are not predictive of digestion in complex food complexes and can be misleading. In this connection, the study of digestion is desirable to conduct using mixed substrates [8]. The reason for this is that food substances proteins, fats and carbohydrates can form various types of physical complexes with

each other [3].

For example, polysaccharides due to electrostatic force can form various types of physical complexes with proteins depending on the pH, ionic strength and charge distribution of the biopolymer, which can prevent the hydrolysis of proteins in the stomach [2; 7]. At the same time, many proteins are surface active compounds at the water/fat interface, and can inhibit pancreatic lipase. This inhibition may be the result of competitive protein

adsorption and protein desorption of lipase from the surface of fat droplets. Lipase inhibition is associated with the ability of proteins to interact with lipids and change the quality of the water/fat interface; it is not caused by direct interaction of the protein with the enzyme [4; 5;9].

For several decades, the interaction of proteins with fatty acids has been studied. Despite this, the information obtained so far explains only some aspects of the interaction between proteins and fatty acids [6].

Being adsorbed on the surface of fat droplets, many proteins can prevent the hydrolysis of fats by pancreatic lipase due to the competitive adsorption of proteins and desorption of lipase proteins from the surface of fat droplets. In addition, the adsorption of proteins on the surface of fat droplets can prevent their hydrolysis by proteases.

Material and methods

In the work, gastric and pancreatic juices obtained in chronic experiments in dogs with fasting secretion were used. The effect of various concentrations of fats on the total proteolytic activity [1] of gastric and pancreatic juices was studied using a protein-fat emulsion (casein + tributyrin, casein + sunflower oil, gelatin + tributyrin, gelatin + sunflower oil). Under conditions of use as a substrate with gastric or pancreatic juice: casein or gelatin only, 1.0% oil

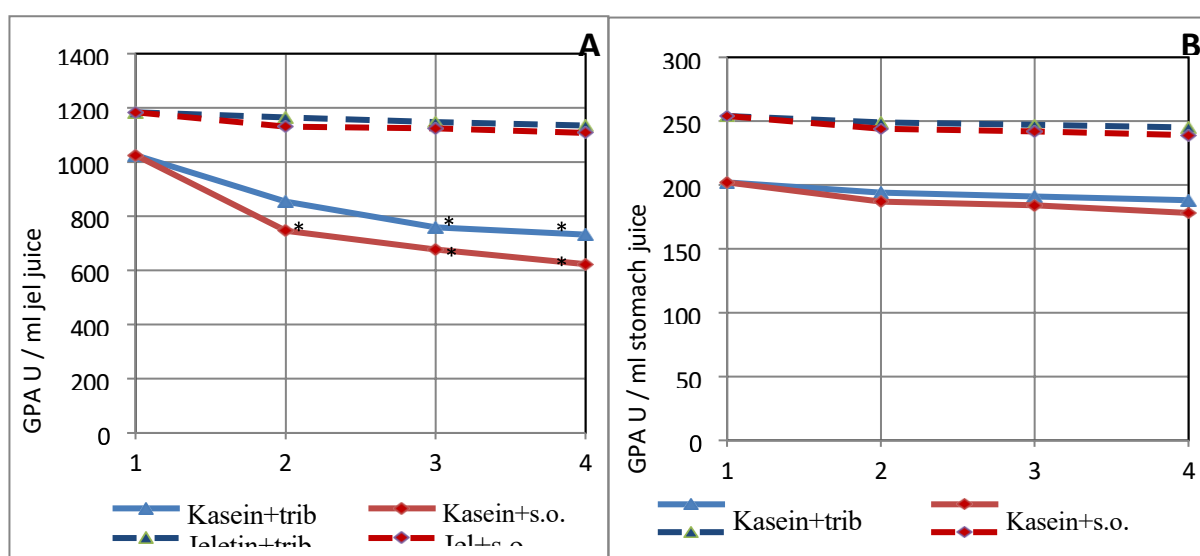
emulsion, 1.5% oil emulsion, 2.0% oil emulsion.

Statistical processing was carried out by the method of variation statistics with the calculation of average values and their average errors, determination of the coefficient of reliability of the Student-Fisher difference (t). Differences were considered statistically significant at $p < 0.05$ or less.

Results

In the conducted studies, which studied the effect of various concentrations of sunflower oil in the composition of the protein-fat emulsion on the total proteolytic activity of pancreatic juice, it was found that when using a 1.0% emulsion of casein and sunflower oil, the OPA indicators were significantly lower compared to the total proteolytic activity, where There was only casein without fat emulsion. At the same time, the indicators of total proteolytic activity when using 1.5% sunflower oil were significantly significantly lower compared to OPA without fat emulsion. The same direction of total proteolytic activity was noted when using 2.0% sunflower oil, which manifested itself in significantly lower rates compared to total proteolytic activity without fat emulsion. In general, there was a significantly pronounced gradual decrease in total

proteolytic activity under the influence of pancreatic juice with an increase in the concentration of sunflower oil (Fig. A).



Picture. Changes in the proteolytic activity of the pancreatic (A) and gastric (B) juices when using a protein-fat emulsion. The following were used as a substrate: 1- only casein or only gelatin; mixtures of casein or gelatin with: 2-1.0% oil emulsion; 3- 1.5% oil emulsion; 4 - 2.0% oil emulsion.

* - significantly different values in relation to the indicators of using only casein or gelatin as a substrate.

When studying the total proteolytic activity of pancreatic juice, using different concentrations of tributyrin in the composition of the protein -fat emulsion on the total proteolytic activity of pancreatic juice, it was found that when using a 1.0% emulsion of casein and tributyrin

, the indicators of total proteolytic activity were significantly lower, but not significantly expressed, compared with total proteolytic activity, where only casein without fat emulsion was used. total proteolytic activity values were higher than those with sunflower oil. At the same time, the total proteolytic activity values when using 1.5% tributyrin were significantly lower compared to the total proteolytic activity without fat emulsion and less than those using 1.0% tributyrin, and the total proteolytic activity values were also higher than those using sunflower oil. The same direction of total proteolytic activity was noted with the use of 2.0% tributyrin, which manifested itself in significantly lower rates compared with total proteolytic activity without fat emulsion and less than indicators with the use of 1.0% and 1.5% tributyrin, also these indicators of total proteolytic activity were higher than using sunflower oil. Thus, there was a significantly

pronounced gradual decrease in the total proteolytic activity of pancreatic juice with an increase in the concentration of tributyrin, it should be noted that the level of these indicators was higher compared to the level of sunflower oil (Fig. A).

In the study of the total proteolytic activity of pancreatic juice using emulsions consisting of gelatin and sunflower oil, as well as gelatin and tributyrin, it was found that with an increase in

the concentration of sunflower oil and tributyrin, there was an insignificant decrease in the TSA of pancreatic juice in relation to the use of only gelatin. At the same time, the real total proteolytic activity values were significantly higher than those with the use of casein emulsions (Fig. A).

When studying gastric juice total proteolytic activity using protein-fat emulsions using various concentrations of fats, it was found that when using a 1.0% emulsion of casein and sunflower oil, the total proteolytic activity was insignificantly lower compared to the total proteolytic activity without fat emulsion. At the same time, the indicators of total proteolytic activity when using a 1.5% emulsion of sunflower oil and casein were unreliably lower compared to total proteolytic activity without a fat emulsion and less than using a 1.0% emulsion of casein and sunflower oil. In the results of studies obtained using a 2.0% emulsion of sunflower oil and casein, there were also unreliably lower indicators of total proteolytic activity compared to those without fat emulsion and less than using 1.0% and 1.5% emulsion of casein and sunflower oil. In general, a less pronounced decrease in total proteolytic activity was observed under the influence of gastric juice with an increase in the concentration of sunflower oil (Fig. B).

When studying the total proteolytic activity of gastric juice using protein-fatty emulsions with different fat concentrations, it was found that when using an emulsion of casein and tributyrin, both 1.0% and 1.5%, as well as 2.0%, the total proteolytic activity was insignificantly less compared to total proteolytic activity without fat emulsion. At the same time, a slight decrease in total proteolytic activity was noted with an increase in the concentration of tributyrin (Fig. B).

In the study of gastric juice total proteolytic activity using emulsions consisting of both gelatin and sunflower oil, and gelatin and tributyrin, it was found that with an increase in the concentration of sunflower oil and tributyrin, there was an insignificant decrease in gastric juice PSA in relation to the use of only gelatin. At the same time, these figures were significantly higher than those with the use of casein emulsions (Fig.

A).

The discussion of the results

As a result of the research, when studying the effect of various concentrations of sunflower oil in the composition of the protein-fat emulsion on the total proteolytic activity of pancreatic juice, a significantly gradual decrease in the total proteolytic activity of pancreatic juice with an increase in the concentration of sunflower oil was found. This is due to the fact that proteins have adsorption on the surface of fat droplets, in protein-fatty emulsions. The results obtained can also be explained by the fact that with an increase in the concentration of sunflower oil in the composition of protein-fat emulsions, the number of fat droplets and the total surface of these droplets increase. Due to this, the amount of casein adsorbed on fat drops increases, and this interaction prevents the effect of proteases on the casein molecules, as a result, a decrease in the total proteolytic activity of pancreatic juice is noted when using a protein-fat emulsion.

When studying the effect of different concentrations of tributyrin in the composition of the protein-fat emulsion a significant gradual decrease in the total proteolytic activity of pancreatic juice was observed with an increase in the concentration of tributyrin, but the level of these indicators was higher compared to those of sunflower oil. Based on these data, it can be assumed that the difference in the effects of sunflower oil and tributyrin can be influenced by the difference in the physicochemical structure of these oils, which affects the difference in the degree of adsorption of casein on sunflower oil and tributyrin. As we noted above, sunflower oil is a triglyceride in the composition, which includes mainly long-chain fatty acids oleic and linoleic acids. While tributyrin triglyceride contains short-chain butyric acid. It can be assumed that the force of interaction of casein with sunflower oil, when it is adsorbed on the surface of a fat drop, due to the presence of long-chain fatty acids, is much higher than with tributyrin. This prevents the effect of pancreatic juice proteases on casein adsorbed on the surface of the fat droplet, which leads to a more

pronounced decrease in when using sunflower oil than when using tributyrin.

At the same time, in studies of the effect of protein-fat emulsions with the use of sunflower oil in their composition on the total proteolytic activity of gastric juice, a slight decrease in the total proteolytic activity of gastric juice was found with an increase in the concentration of sunflower oil. The obtained results can be explained by the fact that, despite the increase in the concentration of sunflower oil in the composition of protein-fat emulsions and the increase in the number of fat drops, as well as the total surface of these drops, the amount of casein adsorbed on fat drops does not increase. That is, in an acidic environment, the adsorption of casein on fatty drops of sunflower oil is reduced, and this interaction does not prevent the effect of proteases on casein molecules, as a result, the total proteolytic activity of gastric juice does not change significantly when using a protein-fat emulsion.

Based on the data obtained in the study of gastric juice total proteolytic activity using protein-fat emulsions with different fat concentrations, it was found that when using an emulsion of casein and tributyrin, there was a slight decrease in total proteolytic activity with an increase in tributyrin concentration. The obtained results can be explained by the fact that, despite the increase in the concentration of tributyrin in the composition of protein-fat emulsions, and the increase in the number of fat droplets, as well as the total surface of these droplets, the amount of casein adsorbed on the fat droplets does not increase. That is, in an acidic environment, the adsorption of casein on fatty drops of tributyrin is reduced, and this interaction does not prevent the effect of proteases on casein molecules, as a result, the total proteolytic activity of gastric juice does not change significantly when using a protein-fat emulsion using tributyrin.

In the study of the total proteolytic activity of gastric and pancreatic juice using emulsions consisting of gelatin and sunflower oil, as well as gelatin and tributyrin, there was a slight decrease in the total proteolytic activity of gastric and

pancreatic juices in relation to the use of gelatin alone. The obtained results can be explained by the fact that, despite the increase in the concentration of sunflower oil and tributyrin in the composition of gelatin-fat emulsions, and the increase in the number of fat drops, as well as the total surface of these drops, the adsorption and interaction of gelatin on fatty drops of sunflower oil and tributyrin does not prevent the influence of proteases on gelatin molecules, as a result, the total proteolytic activity of gastric and pancreatic juices does not change significantly.

Conclusions

Increasing the concentration of sunflower oil in the composition of the emulsion with casein contributes to a significant decrease in the total

proteolytic activity of pancreatic juice. Increasing the concentration of tributyrin in the composition of the casein emulsion also contributes to a significant decrease in pancreatic juice total proteolytic activity, but this effect is less pronounced than when using sunflower oil. Increasing the concentration of both tributyrin and sunflower oil in the composition of the emulsion with casein in an acidic environment does not significantly affect the total proteolytic activity of gastric juice. Similarly, an increase in the concentration of both tributyrin and sunflower oil in the composition of the emulsion with gelatin also does not significantly affect the total proteolytic activity of gastric and pancreatic juices.

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