which is a more valuable food product for snails than apple, induces stronger motivational excitation, and under the influence of γ-Np 3.5, this becomes dominant whereas the initially weak motivation induced by apple remains nondominant. However, this hypothesis is less probable because the time course of formation and extinction of learning, depending on the level of motivation [10], did not differ when carrot and apple were used as the conditioned stimulus. Furthermore, no preference was found for carrot or apple with respect to the rate of their consumption and the quantity consumed by the snails.

The possibility cannot be ruled out that selective action on species-nonspecific, grain-specific NHCP Np 3.5, in the experimental situation used, may affect other mechanisms of behavior of snails also. The facts obtained are evidence that brain-specific NHCP are selectively involved in the processes of recall of information from memory. These processes are evidently closely linked with activity of the genome of the nerve cell, regulating the function of NHCP and playing an operative role in the molecular determination of processes of integrative activity.

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EXPERIMENTAL STUDY OF THE INITIAL STAGES OF PROTEIN ASSIMILATION IN LATE ONTOGENY

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KEY WORDS: aging; stomach; protein assimilation.

The particular features of protein assimilation in late ontogeny remain inadequately studied. According to data in the literature [9] in old age hydrolysis and absorption of proteins are reduced, and this leads to the reorganization of amino-acid metabolism, with a decrease in the utilization of free amino acids for structural processes, and to changes in synthesis of digestive enzymes. It has also been shown that during aging it is the function of the transport systems that suffers rather than the sorptive properties of the enterocytes and peptidase synthesis [8]. It has been shown [7] that a high level of membrane hydrolysis of proteins, which continues into old age, helps to protect the body against protein deficiency.

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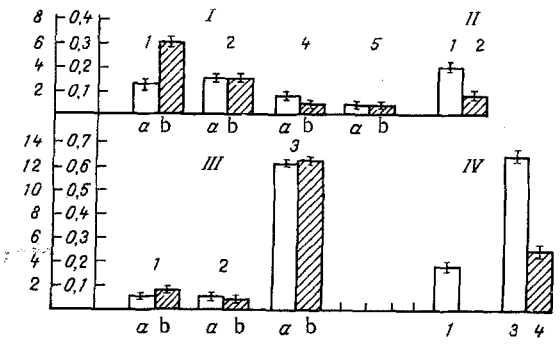

Fig. 1

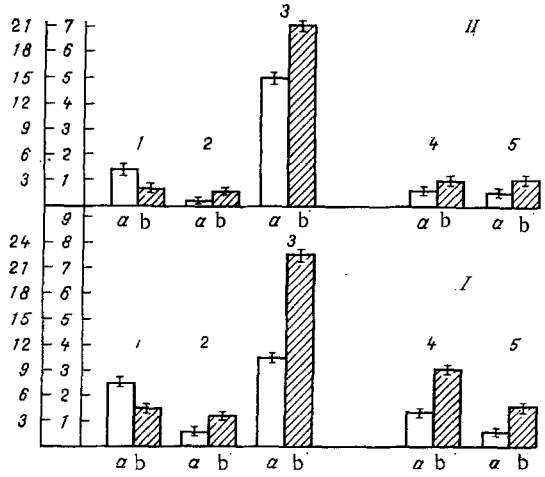

Fig. 2

Fig. 1. Proteinase activity in gastrointestinal tract of young animals and during aging. I) Activity of pancreatic proteinases (1), CD (2), AP (3), and Gly-Leu-dipeptidase (4) in chyme of jejunum (a) and ileum (b); II) activity of Gly-Gly-dipeptidase (1) and Gly-Leu-dipeptidase (2) in gastric mucosa of young rats; III) activity of panceatic proteinases (1), CD (2), and AP (3) in mucosa of jejunum (a) and ileum (b) of young rats; IV) activity of Gly-Gly-dipeptidase (1), AP (3), and CD (4) in gastric mucosa of old animals. Here and in Fig. 2: ordinate, enzyme activity (in optical density units/mg protein/min).

Fig. 2. Proteinase activity in chyme and mucosal deposits of SI during aging. I) Pancreatic proteinase (1), CD (2), AP (3), Gly-Gly-dipeptidase (4), and Gly-Leu-dipeptidase activity (5) in chyme from jejunum (a) and ileum (b) of old rats; II) activity of these same enzymes in mucosal deposits of old rats.

To shed light on the initial stages of protein assimilation in late ontogeny, an experimental study was undertaken of activity of the lysosomal proteinases acid phosphatase (AP) and cathepsin D (CD) in the chyme and mucosal deposits of the gastrointestinal tract, and also activity of pancreatic proteinases and dipeptidases in the chyme and mucosal deposits of various parts of the small intestine (SI).

EXPERIMENTAL METHOD

Experiments were carried out on young Wistar rats weighing 200 g and old Wister rats (aged 2 years) weighing from 600 to 700 g. The animals were kept on the ordinary animal house diet. Activity of AP and CD in the chyme and mucosal deposits of the gastro-intestinal tract was determined by the method in [5]. The fractional composition of the nitrogenous fraction of the contents of the gastrointestinal trace was studied by gel-chromatography with Sephadex [7]. Pancreatic proteinase activity was determined by the method in [11], dipeptidase activity by the decrease in the quantity of substrate [6], and the protein concentration by Lowry's method [10].

EXPERIMENTAL RESULTS

The study of the dipeptidase activity of the gastric mocusa showed that glycyl-glycine dipeptidase activity was rather lower in the old than in the young rats (Fig. 1). AP activity was rather lower in the old than in the young rats (Fig. 1). AP activity in the gastric mucosa of the old animals was quite high (Fig. 1). CD activity, like AP activity, in the gastric mucosa, was sufficiently high. Activity of these lysosomal marker enzymes was a little higher than in young rats [9, 12].

Pancreatic proteinase activity in the chyme (Fig. 1) and mucosa of the ileum of young rats was significantly higher than in the chyme and mucosa of the jejunum. During aging, on the other hand, pancreatic proteinase activity was higher in the proximal portion of SI than in the distal, as was shown both for the chyme and for the mucosal deposits (Fig. 2). Whereas in the proximal part of SI in old rats pancreatic proteinase activity was at virtually the same level as in young rats, in the distal part it decreased during aging (Figs. 1 and 2). Activity of the lysosomal marker enzymes, CD and AP, was distributed virtually uniformly in

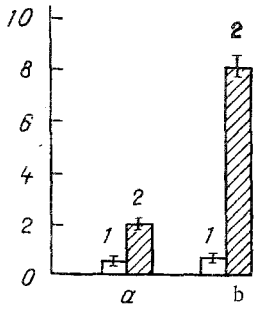

Fig. 3. Concentration of protein (1) and low-molecular-weight (2) fractions in chyme of SI. Ordinate, area below peak (in relative units).

the young rats between the proximal and distal portions of SI, both in the chyme and in the mucosa of these regions. During aging, AP and CD activity was found to be almost twice as high in the distal part of SI than in the proximal part, both in the chyme and in the mucosal deposits. During aging a proximal-distal gradient of distribution of lysosomal marker enzymes is thus observed.

Previously the authors found that the period of milk feeding in animals is characterized by a proximal-distal gradient of distribution of lysosomal proteinases in SI, which flattens out on the transition to definitive feeding [2, 4]. In old animals a redistribution of lysosomal proteinases was found to take place, similar to that in animals during the postnatal period of development.

The results of the study of dipeptidase activity in the young animals showed that specific Gly-Gly-dipeptidase activity is higher in the proximal part of SI than in its distal part. Gly-Leu-dipeptidase activity in young animals was uniformly distributed between the proximal and distal portions of SI. During aging a proximal-distal gradient of distribution of both dipeptidases was found both for the chyme and for the mucosal deposits.

When the fractional composition of the chyme from the proximal and distal portions of SI was studied during aging an increase in the content of the low-molecular-weight fractions was found in the distal part compared with the proximal part (Fig. 3). The authors found previously that the proximal-distal gradient of luminal protein digestion is characteristic of the period of milk feeding of mammals, it is accompanied by a proximal-distal gradient of the distribution of lysosomal proteinase activity, and it ensures increased reliability of function of SI at this period of development [3].

In adult animals luminal protein digestion takes place in the proximal part of SI, and the distal part acts as a reserve zone [4]. Activity of lysosomal proteinases in young animals is uniformly distributed between the proximal and distal parts of SI [1].

During aging a redistribution of activity of pancreatic proteinases is observed between the different parts of SI and a proximal-distal gradient of distribution of lysosomal marker enzymes takes place both in the chyme of the proximal and distal parts of SI and in the mucosal deposits. It can be tentatively suggested that during aging the concluding stages of luminal protein digestion shift toward the distal part of SI, the reserve zone is reduced, and for that reason the gradient observed in the distribution of activity of lysosomal marker enzymes and dipeptidases therefore serves to increase the reliability of function of SI.

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