Adaptation of Intestinal Amino Acid Transport

Amino acids are absorbed against a concentration gradient by the mucosa of the small intestine¹. In previous experiments we have demonstrated that active amino acid transport of rat small intestine is enhanced by an increase of dietary protein^{2,3}. We wished to investigate in further experiments whether this change in intestinal transport is specific to amino acid transport. For this reason, transport of L-leucine was compared with transport of D-galactose, which is also absorbed against a concentration gradient⁴.

42 adult male Sprague Dawley rats (average body weight: 181 g) were fed diets either low (13% casein) or high (88% casein) in protein for 2 weeks. The exact composition of the diets is described elsewhere⁵. Since

against a concentration gradient than did intestinal sacs of rats fed the low protein diet. As to galactose transport there was no difference between both groups. These findings indicate a specific adaptation of active intestinal amino acid transport to the level of dietary protein intake¹².

Zusammenfassung. An evertierten Dünndarmsäcken (proximales Jejunum) erwachsener Ratten, die zwei Wochen lang eine proteinarme (13% Kasein) oder proteinreiche (88% Kasein) Diät erhalten hatten, wurde der aktive intestinale Transport von L-Leuzin und D-Galaktose untersucht. Proteinreiche Ernährung führte zu einer Stimulierung des L-Leuzin-Transports, während der D-

L-leucine and D-galactose transport by everted sacs of upper jejunum of rats fed either a low or a high protein diet

Diet	L-leucine transport		D-galactose transport	
	Low protein	High protein	Low protein	High protein
Dry wt. of the everted sacs (mg),	52 ± 4 ^a (n = 11)	57 ± 11 (n = 11)	47 ± 3 (n = 10)	49 ± 6 (n = 10)
Final volume of the serosal medium (ml) ^b	1.00 ± 0.02	1.03 ± 0.06	0.99 ± 0.04	0.97 ± 0.04
s/m Concentration gradients	3.6 ± 0.4	5.3 ± 1.3	5.6 ± 1.1	5.6 ± 0.8
Serosal transfer (μMol)	9.3 ± 1.9	14.4 ± 4.7	16.1 ± 3.0	15.5 ± 1.9
	p < 0.001			
	p < 0.01			

^aS.D. ^bInitial volume of the serosal medium: 1 ml. Initial volume of the mucosal medium: 20 ml.

feeding the high protein diet results in a depression of food intake^{6,7} the animals were pair-fed. The amount of food offered per animal and day was gradually increased from 8 to 15 g. Thus average daily food intake during the 2-week-period was 12.9 g per animal in both groups. The animals were fed twice a day. After 2 weeks on the experimental diets, average body weight of the animals was 204 g (low protein diet) and 207 g (high protein diet), respectively.

Intestinal transport of L-leucine and D-galactose was studied in vitro using everted sacs of upper jejunum according to the method of WILSON and WISEMAN⁸. The upper jejunum was removed under anesthesia (0.6 ml Equi Thesin⁹/100 g body weight). Krebs Henseleit bicarbonate buffer (pH 7.4) containing either 5 mM ¹⁴C-labelled L-leucine¹⁰ (The Radiochemical Center, Amersham) or 5 mM D-galactose was used as incubation medium. The specific activity of the ¹⁴C-labelled L-leucine used was 1 μCi/mMol. Parameters for active transport were increases of substrate quantities in the serosal medium (= serosal transfer) during the incubation (1 h, 37°C) and concentration gradients (s/m) between the serosal (s) and mucosal (m) medium of the everted sacs at the end of the incubation. s/m gradients > 1 are indicative of active transport. ¹⁴C-activity was measured with a liquid scintillation spectrometer (Packard). D-galactose was determined enzymatically with galactose dehydrogenase and NAD using the test combination of Boehringer GmbH, Mannheim.

The results are summarized in the Table. It is evident that everted intestinal sacs of rats fed the high protein diet transported significantly larger amounts of L-leucine

Galaktose-Transport dadurch unbeeinflusst blieb. Diese Befunde sprechen für eine spezifische Adaptation des intestinalen Aminosäuretransports an den Proteingehalt der Nahrung.

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⁹ Jensen Salsbery Laboratories, Richardson-Merrell Inc., Kansas City, Mo.

¹⁰ L-leucine is not catabolized by the small intestine¹¹.

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¹² Mit Unterstützung der Deutschen Forschungsgemeinschaft.