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PROTEIN DIGESTION AND ABSORPTION BY THE ENTIRE GASTROINTESTINAL--ETC(U)  
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Digestion of egg albumin by the human gastrointestinal tract was studied in 15 adult Chinese males, using the oral lavage method developed in our laboratory. Except for an intermission period of 1½ or 2½ hours, subjects drank an isotonic saline solution continuously during the study period. Fractions of the oral protein load digested were significantly greater in		

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subjects allowed 2 hours digestion time (mean, 45%) than in those given only 1 hour for digestion (32%). Furthermore, subjects showed greater digestion of the cooked albumin than the raw protein: 91% versus 36% digestion. These results indicate the feasibility of the oral lavage method for nutritional studies.

The fraction of test protein digested was significantly greater in younger subjects than in older ones: 47% and 32%, respectively, with 1 hour digestion time. This suggests that digestive activity of the human gastrointestinal tract decreases with an increase in age.

Clinical application of the protein digestion test by the oral lavage method was first done on a patient with Kwashiorkor-like syndrome. No protein digestive capacity could be detected during his illness while protein digestive capacity resumed to about 60% that of a normal person during his convalescence, 5 weeks after removal of a blind intestinal loop.

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Protein Digestion and Absorption by the Entire  
Gastro-Intestinal Tract in Man.

by  
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(a) a summary of all research accomplished:

During the past 3 years, an oral lavage method has been developed for studying protein digestion and absorption by the entire gastro-intestinal tract in man. The oral lavage method has been found to be safe without untoward effects. Heart rate, blood pressure and plasma electrolytes have been stable during the period of lavage (Phillips et al. 1977).

The method of study has been described previously (Phillips, 1975). Essentially, the fasting normal subject drinking an isotonic saline solution at a rate of 40 g/min develops, in 1 hour, a diuresis and a diarrhea. Continued drinking for a second hour completes flushing out of all food, feces, and bacteria from the gastro-intestinal tract. Drinking for a third hour enables collection of two 30-min control samples of urine and stool. Drinking is then stopped. Thirty minutes later, 32 g of egg albumin in 200 g of saline solution are ingested, and 1 or 2 hours are allowed for digestion. Then drinking is resumed (40 g/min) with a dye marker in the first 200 ml. Stool and urine samples are collected every 30 min, from the occurrence of free-flowing diarrhea until 30 min after all dye has disappeared. Aliquots of stool specimens are analysed for total nitrogen and non-protein nitrogen. The amount of protein nitrogen is estimated by difference. In healthy Chinese males given 32 g of egg albumin the average digestion is:

20-30 years-old males and 1-hour digestion = 47%  
40-50 years-old males and 1-hour digestion = 32%  
40-50 years-old males and 2-hour digestion = 45%

It is well known from conventional nutrition studies that heat denaturation of protein increases digestibility. Our 6 paired studies in normal Chinese subjects have shown that 91 per cent of the cooked egg albumin is digested in 1 hour while only 36 per cent of the raw protein is digested during the same digestion time. Thus, there is indication that the oral lavage method is a rapid and convenient procedure for such studies (Phillips, 1975).

The first clinical application of this oral lavage method in diagnosis of protein maldigestion was done on a patient with Kwashiorkor-like syndrome.

During his illness his ability to digest protein was studied by the oral lavage method; no protein digestive capacity could be detected. During the convalescent period, 5 weeks after resection of a proximal jejunal blind loop, the patient's ability to digest protein was again studied and found to be about 60% that of a normal person of his age (Huang et al., 1976).

Amino acid clearances by the gastrointestinal tract are determined. Intestinal clearances for methionine, tyrosine and the branched chain amino acids are around 20 ml/min; clearances of other amino acids are all beyond 3 ml/min. However, clearances of amino acids by the kidney are only about 1 ml/min, except for glycine, histidine and tryptophan which are close to 3 ml/min (Lee et al, 1975).

(b) an index of all technical reports issued under the contract.

Annual Report, by Robert A. Phillips, 25 March 1975.

(c) an index of all publications issued under the contract.

Lee, S.C., C.C. Huang, T.K. Young, R.Q. Blackwell and R.A. Phillips; Preliminary studies on the determination of human gastrointestinal clearances of amino acids by an oral lavage method. Chinese Med. J., 22:16-21, 1975.

Huang, C.C., H.C. Huang, S.C. Lee, T.K. Young, R.Q. Blackwell and R.A. Phillips; Defective protein digestion with Kwashiorkor-like syndrome in a Chinese adult following subtotal gastrectomy. Chinese Med. J., 23:118-122, 1976.

(d) conclusion drawn based on the research:

Digestion of egg albumin by the human gastrointestinal tract was studied in 15 adult Chinese males using the oral lavage method developed in our laboratory. Except for an intermission period of  $1\frac{1}{2}$  or  $2\frac{1}{2}$  hours, subjects drank an isotonic saline solution continuously during the study period. Fractions of the oral protein load digested were significantly greater in subjects allowed 2 hours digestion time (mean, 45%) than in those given only 1 hour for digestion (32%). Furthermore, subjects showed greater digestion of the cooked albumin than the raw protein, 91% versus 36% digestion. These results indicate the feasibility of the oral lavage method for nutritional studies.

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(e) a list of major accomplishments:

A new procedure, the oral lavage method, is developed for nutritional studies. The method is simple and requires no more than 8 hours. In our study we found that this method was sensitive enough to detect protein digestion altered by

(1) digestion time,

(2) age,

(3) heat denaturation of protein.

The method was also sensitive enough to diagnose protein maldigestion at least in one patient with Kwashiorkor-like syndrome.

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