



TIM GASTROINTESTINAL TESTING

Triskelion tests and analyses chemical, pharmaceutical and biotechnology products, guaranteeing the safety and quality of the products we use every day. Triskelion ensures that we don't have to worry and that we can live safe and better lives.

FOOD

AS PART OF NUTRITIONAL RESEARCH AND PRODUCT DEVELOPMENT YOU NEED RELIABLE SCIENTIFIC DATA ABOUT THE BEHAVIOR OF THE FOOD PRODUCTS DURING GASTROINTESTINAL TRANSIT, PREFERABLY IN A TIME- AND COST-EFFICIENT WAY. TRISKELION FULFILLS THESE REQUIREMENTS BY OFFERING GASTROINTESTINAL TESTING WITH THE TNO GASTROINTESTINAL MODELS (TIM). THE TIM-1 AND TINY-TIM SYSTEMS SIMULATE THE DYNAMIC CONDITIONS IN THE STOMACH AND SMALL INTESTINE, WHEREAS THE TIM-2 SYSTEM SIMULATES THE LARGE INTESTINE.

TIM TECHNOLOGY

The TIM technology is used to get consistent and reliable scientific data about the behavior of your oral products during transit through the stomach, the small intestine and large intestine. Twenty years of experience with dynamic gastrointestinal simulation and performance of evaluation studies in comparison with clinical studies guarantees the predictive quality of the results for a broad range of TIM research applications. The TIM-1 and tiny-TIM systems simulate the successive dynamic conditions in the stomach and small intestine, TIM-2 in the large intestine.

BENEFITS

As a reliable *in vitro* predictive tool, the TIM systems are an alternative to animal studies and help you reduce the failure rate of time-consuming and expensive human clinical studies. The TIM system contributes to an efficient product development by selecting your most promising candidate aimed for selected consumer populations (adult, children, elderly and healthy or diseased). TIM studies quickly and cost-efficiently provide reliable information about the gastrointestinal digestion of your products and

subsequent release, stability and bio-accessibility of the relevant compounds. Studies can be performed under simulated human and animal gastrointestinal conditions related to different types of drinks and meals, age and health status. This information enables better informed decisions to be made, minimizing the number of subsequent animal experiments and clinical studies.

TIM-1 SYSTEM

The multi-compartmental, computer-controlled TIM-1 system accurately simulates the successive dynamic human conditions or animal conditions in the stomach and the three parts of the small intestine: duodenum, jejunum and ileum. These conditions are responsible for the digestion of food and the release and dissolution of nutrients, bioactive compounds and pharmaceutical ingredients. Dissolved low molecular weight compounds are dialyzed or filtrated from the jejunum and ileum compartments. Samples collected during the experiments are analyzed for the respective compounds. These data give an accurate insight into the total and time-related availability for absorption of nutrients and drugs.



FOOD

APPLICATION

THE TIM SYSTEMS HAVE BEEN EVALUATED AND APPLIED FOR A BROAD RANGE OF HUMAN NUTRITION STUDIES, RELATED TO FOOD QUALITY, FUNCTIONAL FOODS AND FOOD SAFETY. THE TIM SYSTEMS HAVE ALSO BEEN EVALUATED AND APPLIED FOR VARIOUS PET FOOD AND ANIMAL FEED STUDIES, SIMULATING SPECIES SPECIFIC ANIMAL GASTROINTESTINAL CONDITIONS, RELATED TO FOOD/FEED QUALITY, FUNCTIONAL COMPOUNDS AND SAFETY. TIM STUDIES OFFER YOU RELIABLE INFORMATION ABOUT THE GASTROINTESTINAL RELEASE, STABILITY, DIGESTION, INTERACTION AND THE AVAILABILITY FOR INTESTINAL ABSORPTION (BIO-ACCESSIBILITY) OF FOOD PRODUCTS AND INGREDIENTS IN A RAPID AND COST-EFFICIENT WAY. STUDIES CAN BE PERFORMED SIMULATING VARIOUS CONDITIONS RELATED TO DIFFERENT TYPES OF MEALS AND DRINKS AS WELL AS SINGLE INGREDIENTS FOR ADULTS AND INFANT OR ELDERLY CONDITIONS OR VARYING HEALTH STATUS. THIS INFORMATION SUPPORTS THE PRODUCT DEVELOPMENT PROCESS TOWARDS OPTIMIZED CLINICAL STUDIES.

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TINY-TIM SYSTEM

The tiny-TIM system simulates the successive dynamic human conditions (adults and children) or animal conditions in the stomach and small intestine. It has, however, one compartment for the small intestine in which the intestinal passage is mimicked (in contrast to TIM-1, which has separate compartments for the duodenum, jejunum and ileum).

Tiny-TIM has been successfully evaluated for research applications for food and nutrition, pet food, animal feed and pharmaceuticals (including pediatrics). In line with TIM-1, tiny-TIM has a high predictive value for clinical data, but it should be noted that tiny-TIM gives less detailed information compared with TIM-1. An advantage of the tiny-TIM system is that two parallel experiments can be performed at the same time by one operator, which saves time and costs.

TIM-2 SYSTEM

The TIM-2 system simulates the large intestine (colon). This includes high-density, metabolic active microbiota of human (e.g. adult or children, healthy or diseased) or animal origin under strict anaerobic conditions. The composition of the microbiota in TIM-2 is stable over a long term, as measured using DNA technologies. This is realized through accurately simulating the colon conditions, such as temperature, pH control, peristalsis, the supply of non-digested food compounds like substrates for the microbiota, and continuous filtration of the microbial metabolites that are produced.

This enables the effect of a test product (e.g. prebiotics or a colon-targeted drug)

on the microbiome and vice versa to be measured. Besides measurements of the microbiome using DNA technologies, metabolites produced by the microbiome are also measured using Triskelion's analytical platforms. At least three experiments (for example, a duplicate experiment with the test product and one blank experiment) are performed in parallel. This enables a direct and reliable analysis of the effect of the test product on the microbiome compared to the blank experiment with identical start compositions of the microbiome. The throughput performance is relatively high in contrast to other *in vitro* dynamic colon systems.

Over 160 scientific peer-reviewed publications demonstrate the broad application and predictive quality of the TIM models. Applications include:

- Digestion of foods, food ingredients and supplements
- Protein quality, digestibility and bio-accessibility of (indispensable) amino acids (PDCAAS and DIAAS)
- Bio-accessibility of (macro- and micro-) nutrients, e.g. phytochemicals or vitamins
- Survival of probiotics and pathogens
- Colon fermentation of prebiotics
- Bio-accessibility and colon metabolism of phytochemicals (botanicals)
- Release, stability and bio-accessibility of food allergens, (potential) toxic compounds (mycotoxins)

The main applications of TIM in pet food and animal feed research focus on the digestion of pet food and animal feed and food/feed ingredients and the effect of food/feed processing on digestion.