MODELS OF THE GASTROINTESTINAL TRACT

The Tiny-TIM system in a laboratory setting

TNO innovation for life

TNO's models for gastrointestinal research (TIM) represent the most advanced, patent protected platforms for studying the fate of food and food constituents during digestion in the stomach and small intestine and fermentation in the large intestine.

TIM FOR RAPID AND ACCURATE DIGESTIVE MODELLING

TIM mimics human or animal digestion and can be used for a broad range of study objectives. These include digestion and availability for absorption of macro-nutrients (carbohydrates, proteins, oils and fats), and micronutrients (minerals, trace elements, water- and fat soluble vitamins).

Cellular absorption, transport, metabolism and response are studied using TIM samples in combination with various cell line and tissue cultures. When used with advanced analytical analysis (including quantitative biochemical analysis, DNA chips, immune assays, pyrosequencing) and modeling software, these platforms offer the best one can get for the *in vitro* evaluation of dietary components during digestion.

BENEFITS

TNO's TIM platforms allow you to replace the use of animals, reduce the number or size of human volunteer studies and make better choices during product development. Hence, conducting TIM studies can add up to a considerable cost savings in your development process. In general, the technology contributes to shorten the time-to-market of new products by up to several months. Experiments in TIM do not require ethics approval and allow one to work with early development compounds (before safety evaluation), labeled compounds or pathogens.

TIM-1

TIM-2

TECHNOLOGY

The TIM technology is groundbreaking in combining advanced peristaltic simulation, membrane technologies with full computercontrol and versatile experimental settings. This offers great flexibility in experimental design and study goals, while maintaining a high reproducibility.

The family of TIM platforms:

- TIM-1: simulating the stomach and small intestine;
- Tiny-TIM: simplified and downscaled TIM-1 for rapid screening;
- TIM-Carbo: specialized system for the *in vitro* assessment of Glycemic Response and Index;
- TIM-2: simulating the large intestine.

COMBINED WITH OTHER TECHNIQUES

TNO's in house capabilities for complex analyses are a strong contributor to TIM's effectiveness. Another example is TIM-2's combination with our unique microbiotic screening tools.

EXAMPLES OF TIM AT WORK

Stability and efficacy of functional compounds; e.g. fat and cholesterol binders, enzyme supplementation, antioxidants, anti-inflammatory compounds, probiotic bacteria, prebiotics and omega-3 fatty acids (in food matrices or in protective coatings or capsules), mycotoxins binders, as well as various screening purposes.

SPECIALIZED APPLICATIONS

TNO is able to simulate the healthy digestive conditions of various age groups (babies, adults and elderly people), as well as disease conditions (e.g. pancreas insufficiency). Also the gastrointestinal tract of some animal species can be simulated (pigs, preruminant calves, dogs). Additionally, modeling tools (computer-simulation) have been developed to predict blood concentrations of the compounds being studied.

BUSINESS MODELS

Studies of your product in the TIM systems are performed as contract research at TNO. For your in house research, you could also choose a lease construction for the TIM systems, which includes the installation of a model at your research facility, training of your staff and servicing.

REFERENCES

The TIM platforms are highly appreciated by our food and pharma customers. More than 80 scientific papers have been published in peer-reviewed journals referring to a broad array of TIM studies.

REGULATORY AUTHORITIES

The results of TIM studies are increasingly being used to substantiate product claims in product dossiers for legal registration purposes. Evidence from *in vivo* trials, however, will still be required to complete health claim dossiers.

TNO.NL

HEALTHY LIVING

TNO initiates technological and societal innovation for healthy living and a dynamic society.

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