

Lowering energy intake

Weight management

Joined effort to get insight

Considering the increasing number of overweight people (more than 50% of the Europeans between 35 and 65 yr of age being overweight), there is an urgent need for food products that help to lower energy intake.

We have started a substantial research programme, with the ultimate goal to develop and evaluate food products that help to lower or maintain body weight.

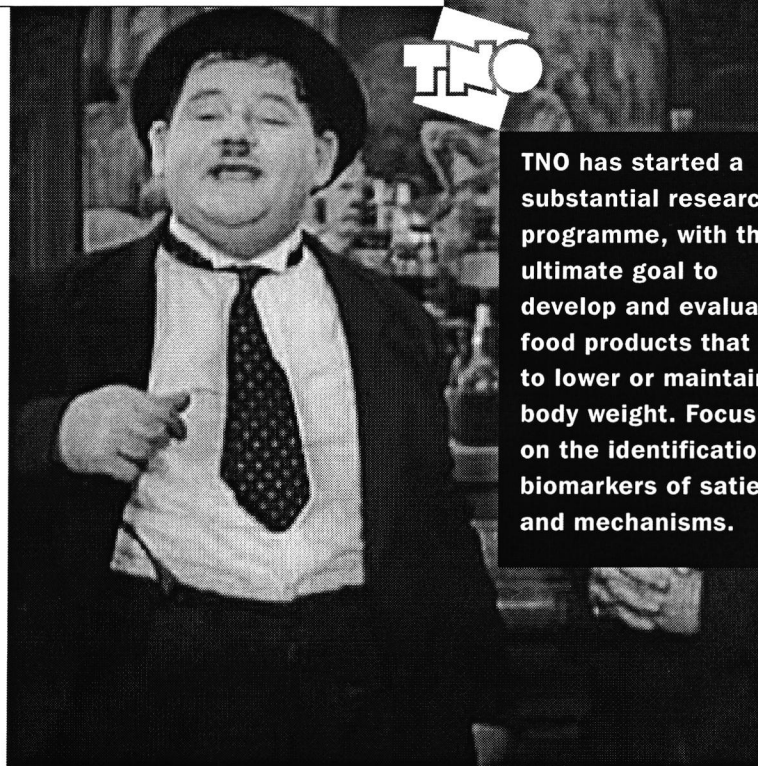
Due to the complexity of overweight and lowering energy intake, we mobilized all related knowledge and expertise within TNO and some universities in the Netherlands. The first step in our research programme was developing methods and techniques to measure biomarkers. These biomarkers can provide insight into, and may serve as a standard for, the effects of foods and food components on satiation and satiety. Once biomarkers are identified, the underlying mechanisms influencing satiety and satiation can be clarified. This will enable industry to design food products that either speed up satiation (= the process that makes us stop eating) or induce long term satiety (= not feeling hungry).

The ultimate challenge is to develop foods that show a desired degree of satiation and satiety, and are appreciated as much as, or better than their conventional counterparts. More importantly, satiety engineered food should be appreciated in the long term.

In our research programme, we focus on all factors influencing food intake as satiety/hunger is a complex phenomenon.

Factors that influence food intake

- Sensory perception (smell, taste and texture)
- Processes mediated by the gastrointestinal tract (stomach filling and digestion)
- Metabolic processing of food
- Perception of hunger and satiety
- Cognitive signals (time of the day and social circumstances)

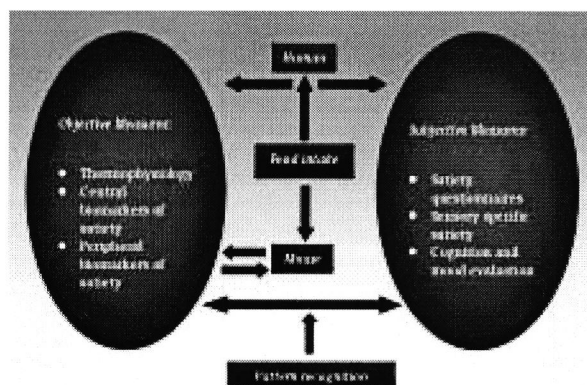


TNO has started a substantial research programme, with the ultimate goal to develop and evaluate food products that help to lower or maintain body weight. Focus is on the identification of biomarkers of satiety and mechanisms.

Specific biomarkers for each of these factors are needed and they are being identified by TNO. Examples are:

- peripheral biomarkers (blood parameters, dietary induced thermogenesis)
- central biomarkers (f-MRI scans of the brains)
- psychomotor biomarkers
- sensory specific satiety

Figure 1: Schematic representation of factors studied in the TNO Biomarkers of Satiety project



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Techniques involved

New techniques will be used to identify biomarkers, such as proteomics, metabolomics, transcriptomics, fMRI (functional Magnetic Resonance Imaging) scans of the brains and Nuclear Magnetic Resonance Spectroscopy (NMR) combined with pattern recognition techniques.

Systems Biology

To explain the 'system' hunger we will apply the Systems Biology approach. All available knowledge and data at different levels of the human body (genome, gene expression, protein, substrate, chemical structure etc) will be integrated into a data set. These data will be analysed using advanced multivariate analyses to identify mechanisms and biological pathways.

Screening and validation of components/ ingredients

With our gastro-intestinal model "TIM", a first screening of promising ingredients or components is possible. The results of this screening will provide a first indication about physical-chemical effects related to satiety such as gel-forming properties and slow-release effects on glucose absorption. In the final stage of the project, specific food components will be tested on their satiating efficacy in human volunteer studies. Also, studies using animal models for obesity and diabetes are applied (the latter enabling to study underlying mechanisms).

Current expertise

In metabolic nutrition studies with human volunteers, and in animal model studies, TNO can measure a range of clinical and physiological parameters highly relevant for weight management. Clinical parameters include hormones like insulin, glucagon, leptine, ghrelin, PYY, GLP-1 and IGF-1, in addition to parameters relevant for the assessment of metabolic control,

Collaboration

In this programme TNO Nutrition and Food Research co-operates with TNO Prevention and Health, TNO Human Factors, Wageningen University and University Medical Centre Utrecht.

e.g. plasma free fatty acids and glucose. Also, the adipose tissue hormone adiponectine can now be measured. Physiological parameters include energy expenditure and thermo-physiological parameters. Using Visual Analogue Scales, subjective feelings of satiation, satiety, and hunger can be measured. Extensive experience is available for the measurement of the Glycaemic Index of particular foods.

Invitation to participate

The knowledge and methods we have developed so far are already applicable in applied research for weight management products, and we are ready to share this with the industry. In our ongoing research programme we are developing new methods and techniques; for this programme there are possibilities for the industry to participate with us in subsidized projects.

Services offered

TNO offers the following services concerning weight management:

- Biomarker identification
- Bioactive compound screening
- Efficacy studies (in vitro, in vivo, human, animal)
- New food ingredient application research
- Claim support
- Regulatory support and dossier preparation
- (Consumer-led) Product Development
- Product optimization
- Consultancy

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