Satiety Control Through Food Structures
Made by Novel Processing:
Generating Novel Food Structures to Aid Consumer Weight Management

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Background

Despite advances in the
i) measurement of appetite expression and the biomarkers underpinning the processes of satiation and satiety,
ii) understanding of the impact of nutrient composition
iii) knowledge of the physical characteristics of food on eating behaviour

Few satiety-enhancing products have successfully remained in the European market, due to the failure of producing effective and appealing products.
The SATIN consortium aims to develop novel food products for European consumers through processing innovation that will enhance satiety and help to achieve a balanced diet.

The multidisciplinary collaboration will develop food products that help regulate food intake by accelerating satiation during a meal, enhancing satiety and/or reducing appetite through novel processing methods and validate these products in human trials by examining key biomarkers, nutrient availability and behaviour.
Objectives

1. INTEGRATE ADVANCED TECHNOLOGIES to screen novel food structures through *in vitro* models to isolate and refine products according to their satiating potential.

2. DEVELOP NOVEL FOOD PROCESSING TECHNOLOGIES that combine active ingredients and changes in food structure to produce a range of novel satiety enhancing ingredients.

3. PRODUCE FINISHED FOOD PRODUCTS that pass through safety analysis, early sensory evaluation and consumer testing.

4. DEMONSTRATE THE EFFECTS OF PROTOTYPE PRODUCTS on biomarkers of satiety and on nutrient bioavailability using *in vivo* studies and validating new *in vivo* approaches.

5. DEMONSTRATE THE EFFECTS OF FINAL FOOD PRODUCTS on within-meal satiation, post-meal satiety and/or reduced appetite using biomarkers of satiety.

6. DEMONSTRATE THE ENDURING EFFECTS OF INDIVIDUAL FOOD PRODUCTS on satiety and their potential to induce weight loss.

7. DEMONSTRATE THE LONG-TERM CONSUMER AND HEALTH BENEFITS of adhering to a diet containing satiety-enhancing products.

8. VALIDATE HEALTH CLAIM ENDPOINTS AND COMMERCIALISE.

Phase 1

Phase 2
Satiety Cascade

Meal Quality
- Consumer appeal
- Flavour
- Texture
- Nutrient composition

Meal Quantity
- Oral metering
- Osmotic load
- Gastric stretch
- Gastric emptying

Nutrient status
- Microbiota
- Gut biomarkers
- Nutrient absorption
- Substrate oxidation

Cognitive Sensory
Pre-absorptive

Termination of meal
Inhibition of food intake
Onset of next meal

Satiety

Pre-prandial motivation

Finlayson & Blundell, 2012
Satiation and Satiety

Finlayson & Blundell 2012

Satiety Innovation
The Consortium

SATIN consortium

7
SME’s

7
Universities

4
Industry Partners

Advisory Board

www.satin-satiety.eu
SATIN – Overall Study

WORK PACKAGE INTERRELATION

PHASE 1

WP 1 In vitro screening
Month 1 - 24

WP 2 Sensory factors and Food Structures
Month 1 - 36
(+30 months production)

WP 3 Microbiota, Gut and Biomarkers
Month 1 - 58

WP 4 Satiety, Consumer and Health
Month 12 - 48

Foods

Samples

Foods

PHASE 2

WP 5 Intervention - lasting health benefits
Month 36 - 58

WP 6 Dissemination and Exploitation
Month 1 - 60

WORK PACKAGE TIMELINES

WP 7 Management

WP 1 Ingredient identification

WP 2 Novel Processing an Up Scaling

WP 3 Gut and Biomarkers

WP 4 Satiety Studies

WP 5 Interventions

WP 6 Dissemination and Exploitation

GOAL - PRODUCT(S) AND TECHNOLOGIES
WP 1 - Selection of Improved Satiating Food Components by *in vitro* satiety

A complementary and comprehensive *in vitro* platform, suitable to perform *preliminary and high throughput tests* on the activity of *new food components with potential satiety effects* has been developed and validated:

- The existing **SHIME® model** has been adapted for nutrient absorption, with the inclusion of a mouth step and a dynamic dialysis step to simulate absorptive processes in the small intestine.
- Cell-based assays have been established to assess ingredient **solubility, stability and bioavailability**.
- An *in vitro* cell based platform comprising primary assays, **GI hormone secretion assays** and secondary assays for **chemosensors** has been developed, optimized and validated with reference controls.
- An *ex-vivo* gut tissue based **GI hormone secretion** assay panel using Ussing Chamber technology has been optimized.
WP 1 - SATIN *in vitro* testing platform

Simulator of the Human Intestinal Microbial Ecosystem

- GI Hormone secretion & chemosensors
- Intestinal parameters
- Solubility, stability and bioavailability
- Ussing Chamber

PRODUCT PROFILE

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New food products with **optimised food structures & flavours** and potentially **enhanced satiety/satiation properties** were developed using a combination of novel processing techniques, active ingredients and pre-screening methods:

- Creation and screening of **broad range of food matrices** such as beverages, fruit & vegetable juices and appetizers, dairy products, fish and meat products, breakfast cereals & breads.

- Inclusion of **active ingredients** with possible cognitive, sensory, immediate post-ingestive and pre-absorptive effects in recipes.

- Assessment of **sensory satiation & early satiety effects** through sensory analyses (flavour release - APci-MS) and rheology measurements (viscosity, coagulation and emulsion stability – SIMPHYD+).

→ **Best performing food products** have been produced for clinical trials in WP 4 and WP 5.
WP3 - Microbiota, Gut Function & Biomarkers of Appetite & Related Health Claims

Food components and their digestibility and fermentability have an impact on gut metabolism and the composition of the microbial community of the intestine. WP3 assessed the effect of gut microbiota and gut function on satiation and satiety:

- **In vitro** assessment of prototype foods using the SATIN platform to demonstrate their **effects on nutrient bioavailability and mechanism of action** in the gut.
- Short-term human dietary intervention studies to assess effects of fibre-enriched prototype foods on **gut function and biomarkers of satiety in vivo**.
- **Validation of SATIN in vitro platform** through in vivo studies
- **Analyses of biomarkers** relevant to satiety and food intake such as gut hormones, inflammatory markers and metabolism related molecules as well as impact on gut microbiota and their metabolites from in vivo studies.

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WP4 assesses the effects of the prototype foods on the control of appetite and the consumer benefits beyond weight management. This involves the identification of key processes controlling food consumption. For the benefit of SATIN clinical trials WP4 developed

- methodological platforms to identify the short term behavioural mechanisms behind satiating dietary components as well as consumer benefits beyond appetite control and weight management.
- platforms have been used to assess the six prototype foods selected from WP2 in short-term clinical trials and have the potential to provide guidance to industry and EFSA.

In medium-term clinical trials, two prototype foods are being tested for their weight loss potential as well as their effect on the eating behaviour during energy deficit.
The purpose of generating satiety-enhancing processed food products is to help consumers achieve a balanced diet, resulting in long-term beneficial effects in body weight and health. Large-scale clinical trials are required to demonstrate that changes in food structure can modify the mechanisms involved in the regulation of total energy intake, beneficially affecting energy balance and body weight regulation.

The prototype foods developed in WP2 and shown to be effective in acute WP4 trials will be tested in a long-term, multisite dietary intervention study, with the ability to maintain a reduced body weight being the primary outcome. In addition the effects on biomarkers for satiety and food intake (as defined in WP3) will be assessed.

This proof of concept study will be conducted in line with EFSA’s Scientific Opinion on the scientific requirements for health claims related to appetite ratings and weight management.
SATIN – The Team
Thank you!

More information:

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