# MetaCliniq: a metabolomics tool for the development of a personalised nutrition service within the Stance4Health project

**Unhealthy dietary patterns are leading to an increase in non-communicable diseases, and great efforts are being paid to promote healthier diets and lifestyles around the world. The Stance4Health project, funded by European Union's Horizon 2020 research and innovation programme, proposes a complete smart personalised nutrition (SPN) service based on the use of mobile technologies, tailored food production and a metabolomics test that will optimise the gut microbiota activity and promote long-term consumer engagement** (Hinojosa-Nogueira *et al.*, 2020).

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The gut microbiota is now known to affect host health at different levels: competing with pathogens, interacting with the immune system or producing either beneficial or detrimental metabolites (Marungruang *et al.*, 2016). Hence, it is thought to play a critical role in the modulation of host physiological processes related to chronic diseases (obesity, type II diabetes, etc.). The microbiota feeds on dietary components that remain undigested in the upper gut and ferment them to different health-affecting substances, which are metabolised by the human host and excreted mainly in urine (Tremaroli and Bäckhed, 2012).

## MetaCliniq in personalised nutrition

RM FARMAMÉDICAL, a Spanish SME (www.rmfarmamedical.com), developed MetaCliniq® profiles and metabolic studies (Figure 1). This is an in vitro test carried out with biological (urine, blood, cerebrospinal fluid) and culture media samples, collected and stabilised on filter paper. These filter papers are then dried and sent at ambient temperature for analysis. This single test shows what is happening at the metabolic level.

*Figure 1: RM FARMAMÉDICAL, a Spanish SME (www.rmfarmamedical.com), developed MetaCliniq® profiles and metabolic studies.*

Many studies have demonstrated the validity of collecting biological fluids, either blood or urine, on filter paper for analysis (Hampe *et al.*, 2017). Nowadays, such a technique is used worldwide to detect well-known diseases, such as Phenylketonuria, in public health programmes. The collection of samples in filter paper:

- improves the quality of the sample to be analysed
- stabilises metabolites
- blocks enzymatic activity that degrades metabolites, inactivating ongoing metabolism
- preserves the integrity of the sample
- avoids degradation and loss of metabolites
- enables adequate ranges of metabolite concentration to be obtained
- avoids freeze-thaw cycles that lead to a loss of quality.

RM FARMAMÉDICAL participates as a partner with MetaCliniq and the nutraceutical AlcaLip in the Stance4Health project. MetaCliniq will be used throughout the project in a large clinical study to rule out metabolic alterations and analyse the gut microbiota activity in urine samples. Urine is a biological matrix that contains hundreds of metabolic end products at various concentrations (Khodadadi & Pourfarzam, 2020). Its use presents a number of important advantages over the use of blood samples. Firstly, urine can be collected easily, in large quantities, and in a non-invasive way, which makes it less annoying for the patient (Jóźwik & Kałużna-Czaplińska, 2016). Conversely, the use of dry urine samples has the added advantage of inactivating the ongoing metabolism of the sample (Hampe *et al.*, 2017).

MetaCliniq enables the ability to carry out a global study of the metabolites and co-metabolites that participate in the metabolic routes, either at starting or finishing point or in the intermediary metabolism. MetaCliniq also enables the detection and identification of metabolism disorders of different groups of diseases and alterations, including amino acids, carbohydrates, fatty acids, purines and pyrimidines. Conversely, in urine, it reveals the metabolic impact of the intestinal microbiota, the possible damage that it may be causing in the whole organism and possible microbiota-related imbalances (López-Maldonado *et al.*, 2021).

In urine, MetaCliniq can detect and identify by gas chromatography-mass spectrometry (GC-MS) the metabolites produced by the microbial metabolic activity of intestinal bacteria, fungi or yeasts (Figure 2). In this sense, GC-MS has shown to have a high sensitivity and specificity, making it one of the preferred techniques for conducting urinary metabolomic investigations (Jóźwik & Kałużna-Czaplińska, 2016; Khodadadi & Pourfarzam, 2020). Moreover, GC-MS has a long history of achievements in the description of complex biological systems (Khodadadi & Pourfarzam, 2020). In relation to urine samples, it has especially been used in mass-screening tests for early diagnosis and treatment of the inborn errors of metabolism (Hao *et al.*, 2015; Hampe *et al.*, 2017).

Gut Microbiota

Urine Metabolites

Metabolites produced by
**Microbial Activity**
Intestinal Bacteria
Fungus or Yeast

Stance4 HEALTH
www.stance4health.com

Detects and Identifies
Urine Metabolites
OF THE ENTIRE
GASTROINTESTINAL TRACT

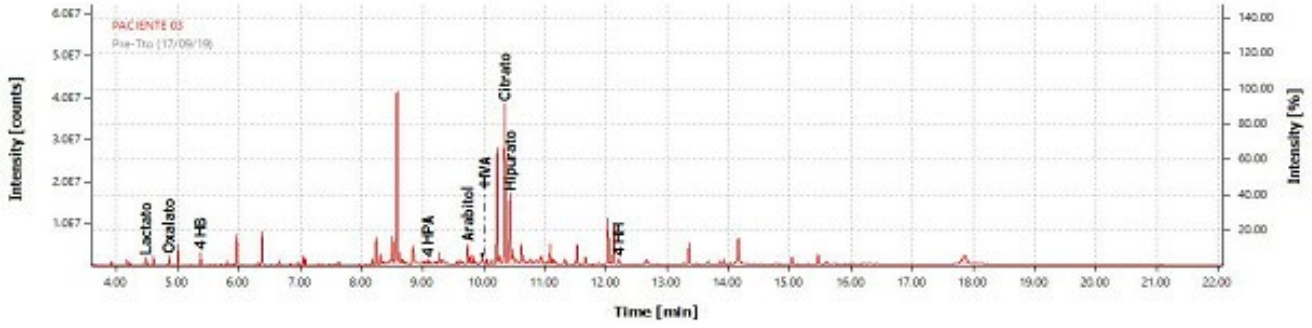


*Figure 2: MetaCliniq gut microbiota in urine.*

# Stance4Health

**How to optimise the activity of the Intestinal Microbiota**
A Healthier Microbiota for Better Health

| | | | |
|---|---|---|---|
| Adults and children presenting **overweight** | Children with **coeliac** disease | Children with **food allergy** | Athletes regular **exercise** |

*Figure 3: AlcaLip use throughout Stance4Health.*

**Stance4Health:** HOW TO IMPROVE METABOLISATION

MetaCliniq provides excellent clinical and scientific value since it obtains more metabolites from the analysed sample and offers a personalised integration and interpretation of all the results. The system achieves extraction, detection, identification, integration and interpretation of more metabolites from the sample. RM FARMAMÉDICAL works with professional experts with extensive experience in metabolomics, metabolism and inborn errors of the metabolism, which provides great scientific value for the researcher and significant clinical value for the doctor.

**AlcaLip**
MITOCHONDRIAL PROTECTOR.

## AlcaLip in personalised nutrition

The objective of Stance4Health, as stated previously, is to develop a personalised nutrition service based on the use of mobile technologies, as well as the production of food and nutraceuticals, as it will optimise the activity of the intestinal microbiota and the consumer's commitment to long-term use (Figure 3).

AlcaLip is a nutraceutical with demonstrated activity in the mitochondria (López-Maldonado *et al.*, 2021). AlcaLip protects against oxidative damage and has a high antioxidant capacity against hydroxyl radicals and a high reduction capacity against ferric iron at the cellular and mitochondrial level. AlcaLip also works by improving mitochondrial function and metabolisation. AlcaLip takes action in the Krebs cycle, favouring metabolic activity but does not act as a pro-oxidant. Therefore, AlcaLip is a mitochondrial protector that will be used throughout the nutritional intervention of the Stance4Health project in adult athletes and children with coeliac disease, obesity or an allergy to cow's milk.

## References


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## PROJECT SUMMARY

The overall objective of Stance4Health is to develop a complete smart personalised nutrition service based on the use of mobile technologies as well as tailored food production that will optimise the gut microbiota activity and long-term consumer engagement. The project will focus on the adult population (lean and overweight people) and children (lean, obese coeliac disease or food allergy).

## PROJECT LEAD PROFILE

Stance4Health is led by **Prof. José Ángel Rufián-Henares**, Professor of Nutrition and Food Sciences at the University of Granada (Spain). Prof. Rufián-Henares has a strong background in food processing, food composition analysis and the effect of food on gut microbiota composition and functionality.

## PROJECT PARTNERS

The Stance4Health consortium consists of 19 partners from 8 European countries (Spain, Germany, Denmark, Romania, Italy, Greece, Belgium, UK). Six SMEs will be in charge of developing and the future commercialisation of a new app for personalised nutrition, tailored cereal-derived foods, one nutraceutical and one in vitro diagnostic test to control the gut microbiota activity.

## CONTACT DETAILS


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