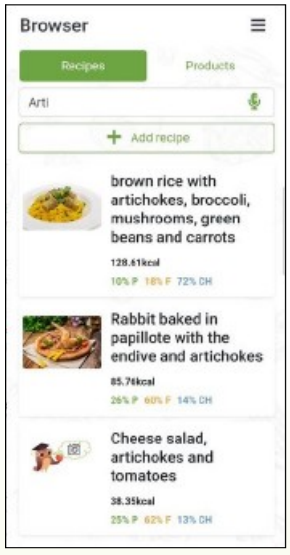
Developing your Personal Nutrition System

The main goal of **Stance4Health** is to develop a complete Smart Personalised Nutrition (SPN) mobile app to assess the nutritional status.

It aims to recommend weekly menus to the users based on their goals, physical activity, and other personal values. While guiding the user towards a healthy/healthier lifestyle, it optimises the gut microbial activity to meet these objectives.

This task is complex and therefore requires an extensive design of an information system, as well as a mobile application that allows the user to interact with the system.

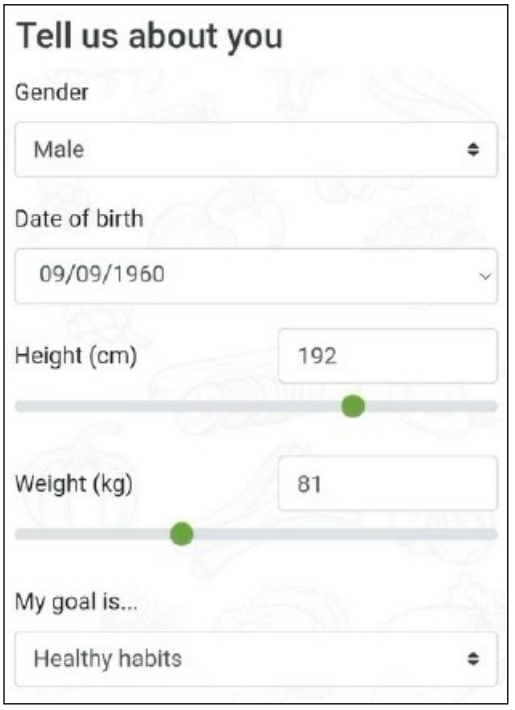


An app is like a house

All apps have two sides that cannot be separated. To understand this, you can think of them as your house. During its construction, we need a strong foundation and walls, as well as a good electrical and plumbing installation. From these bases, we create our home, giving it our personal touch: we choose the colour of the walls, the furniture, or the appliances. Apps are essentially the same.

On the one hand, we need a good foundation, i.e. a source of data that has information relevant to our objective, reliable algorithms, etc. And once we have it, we can start building our house from it, choosing which functionalities, colours, and screens the user will see. Both are important and determine the characteristics that make the **Stance4Health** project unique.

Each person is unique and has different goals and food habits, and a truly innovative nutrition system cannot ignore that.



Our app adapts to you, your preferences and your behaviour.

In order to be able to recommend menus, we need to know you well. Often nutrition recommendations aim to force you to adapt to them. At **Stance4Health** we have turned this around.

This can be achieved thanks to the research we have developed to connect all the characteristics of the diets with these personal factors, developing a database with multiple sources of information. And who hasn't skipped a diet from time to time?

When working with people, we must also consider these situations. Changes in meals throughout the day can occur, and our system can identify them and analyse how to take them into account so that we do not move away from our objective.

Balance is the key to making healthy habits sustainable over time.

Our system allows you to search thousands of different recipes and products. This function not only allows you to see pictures of recipes or learn how to cook them but also serves as a small nutritional encyclopedia of great value.

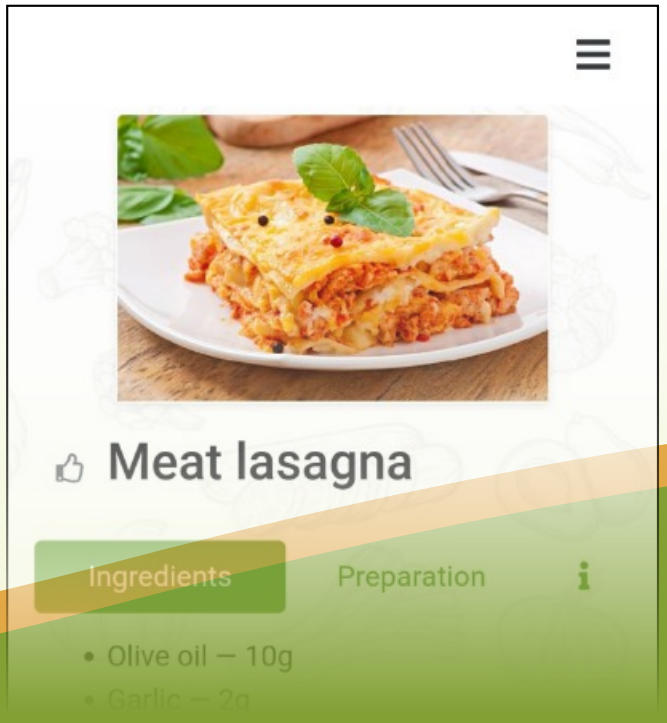
Understanding and discovering the characteristics of foods and how they contribute to a recipe or to our diet is fundamental to making better nutritional choices and living a healthier life.

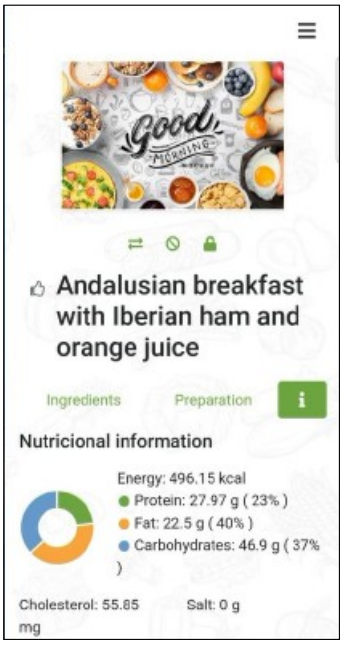
As the app fits you, you can add your own recipes and see how your choices affect the nutritional value. The system does not only contain nutritional information of the foods, but also the possibility of providing information of the products you buy in the market. Additionally, it generates in a weekly fashion the list of ingredients that you need to have in your pantry for cooking all dishes from your menu, making it easier for you to do grocery shopping and contribute to reducing food waste.

Another key factor is the ability to adapt to your food habits. This system is intended to work in different countries uniformly, but we cannot omit the daily dishes that users from several countries expect to find when using the app.

Cultural food diversity is considered in our system, providing the most suitable food and dishes according to your food habits. In this way, it can automatically adapt to your traditional recipes depending on your country of origin. Equally, the app will show your data and recipes in your first language to maximise the user experience.

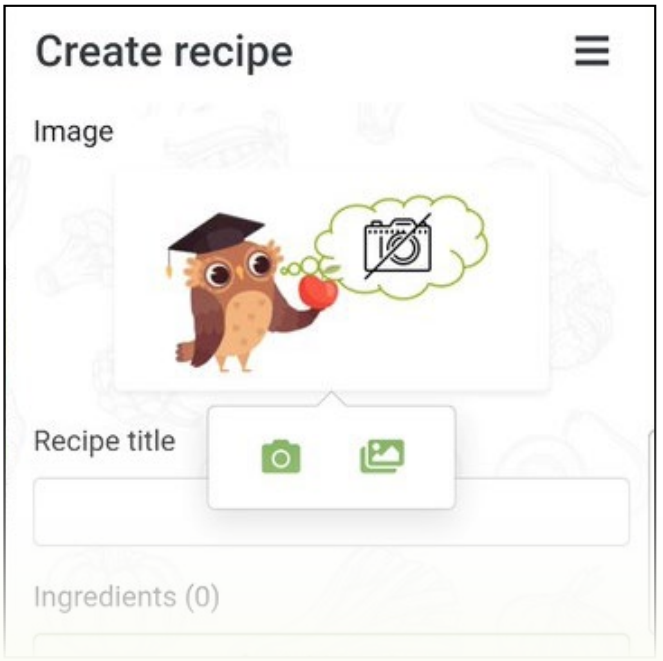
As you may have noticed at this point, our system deals with many different kinds of objectives at the same time. This could not be done without a comprehensive design and development, able to jointly deal with users' needs, working at both visualisation and functionality levels simultaneously.





You can learn a lot from our mascot!

Our mascot will also try to give you useful advice and warn you when you stray from the right path. He is a wise guy and we are all already very fond of him.



For more information about our project

www.stance4health.com

The project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 816303.

Horizon 2020
European Union Funding for Research & Innovation

48 MONTHS

01.10.2018 01.10.2022

FUNDING

€6,393,914

19 PARTNERS

8 Countries

Smart Technologies for personAlised Nutrition and Consumer Engagement

The overall objective of Stance4Health is to develop a complete **Smart Personalised Nutrition** (SPN) 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**.

Six SMEs will be in charge of the development and future commercialisation of the novel SPN service, including two new apps for personalised nutrition, integration of a wearable device for daily analysis of one's body composition, nine tailored cereal-derived foods for specific (vulnerable) consumer groups (overweight, coeliac disease or food allergy, adults, children), six individualised dietary supplements for adults, and one nutraceutical and one in vitro diagnostic test to control the gut microbiota activity.

These novel tools and services have the potential to directly impact more than 67 million European adults and 8 million children by 2022, at a monthly cost of only €0.99 (for the app).

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Smart Technologies for personAlised Nutrition and Consumer Engagement

Consumer Selection

European consumers are using the internet more and more frequently (European Commission 2019). This coupled with the continuous increase in the penetration rate of mobile subscriptions (GSM Association 2018) makes apps a promising source for health-related information. Yet, not all consumers are equally likely to use such apps (Elvosky *et al.* 2017, Serrano *et al.* 2017). The aim of Task 4.1 in the Stance4Health project is to identify consumer groups that vary in wellbeing and health status for the studies of Tasks 4.2, 4.3 and 4.4 that deal with consumer responses to apps.

Segmentation analysis with data from the European Social Survey (ESS) is used in Task 4.1 to identify groups of consumers with relevance for the Stance4Health studies (ESS Round 8 2016, ESS Round 7 2014). Prior literature identifies motivational, health-related and technological factors as important drivers of consumer use of health-related apps (Chae 2018). Consumers' wellbeing (e.g. life satisfaction), their health (e.g. subjective health status) and their openness to try new things were the main characteristics considered for the segmentation. The identified segments are then described based on socio-demographics and health related measures (e.g. health history).

The ESS survey is a cross-national survey that is conducted every two years with newly selected cross-sectional samples and measures people's attitudes, beliefs and behavioural patterns (https://www.europeonsocialsurvey.org 2019). The data used in Task 4.1 was weighted using post-stratification weights that aim to reduce the sampling error and potential non-response bias, together with population size weight that seeks to ensure that each country is represented proportionately to its population size when necessary (https://www.europeonsocialsurvey.org 2019). The survey was conducted in various European countries with the latest round involving 23 countries (ESS Round 8 2018). The segmentation analyses conducted in Task 4.1 take into account the potential impact of the country, given that there are some differences between European countries. In 2016, more than 72% of consumers used the internet at least a few times per week. Over 60% of those surveyed described their health as good or very good and people were an average rather satisfied with their life as a whole. The frequency of internet use, reported life satisfaction and health status differed by country (ESS Round 8 2016).

Identifying consumer groups that vary in key characteristics (e.g. wellbeing, health status) allows to study segments of consumers that react similarly to new health-related apps and to identify best strategies to promote adoption and sustained use of apps across the different groups of consumers with potential to use such apps. These insights from Task 4.1 will contribute to the upcoming tasks in the Stance4Health project.

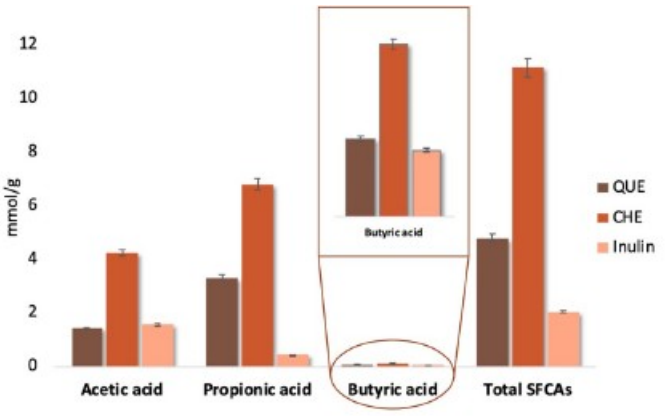

Figure I: Release of SCFAs (mmol per g of fresh food) of QUE and CHE after fermentation.

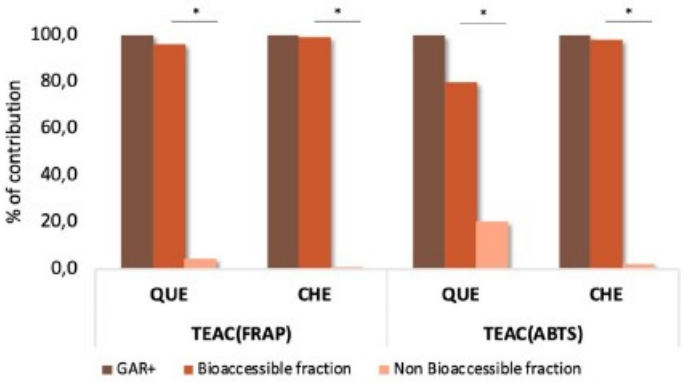

Figure 2: Contribution of bioaccessible fractions (supernatants from digestion and fermentation) and solid residue to the antioxidant capacity of foods.
**indicates statistically significant differences ($p<0.05$)*

Tannins Bioactivity

The origins of the Silvoteam dote bock 160 years, when, in 1854, Carlo Giuseppe Battaglia built his first factory in Corsaglia di Frabosa, in the province of Cuneo, Italy for the extraction of tannins from chestnut wood. During the 20th century, the company has developed and become a world leader in the production and commercialisation of vegetable extracts and their derivatives.

During the last few years, Silvoteam has invested important resources in Research & Development in order to find new applications related to its core business of vegetable extracts and to explore fast-growing markets and thus diversify its business. Silvoteam's produced tannins are extracted from many vegetable raw materials, for example, chestnut wood, quebracho wood, oak wood, tara pods, Chinese gallnuts, Turkish gallnuts, barks. Every raw material has the property to contain tannins with a specific chemical composition.

Tannins have already been proven to determine, through *in vitro* gastrointestinal digestion and fermentation, a positive effect on the metabolism, the production of short-chain fatty acids (SCFAs), and the antioxidant capacity.

Within the Stonce4Heolth project, an *in vitro* digestion and fermentation with fecal samples from healthy, overweight, celiac disease and food-allergic donors will allow selecting tannin extracts with differential activity on the gut microbiota.

The aim is to formulate new functional foods or nutraceuticals for specific target groups (i.e. overweight, celiac disease, and food allergy), in collaboration with the other companies involved in the project. Thus, the products will be tested in a relevant environment for their acceptance by a sensory analysis panel and consumers (i.e. overweight, celiac disease, and food allergy patients). It will allow defining the maximum amount of different tannins in different foods that are not detectable by tasting.

The best-designed products will be tested in a short human intervention to validate the *in vitro* effects. Their effect over the gut microbiota will be assessed through metogenomic and metatranscriptomic analyses, SCFAs and bile acids.

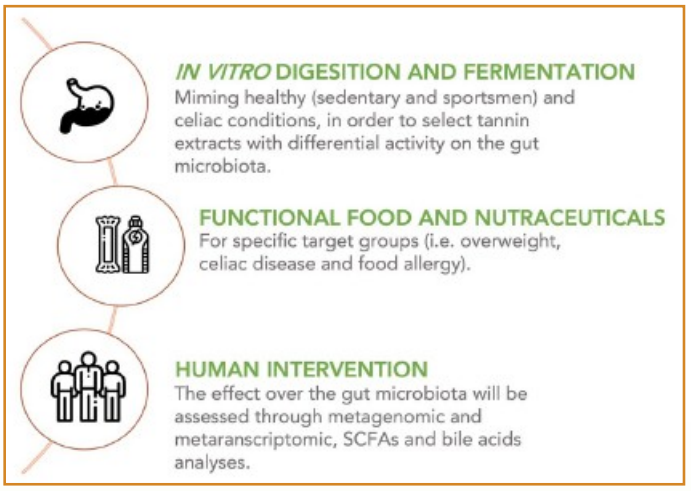

Figure 3: Digestion.

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In Vitro Gastrointestinal Digestion-Fermentation

Along the Stance4Health project, the first set of experiments comprises the study of the effect of different foods and cooking methods over the gut microbiota composition and functionality. To do so, at UGR, we are using an *in vitro* gastrointestinal digestion involving three steps (Figure I) to simulate physiological extraction of nutrients from foods: oral phase with α-amilose and salts to simulate salivary fluid, gastric phase with pepsine and salts to simulate gastric fluids (pH 3), and intestinal phase with pancreatine, bile salts and other salts to simulate intestinal fluid (pH 7). Then, the digested fraction of foods, after *in vitro* digestion, is submitted to *in vitro* colonic fermentation using a sample of microbiota from feces from healthy volunteers.

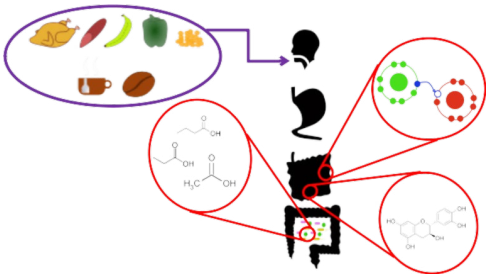


Figure I: Three-steps gastrointestinal digestion.

This method allows us to analyse several biological activities:

- Antioxidant capacity of foods potentially absorbable in the small intestine, along with bioactive compounds, such as phenolics.
- Antioxidant capacity released after gut microbial degradation of food in the large intestine.
- To study gut microbial functionality through the measurement of some of the main metabolites derived from fermentation, i.e. short chain fatty acids (SCFAs).
- To study the effect of different foods on gut microbial community structure.

We can measure the antioxidant capacity potentially absorbable in the small (blue bars in Figure 2) and large intestine (purple bars in Figure 2), and also the antioxidant capacity that is not absorbed (red bars in Figure 2) and, therefore, excreted with feces.

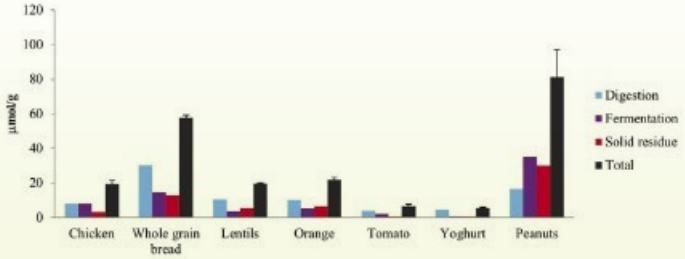


Figure 2: Antioxidant capacity.

In vitro fermentation also allows us to check gut microbes functionality through the measurement of the main fermentation metabolites: short chain fatty acids (Figure 3). SCFAs ore beneficial metabolites acting as anti-inflammatory substances, protecting the intestine, preventing obesity, etc.

In vitro fermentation also allows us to study how microbial communities change ofter being exposed to a certain food (Figure 4). Therefore, we con predict how to reach a healthier microbial community.

Figure 3: Short-chain fatty acids (SCFAs) measurement

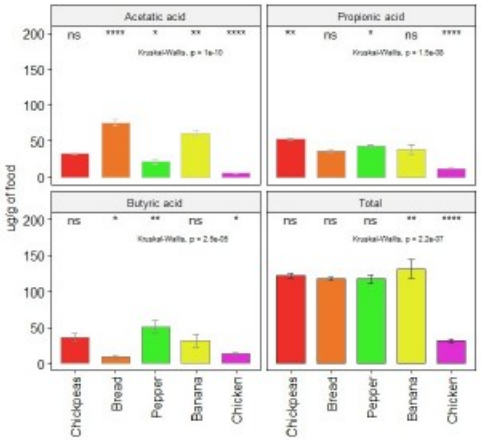
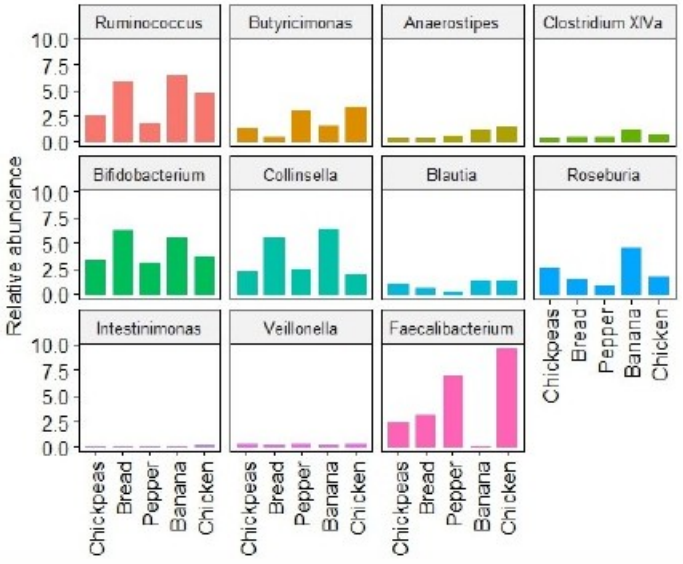


Figure 4: Changes in microbial communities after being exposed to a certain food.



This *in vitro* digestion-fermentation method can be used to unravel the complex interactions between foods and human beings. Thus, it can be used to simulate changes during digestion in order to improve food formulation (both technological and nutritional-health aspects), modifications of biooctive compounds-extracts, direct effects over the gut microbiota of healthy people, effects of foods or biooctive compounds on gut microbiota composition-functionality of people suffering obesity, diabetes, inflammatory bowel disease, food allergies or other pathologies with dysbiosis.

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References click here

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