INTRODUCTION
Over the past two decades, high pressure food processing at ambient temperature has become a mature technology and has successfully been introduced at industrial scale for a large range of food products. The technology offers the food industry an alternative to conventional methods of thermal processing because in a number of cases it allows avoiding the production of undesirable changes in foods that hamper the balance between high quality (color, flavor and functionality) and safety. At the same time the technology offers an additional processing variable that allows creating new (combinations of) functional properties of foods better addressing consumer preference, acceptance and needs. This paper focuses on high pressure high temperature processing of foods, in particular plant based food systems. Parts of the data that will be presented have recently been obtained in the context of NovelQ. NovelQ represents an integrated interdisciplinary research, demonstration and dissemination project designed to overcome bottlenecks inhibiting the introduction of novel technologies in the European food industry.

RESEARCH APPROACH
The central approach in NovelQ Subproject 1 was the integration of all key safety and quality aspects from both a mechanistic and kinetic point of view. Research was conducted following a five-level approach reflected in five workpackages, considering (i) microbial inactivation (WP1), (ii) allergen inactivation (WP2), (iii) chemical safety (WP2), (iv) improved food structure (WP3) and (v) improved colour, flavour and health functionality (WP4). The project followed a five-step research innovation approach, consisting of (i) identification of processing conditions and food matrix, (ii) detailed kinetic studies based on a common methodological approach, (iii) development of predictive models, (iv) mechanistic understanding of the phenomena observed (WP1-4) and (v) compilation of all information obtained in integrated models and specific sensors (WP5). As a consequence, common and specific windows of processing conditions and food matrices were defined, allowing not only maximal interaction between the work packages, but also comparison of (novel) unit operations on a quantitative basis and from a viewpoint of true equivalence.

RESULTS & DISCUSSION
This presentation will discuss recent insights in high pressure high temperature processing of food systems. It will focus on mechanisms and kinetics on (i) effects of high pressure thermal processes on microbial inactivation, (ii) effects of high pressure thermal processing on enzyme inactivation and activity, (iii) effects of high pressure thermal processes on food allergens, (iv) effects of high pressure thermal processes on texture characteristics of plant based foods, (vi)
effects of high pressure thermal processes on plant based food related chemical reactions, (vii) effects of high pressure thermal processes on color and flavor characteristics of plant based foods, (viii) effects of high pressure thermal processes on nutrients and (ix) process impact evaluation approaches for high pressure thermal processes based on integrated mathematical models and/or extrinsic indicator systems.

CONCLUSIONS

Some important conclusions obtained in NovelQ are:

- Based on a number of considerations including the fact that only high water content products are relevant for high pressure processing applications, experimental evidence suggested that acrylamide formation is not expected to pose a major hazard to this type of products.
- HP/HT processing makes apple safer to eat with respect to allergens as the Mal d 3 is modified by the process and the Mal d1 allergen is modified by the disruption of the tissue. It is difficult to draw a general conclusion on the effect of HP/HT, as there is clearly an effect of the matrix on allergen inactivation and the mechanism seems to differ between allergens.
- HP/HT processing offers potentials to new and even unexpected or different textures and structures for plant based food products.
- While high pressure processing at ambient temperature has a limited effect on health related compounds, the additional process parameter temperature in HP/HT processing can induce losses in some nutrients. This strongly depends on the type of nutrient. The results obtained within the NovelQ project suggest that fat soluble nutrients are less sensitive to HP/HT processing than water soluble, at least for the ones studied (carotenoids versus anthocyanins). In addition, HP/HT processing for a long time has detrimental effect on the fresh flavour of strawberries and tomatoes. However, because of the shorter treatment times during these processes (due to fast heating and cooling rates), integrated process impact might be lower in comparison to an equivalent thermal process. By proper selection of processing conditions specific hydrolysis products, with potentially higher health beneficial effects can be obtained in pressure processed broccoli.
- pTTIs and CTFD modelling are complementary methods for documenting HPP conditions. In this context, CTFD modelling can be a method to compare the temperature distribution of different equipment designs in combination with different pressure media, food packages, isolating materials, etc. before the HP equipment is actually built. In addition, the thermofluidodynamical characterisation of the HP vessel by CTFD modelling enables definition of critical vessel positions that have to be checked with pTTIs to validate the process impact. When the most uniform set-up has been selected and has been constructed, pTTIs can be a fast and easy way to document and validate the HP process in terms of temperature uniformity during actual processing.

REFERENCES
