Título: DEVELOPMENT OF NOVEL FUNCTIONAL DAIRY FOODS USING BYPRODUCTS FROM THE COFFEE AND WINE INDUSTRIES FOR SUSTAINABLE NUTRITION AND HEALTH

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Resumen: Providing a growing population with healthy diets from sustainable food systems is an immediate global challenge. In a context where food byproducts represent an environmental issue and diet-related chronic diseases are still projected to increase, we propose the development of novel functional dairy foods without added sugars, containing dietary fiber and bioactive compounds extracted from coffee and wine-making byproducts which are able to modulate the carbohydrate metabolism for reducing the risk of diet-related chronic diseases, such as diabetes and obesity.

The aim of the present PhD thesis was to evaluate the potential of using coffee (cascara and coffee silverskin) and wine-making (grape pomace, seeds and skins) byproducts as food ingredients for the development of innovative and sustainable functional yogurts. The new product development was conducted following a holistic approach to optimize the technological, biological, nutritional and sensory dimensions of yogurts. The selection of the coffee and wine-making byproducts was based on findings from a literature review conducted in the present thesis, results previously generated from our research group and those derived from the present...
investigation in relation to the in vitro antioxidant, antidiabetic and anti-inflammatory properties of the byproduct extracts.

A first prototype of yogurts containing wine-making byproducts was developed which showed that the in vitro antioxidant and antidiabetic properties of the grape pomace, seed and skin extracts were present after their addition into a yogurt matrix with dietary fiber (inulin and FOS), whose combination had not been previously studied for the development of functional yogurts. In addition, yogurts showed stable physicochemical, textural and microbiological characteristics during storage, assuring an optimal 21-day shelf life.

Consumer perception towards the use of food byproducts as novel ingredients in dairy foods was evaluated using the grape pomace, seed and skin yogurts. Overall liking was influenced by the type of byproduct, the evaluation condition and its interaction. Information regarding the origin of the wine-making ingredients did not negatively affect consumer perception of the foods. Moreover, it significantly (p < 0.001) increased the overall liking of the grape skin yogurt. Consumers described the formulated yogurts in informed conditions with non-sensory health and sustainability terms such as “healthy”, “antioxidant”, “high in fiber”, “sustainable” and “novel”. The consumer clusters identified showed a consistent high overall liking of the grape pomace yogurt, suggesting its potential marketability as a novel sustainable dairy food. In addition, its use may present economic and sustainable advantages due to the direct use of the byproduct without producing further residues.

The comparative study of the biological properties of yogurts containing coffee and wine-making byproduct extracts identified the coffee cascara yogurt as the most suitable candidate as a potential functional food. Coffee cascara yogurt showed a high sensory acceptance (6.96), high antioxidant capacity (5.03 ± 0.11 µTE/g yogurt), the best inhibition of α-glucosidase activity (83%) and a significant (p < 0.05) reduction of NO levels at 10 mg/mL. In addition, the digest obtained from the in vitro simulated human digestion of coffee cascara yogurt showed significantly higher (p < 0.05) antioxidant capacity and greater inhibition of α-glucosidase than the control digest. The risk-benefit balance assessment of the cascara yogurt to adjust the concentration of dietary fiber (0, 3, 7 and 13% of inulin) that avoided potential gastrointestinal secondary effects was conducted in a blind crossover nutritional trial in healthy adults (n = 45) (Registration No. NCT03539146). Results showed that the cascara yogurt containing 3% of inulin was the most suitable yogurt formulation to contribute to the dietary recommended intake of fiber, as it could be labelled with the nutritional claim “source of fiber”, without causing secondary gastrointestinal symptoms.

In conclusion, findings derived from the present PhD thesis confirmed the feasibility of using coffee and wine-making byproducts as sustainable ingredients in yogurt innovations. The application of the multidisciplinary approach proved to be an effective strategy for the development of safe and high-quality products in terms of their physicochemical, sensory and health-promoting properties, which may contribute to commercialization and consumer adhesion to the product. The coffee cascara yogurt containing 3% inulin and no-added sugars may stand as a healthier and more sustainable alternative to current market options.