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Metabolic effects of goat milk yogurt supplemented with yacon flour in rats on high-fat diet

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ABSTRACT

This study aimed to evaluate the effects of addition of yacon flour on the quality parameters of goat milk yogurt and investigate the metabolic effects of its regular consumption on high fat diet-fed *Wistar* rats (30 days). The formulation containing 7% (w/v) yacon flour had higher nutritional values, acceptable sensory attributes and higher count (10^7 cfu/g) of viable probiotic microorganisms, with shelf life of at least 30 days. 7% yacon flour addition improved goat yogurt sugar profile, reducing lactose (0.94%) and increasing prebiotic fructooligosacharides (4.55%) content in the final product. Supplementation of goat yogurt + yacon to a high fat diet resulted in lower body weight, body mass index, fasting glucose levels, HOMA-IR and atherogenic indices of rats, improving the effects of goat yogurt or yacon flour alone ($P < 0.05$). Our results showed conclusive evidence indicating that goat yogurt + yacon is an excellent functional food that avoids the metabolic impact of high fat feeding.

1. Introduction

The increasing value of functional foods throughout the world has encouraged innovation in the production of new food products, stimulating their use (Kumar et al., 2015).

The dairy industry has been a pioneer in this regard, by encouraging the production of a large number of functional products, by adding prebiotic and probiotic agents to foods (Lollo et al., 2012, 2015a; Moura et al., 2016). Fermented milk and cheeses have been the subject of several studies focused on technological aspects and health benefits (Shiby and Mishra, 2013; Tripathi and Giri, 2014; Lollo et al., 2015a; Sperry et al., 2018).

Yogurt is the most popular of fermented milks and is considered a rich source of calcium and milk proteins with higher biological value (Sivieri et al., 2017). The regular incorporation of yogurt in the diet provide the balance of the intestinal microbiota improving the immune system (Lollo et al, 2013; Nabavi, Rafraf, Somi, Homayouni-Rad, & Asghari-Jafarabadi, 2015; Liu, Tang, Yu, Zhang, & Li, 2017). Although most yogurts are prepared from bovine milk, other mammalian species such as goat and sheep, are being recently used due to their intrinsic nutritional composition. In this sense, goat milk yogurt has been considered a functional food potentially useful in medicine and human nutrition (Clark and García, 2017; Ranadheera, Naumovski, & Ajlouni, 2018).

Yogurt has also been shown to be an excellent delivery vehicle for functional ingredients (Champagne, da Cruz, & Daga, 2018; Ranadheera et al., 2018; Zuidam and Velikov, 2018). Inulin, fructooligosaccharides (FOS), galactooligosaccharides, polydextrose and

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resistant starch are the main prebiotics incorporated in the food systems to improve sensory, rheological, physicochemical and physiological properties (Yoo and Kim, 2016; Batista et al, 2017). FOS are soluble fibers consisting of fructose subunits (2–16), linked to each other by β (2 → 1) bonds. They are metabolized by specific groups of bacteria in the colon providing, numerous local and systemic benefits to the host (Roberfroid, 2007, Cao et al., 2018).

Smallanthus sonchifolius (yacon) roots are considered the best natural source of FOS (Cao et al., 2018). Yacon pulp and root concentrate have been incorporated on yogurts to confer different physicochemical and sensory characteristics (Parra, 2014; Montarroyos Padilha et al., 2017). Additionally, yacon flour has been used as an ingredient to elaborate cow light yogurt with low fat content and a high concentration of soluble fiber, suggesting possible benefits for customers health (Mileib Vasconcelos et al., 2012).

Yacon roots consumption has been associated with several health benefits, such as improvement in gastrointestinal motility (Geyer, Manrique, Degen, & Beglinger, 2008), increased bone calcium retention (Lobo, Colli, Alvares, & Filisetti, 2007), triacylglycerols-lowering effects (Genta, Cabrera, Grau, & Sánchez, 2005), positive impact on glucose homeostasis (Genta et al., 2009; Honoré, Genta, & Sánchez, 2013), antioxidant activity (Habib, Serra-Barcellona, Honoré, Genta, &

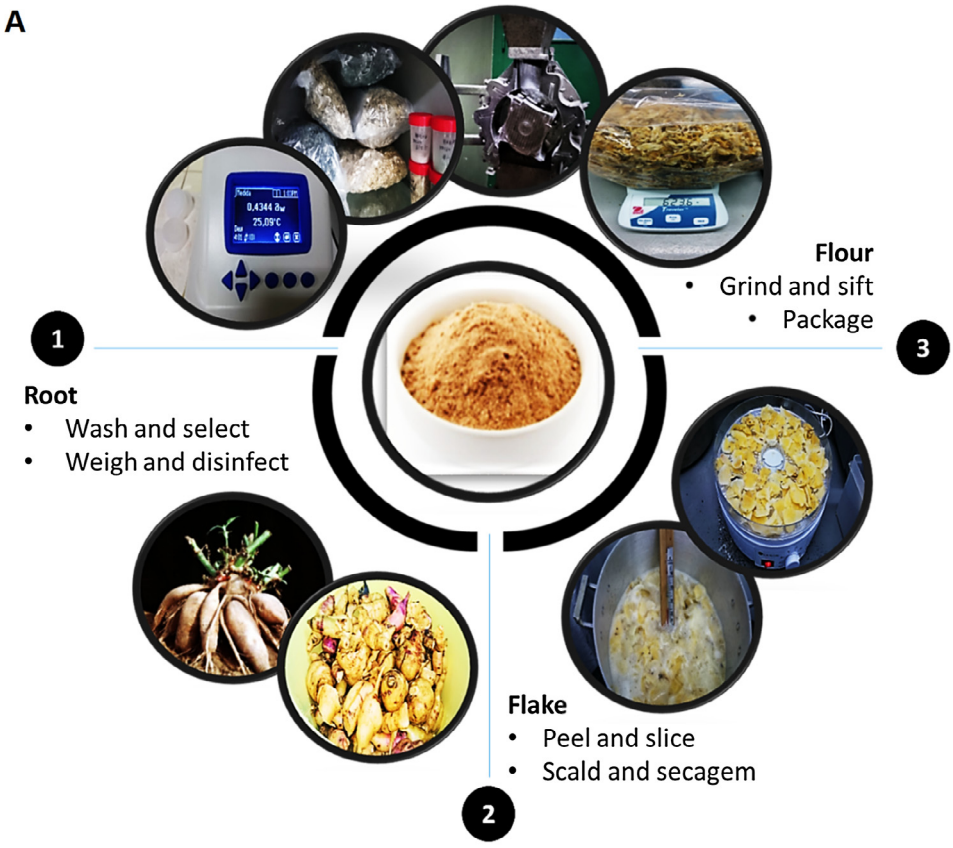

Fig. 1. Schematic summary of yacon roots processing for obtaining flour with high quality of FOS (A). Experimental design (B).