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A sensory- and consumer-based approach to optimize cheese enrichment with grape skin powders

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ABSTRACT

The present study aimed to present a sensory- and consumer-based approach to optimize cheese enrichment with grape skin powders (GSP). The combined sensory evaluation approach, involving a descriptive and an affective test, respectively, was applied to evaluate the effect of the addition of grape skin powders from 2 grape varieties (Barbera and Chardonnay) at different levels [0.8, 1.6, and 2.4%; weight (wt) powder/wt curd] on the sensory properties and consumer acceptability of innovative soft cow milk cheeses. The experimental plan envisaged 7 products, 6 fortified prototypes (at rates of Barbera and Chardonnay of 0.8, 1.6, and 2.4%) and a control sample, with 1 wk of ripening. By means of a free choice profile, 21 cheese experts described the sensory properties of prototypes. A central location test with 90 consumers was subsequently conducted to assess the acceptability of samples. The GSP enrichment strongly affected the sensory properties of innovative products, mainly in terms of appearance and texture. Fortified samples were typically described with a marbling aspect (violet or brown as function of the grape variety) and with an increased granularity, sourness, saltiness, and astringency. The fortification also contributed certain vegetable sensations perceived at low intensity (grassy, cereal, nuts), and some potential negative sensations (earthy, animal, winy, varnish). The white color, the homogeneous dough, the compact and elastic texture, and the presence of lactic flavors resulted the positive drivers of preference. On the contrary, the marbling aspect, granularity, sandiness, sourness, saltiness, and astringency negatively affected the cheese acceptability for amounts of powder, exceeding 0.8 and 1.6% for the Barbera and Chardonnay prototypes, respectively. Therefore, the amount of powder resulted a critical parameter for liking of fortified cheeses and a discriminant between the 2 varieties. Reducing the GSP particle size and improving the GSP dispersion in the curd would reduce the effect of powder addition on sensory properties, thereby encouraging the use of these polyphenol-based fortifiers in cheeses. The proposed approach allowed the identification of sensory properties critical for product acceptability by consumers, thus helping the optimization of both fortifier characteristics and new cheese production and composition.
Key words: consumer acceptability, free-choice profile, soft cheese, grape skin powder

INTRODUCTION

Consumers are increasingly aware that food directly contributes to their health (Mollet and Rowland, 2002), and the dairy market plays an active role in health and wellness (Brockman and Beeren, 2011). The use of functional ingredients represents one of the most important trends in diary product technological innovation. Dairy product enrichment can include (1) fortification with microingredients (isolated and purified high-value compounds) to enhance the nutritional value of the food or (2) addition of macroingredients (complex ingredients, composed by a mixture of components). Within the first category, several examples are available, such as Bermúdez-Aguirre and Barbosa-Cánovas (2011), Rinaldoni et al. (2014), and Stratulat et al. (2014). Recently, winery by-products, such as grape pomace, were added as macroingredients to several foods to obtain novel functional food products enriched in terms of polyphenols and dietary fiber (Mildner-Szkudlarz et al., 2013; Yu and Ahmedna, 2013).

Several biological activities are reported for dietary fiber and polyphenols from grape pomace, and advantages from their use in dairy production processes, as well as in product quality, have been envisaged (Zhu et al., 2015). Environmental sustainability (Augustin et al., 2013) and contributions to managing waste (Fontana et al., 2013) are similarly important factors encouraging the use of nondairy products as ingredi-

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ents in the dairy industry. To our knowledge, among dairy products grape pomace has been uniquely used to fortify yogurt (Karaaslanet al., 2011; Codaet al., 2012) and salad dressing (Tseng and Zhao, 2013).

Beside the vast literature focusing on the advantages associated with the use of grape pomace as a food ingredient (Yu and Ahmedna, 2013; Zhu et al., 2015), a lack of information exists considering the sensory effect of this ingredient on food prototypes. Generally, the use of ingredients obtained by vegetal by-products to fortify or enrich foods contributes unpleasant sensations, which are detrimental to the overall quality (Ajila et al., 2010; Braghieri et al., 2015) and the acceptability (Marti et al., 2014; Rinaldoni et al., 2014) of food products. A limited number of studies have taken into account the effect of fortification with grape pomace on product sensory properties (Torri et al., 2015) and on its acceptability by consumers (Lavelli et al., 2014; Sant'Anna et al., 2014).

Belief in the health benefits from functional foods is the strongest positive determinant of consumer willingness to compromise on taste (Verbeke, 2006). Moreover, considering the appeal of nutrition and health claims, significant interaction effects were found between claim type and the product concept, indicating that consumers react differently to the product, functional ingredient, and claims of product function (Verbeke et al., 2009).

Thus, implementing healthy properties without taking into account taste modifications and consumer response to the new fortified food appears a highly speculative and risky strategic option (Verbeke, 2006). This aspect deserves even more attention in the case of fortification or enrichment of a familiar food. In fact, the more familiar is a consumer with the product the more deviation from the expected sensory properties will negatively affect the consumer's response (Mildner-Szkudlarz et al., 2013). Based on these considerations, and given the importance of developing successful product for the food industry, it seems extremely important to include a consumer-based approach in product innovation and optimization process to investigate the effect of the fortification or enrichment on acceptability and to increase the probability of success in new products.

In the present study, a sensory- and consumer-based approach to optimize cheese enrichment or fortification conditions was proposed and applied to an innovative cow milk soft cheese developed by incorporating the grape skin powders (**GSP**) obtained from 2 grape varieties (Barbera, a red grape variety, and Chardonnay, a white grape variety) into the curd. The sensory- and consumer-based approach we present (1) evaluates the effect of enrichment conditions (type and concentration of added ingredient) on cheese sensory properties and (2) identifies the sensory drivers of the acceptability of the enriched soft cheeses developed in this study.

MATERIALS AND METHODS

Products

Grape Skin Powders. Grape pomace from nonfermented white *Vitis vinifera* cv. Chardonnay was provided by the Fontanafredda winemaking factory (Serralunga d'Alba, Cuneo, Italy), whereas that from fermented red *Vitis vinifera* cv. Barbera was provided by the Clarea winemaking factory (Chiomonte, Torino, Italy). The skins were mechanically separated, vacuum packaged, and stored at −20°C before being dried in an oven (Memmert, UFE 550, Schwabach, Germany) at 54°C for 48 h and then ground with a Retsch ZM200 grinder (Retsch Gmbh, Haan, Germany) to obtain GSP with a particle size of less than 250 μm.

Cheese Samples. Raw cow milk (3.5% protein, 3.6% fat, 5.1% lactose) was provided from a local farm, pasteurized at 72°C for 15 s, and then calcium chloride (0.1% vol/vol) and mesophilic starter bacteria Lyofast MOSO60D (Clerici-Sacco, Cadorago, Italy) were added. Coagulation was performed at 38 to 40°C with cow rennet (chymosin-to-pepsin 20:80; Clerici, Milan, Italy). After 30 to 40 min of resting, the curd was cut 2 times and left to stand for 10 min at 37°C. Ripening was performed at 6 ± 1°C for 6 d. During ripening, each cheese was manually dry salted. The obtained soft cheeses were fresh products similar to Robiola and considered as control sample (**STD**). Six samples of enriched cow milk soft cheese were developed by incorporating GSP from Barbera (**B**) and Chardonnay (**C**) into the curd during the cheesemaking process. Three different percentages of powders [0.8, 1.6, and 2.4%; weight (**wt**) powder/wt curd] were added directly to the curd before shaping and manually mixed. A preliminary production test showed that it is not possible to obtain a cheese with a powder percentage higher than 2.5%, as cheeses were not able to maintain their shape. The enriched samples were codified as B0.8, B1.6, B2.4, C0.8, C1.6, and C2.4. In total, the study used 7 cheese samples. At the end of ripening, the obtained cheeses (250 ± 10 g) were cut in slices (5 × 3 × 1.5 cm) at room temperature (20 ± 1°C) approximately 20 min before each sensory evaluation. Slices were placed in transparent plastic cups (38 mL) and hermetically sealed with a clear plastic lid. Samples were identified with 3-digit codes, served in randomized and balanced order among subjects, and evaluated at room temperature (20 ± 1°C).