Food Research International 57 (2014) 26–33

Contents lists available at ScienceDirect

Food Research International

journal homepage: www.elsevier.com/locate/foodres

Consumers' acceptance of a high-polyphenol yerba mate/black currant beverage: Effect of repeated tasting

J.M. Orjuela-Palacio [a,1], M.C. Zamora [b,*,1], M.C. Lanari [a,1]

[a] Centro de Investigación y Desarrollo en Criotecnología de Alimentos (CIDCA), CONICET-La Plata, Facultad de Ciencias Exactas Universidad Nacional de La Plata (UNLP), Calle 47 y 116 S/N°, La Plata B1900AJJ, Buenos Aires, Argentina
[b] Facultad de Ciencias Agrarias, Pontificia Universidad Católica Argentina (UCA), R. Freire 183, Ciudad de Buenos Aires 1426AVC, Argentina

ARTICLE INFO

Article history:
Received 27 August 2013
Accepted 8 January 2014

Keywords:
Yerba mate
Black currant
Repeated exposure
Emotions
Acceptability

ABSTRACT

The effect of repeated tasting may improve the acceptance level and positive emotions associated with an unusual food. Our aim was to analyze this effect on the consumer acceptance, emotional status, purchase intention and optimum level of sensory attributes of a yerba mate (*YMI*)/black currant (*BC*) drink with high polyphenol content and low palatability.
Beverage formulations (%) were: YMI 50/BC 30 (S1); YMI 60/BC 20 (S2); YMI 60/BC 20/diet sweetener 0.05 (S3). All samples had 15% maltodextrin, 0.01% aroma and 5.0% sucrose. One hundred participants (70 female, 30 male) aged 25 to 63 years (M = 38.9, SD = 10.9) evaluated the same three samples (S1, S2 and S3) during four sessions to determine the influence of repeated exposure, taking the first session as a control. Acceptance was measured by a 9-point hedonic scale, purchase intent by a 5-point scale and attribute diagnosis (sourness, sweetness, astringency, aroma and body) by a Just About Right scale. Consumers selected at least three terms from a list of 12 words (well-being, displeasure, familiarity, sadness, fear, freshness, anguish, simplicity, relaxation, anger, joy and surprise) to describe their emotional status after tasting the samples. Results showed that the last session displayed the highest values for acceptance demonstrating a repeated exposure effect. The samples with less acceptability in session 1 (S1 and S2) were those with the greatest increase in session 4. Purchase intention was not affected by product exposure. The oldest consumer group (50–63 years old) exhibited the minimum levels of acceptance and purchase intention. The attribute diagnostic evaluations did not change through the four sessions indicating that the consumer opinion of its optimum point was maintained at the same level as the first impression. The word "familiarity" was selected for all the samples in the fourth and final session and also for sample 3 at session 3, confirming its impact and showing the exposure level necessary to develop it.

1. Introduction

The potential health benefits of phenolic compounds have prompted new developments in the food industry. Consumers demand natural products with high palatability, a critical requirement for any food with high polyphenol content. Therefore, in the present work we analyzed the combined use of two products with proven health properties (yerba mate and black currant) as the main ingredients of a healthy drink.

Yerba mate (*Ilex paraguariensis*) is a native plant from South America consumed as an infusion because of its stimulating and energizing characteristics, as well as for other health benefits (Calviño, Tamasi, Drunday, Cossalter, & Garrido, 2012). It has antioxidant and hepatoprotective properties (Filip & Ferraro, 2003; Filip, Lottito, Ferraro, & Fraga, 2000), as well as the capacity to improve the cardiovascular (Heck & Gonzalez de Mejía, 2007) and central nervous systems (González, Ferreira, Vázquez, Moyna, & Paz, 1993). Some of the pharmacological properties attributed to mate infusion have been related to its high content of polyphenolic antioxidants especially chlorogenic acid, caffeic acid and flavonoids like quercetin, rutin and kaempferol (Heck, Schmalko, & Gonzalez de Mejía, 2008) and also by xanthines such as caffeine and theobromine (Heck & Gonzalez de Mejía, 2007). Yerba mate infusions' bitter taste and astringency sensation elicit negative consumer reactions when perceived at high intensities (Jaeger, Axten, Wohlers, & Sun-Waterhouse, 2009; Lesschaeve & Noble, 2005). Moreover, the perceived intensity of both attributes increases with the content of herbaceous material present in the infusion (Calviño et al., 2012).

Black currant (*Ribes nigrum*; BC) has a high natural content of ascorbic acid (Casati et al., 2012) and is an excellent source of bioactive components such as anthocyanins, flavonols, procyanidins, and phenolic acids. Anthocyanins display a wide range of biological activities including antioxidant, antimicrobial, anti-carcinogenic and neuroprotective activities; vision improvement and induction of apoptosis (Han, Shen,

* Corresponding author at: Facultad de Ciencias Agrarias, Pontificia Universidad Católica Argentina (UCA), R. Freire 183, Ciudad de Buenos Aires (1426AVC), Argentina. Tel.: +54 11 45522711/+54 11 45522721.
E-mail address: zamoramariacl@gmail.com (M.C. Zamora).
[1] Members of Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Buenos Aires, Argentina.

0963-9969/$ – see front matter © 2014 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.foodres.2014.01.017

& Lou, 2007; Neto, 2007; Ramos, 2008; Soobrattee, Bahorun, & Aruom, 2006). In spite of its high nutritional value, BC consumption is hindered by its sourness and astringency. Both the organic acids and the ratio of sugar and acid components affect the intensity of the sour sensation and three flavonol glycosides (kaempferol-3-O-(6″-malonyl) glucoside, myricetin-3-O-galactoside, and an unknown kaempferol glycoside) were found to be important contributors to astringency (Sandell et al., 2009).

Anthocyanin molecules are also responsible for BC's black color; however, they have the disadvantage of being unstable and highly susceptible to degradation (Määttä, Kamal-Eldin, & Torronen, 2001; Slimestad & Solheim, 2002) therefore, thermal stability is an important aspect to consider when selecting a drying technique.

Freeze-drying has been proved to be the most suitable method for drying thermosensitive substances, minimizing thermal degradation reactions. Estupiñan, Schwartz, and Garzón (2011) investigated the stability of anthocyanin freeze-dried powders from Andes berry during storage and concluded that the addition of maltodextrin DE20 improved the color and stability of the antioxidants present. Maltodextrin (MD) is the most common carbohydrate matrix used for encapsulation stability, protecting against undesirable physical and chemical changes (Galmarini, Schebor, Zamora, & Chirife, 2009; Roos, 1995; Sánchez, Baeza, Galmarini, Zamora, & Chirife, 2013). Polysaccharides such as MD can help to enhance palatability as a masking agent of bitterness and to reduce the astringency sensation induced by phenolic compounds of foods and beverages (Ley, 2008; Troszynska et al., 2010).

In studies of consumer liking it is important to identify the properties that improve likability for further optimization of the product. The Just About Right (JAR) scale can be applied to obtain information about whether a specific attribute (i.e., sweetness, sourness, bitterness) is at its optimal level. This scale provides an idea of the proportion of consumers who perceive each sample in a certain way and allows the determination of the intensity of an attribute considered ideal for a given product (Costell, Tárrega, & Bayarri, 2010). Other authors have indicated that the JAR scale can be used with the hedonic scale in consumer testing to provide directional information for food optimization (Gacula, Mohan, Faller, Pollack, & Moskowitz, 2008; Xiong & Meullenet, 2006). However, the JAR scale has some limitations because consumers are not trained to describe sensory properties and can give the same word different meanings. The use of JAR scales assumes that all the consumers understand what the attribute listed on the score sheet is referring to. In other words, the consumers must have a common idea or consensus understanding of the attribute in question (Lawless & Heymann, 2010). For this reason in the current study, the JAR scales were used in combination with an exact definition of the attributes to increase the consensual comprehension.

There is evidence that repeated exposure can increase preference for a particular food (Lesschaeve & Noble, 2005). Stein, Nagai, Nakagawa, and Beauchamp (2003) reported that a positive liking shift appeared after 7 days of exposure to a bittersweet drink and this process may be facilitated by a palatable taste modality such as sweetness. The power of 'mere exposure' to alter children's food preferences is well established (Cooke, 2007), however, there is little information in the literature about the influence of repeated exposure on purchase intention. In the current paper this measure will be for guidance only, because it does not represent a real purchase situation for consumers who do not know of a similar beverage on the market to compare prices, packaging or place of purchase.

Consumer expectations for a new food or beverage may also be explored taking into account the emotions that these products generate. It is generally acknowledged that human eating choices are affected by and associated to emotions (Desmet & Schifferstein, 2008; Hanoch, Wood, & Rice, 2007). Manzocco, Rumignani, and Lagazio (2013) studied the emotional response to fruit salads with different visual quality level by analyzing fruit browning, microbiological count, and overall visual acceptability. Less liked or disliked fruit salads changed the emotional status of the participants, who felt less peaceful, friendly and eager whereas they felt more aggressive, sad and disgusted in the presence of the spoiled fruit salads.

In the current paper, a preliminary approximation was made to correlate the acceptance level with the consumer's identification of their emotional status in relation to repeated exposure.

The strategy of providing health-related information can contribute to a more positive evaluation of some products, particularly in relation to purchase intention (Casati et al., 2012; Tuorila & Cardello, 2002). Although the present work did not include this kind of analysis, to enhance the hedonic responses, all participants were told of the new beverage's potential health advantages.

The main objective of this study was to assess the effect of repeated exposure on consumers' acceptance of a new beverage of a yerba mate/black currant mixture with healthy properties but low palatability. The hypothesis to be tested was whether repeated tasting could contribute to a more positive evaluation of the beverage and increase purchase intention. Moreover, which sensory attributes contributed to consumer liking/disliking and the emotional status level evoked in consumers after tasting the beverage were also investigated. In addition, a preliminary approximation of consumers' attitude for a novel product was estimated by emotional status, taking into account the age of the participants.

2. Materials and methods

2.1. Beverage preparation

Organic ripe black currant berries (BC; *R. nigrum* cv. Silvergieter) from a producer (Chacras Cuyen, El Bolson, Chubut, Argentina) were harvested during January 2012 and stored at −20 °C for 270 days. 24 h before beverage preparation, the fruit was defrosted and processed in an industrial fruit pulper (filter net pore diameter: 2 mm).

The yerba mate infusion (YMI) was prepared by extracting 120 g of commercial yerba mate (*I. paraguariensis*, St. Hil; La Unión Suave, Argentina) leaves with 1 L of water (100 °C for 15 min). The supernatant was decanted for 15 min at 25 °C, filtered and stored at 4 °C until required for beverage preparation (within the same day).

Although drinking yerba mate infusions is an everyday habit in Argentina, its combination with black currant as a beverage is not present on the market. The ratio between the two components was selected by taking into account that the beverage was thought of as a yerba mate drink with added BC. Therefore, the main component was the YMI and the BC percentage was limited by the pH level that makes the beverage very sour. The sum of both components (YMI + BC) had to be 80%, because the remaining 20% were carbohydrates used to stabilize the encapsulates. Therefore, the range of YMI was between 50 and 70%, and BC 30 to 10%. The combination 70/10 was discarded because it had low viscosity and a non-attractive green–brown color. On account of its color and viscosity, the beverage was seen as juice by consumers.

The formulations (% w/w) used for beverage production were: YMI 50/BC 30 (S1); YMI 60/BC 20 (S2); YMI 60/BC 20/commercial diet sweetener 0.05 (cyclamate 5700 mg/100 g; saccharin 2000 mg/100 g) (S3). All samples had 15% maltodextrin dextrose equivalent 10 (DE10, MD10; Productos de Maíz S.A., Buenos Aires, Argentina), 0.01% passion fruit commercial aroma (Firmenich, Argentina) and 5.0% sucrose (food grade).

S1, S2 and S3 were freeze dried at room temperature in a FIC L1-1-E300-CRT freeze dryer (Buenos Aires, Argentina) operated with a freezing plate at −35 °C and a vacuum below 100 μm. The freeze dried samples were packaged in a polyamide/polyethylene film (70 μm) and kept at −18 °C until use. The pH, total soluble solids (°Brix) and total polyphenols (mg GAE/g) content of S1and S2/S3 were 3.4 and 3.6; 26 and 25; 68.6 and 73.0, respectively.