

PROXIMATE COMPOSITION AND MINERAL CONTENT OF EXPERIMENTAL AND COMMERCIAL WHEY-BASED FRUIT BEVERAGES

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ABSTRACT - Cheese whey is a dairy industry effluent with a strong organic and saline content. The growing concern about the pollution and the environmental control as well as greater knowledge about its nutritional value has led to the addition of the whey in the food chain. The purpose of this study was to develop a whey-based fruit beverage, and to compare the proximate composition and mineral content of experimental and commercial brands. From the analysis of raw materials, the proximate composition and mineral content of experimental whey-based fruit beverage was calculated. The information related to the commercial brand was obtained in the label. The experimental beverage presented proximate composition and mineral content similar to the commercial brand, except for the high content of selenium (70 µg/100g), which could be attributed to the proximate composition of whey. The production of whey-based fruit beverages is a good source of nutrients and a viable alternative to use the whey in the human food chain offering a palatable product.

KEYWORDS: waste recovery; dairy effluents; whey-based fruit beverage; nutrients.

1. INTRODUCTION

Dairy industry is one of the main sources of industrial effluent worldwide. Cheese whey is considered the most important pollutant in the dairy sector, not only because of the high organic load, but also for the volume generated. For a long time, cheese whey was simply discarded as waste or used for animal feed or for the production of low-value products, such as ricotta. Today, cheese whey has been used in the production of various categories of food (Smithers, 2008; Carvalho et al., 2013).

From the valorization point of view, cheese whey has a high nutritional value. In a dry basis, bovine whey contains 70–80% of lactose, 9% of proteins, 8–20% of minerals and other minor components, such as some hydrolyzed peptides of k-casein, lipids and bacteria. In addition, the processing of whey proteins can also be used for therapeutic purposes such as antioxidants and as antihypertensives because they release, by hydrolysis, bioactive peptides which can trigger physiological effects in the human body (Carvalho et al., 2013).

The use of liquid cheese whey for the production of beverages is an alternative to recover whey nutrients. In Brazil, whey is commonly used in the formulation of milk drinks, but another option would be the production of whey-based fruit beverages, which has been evaluated in several studies (Pelegri and Carrasqueira, 2008; Cruz et al., 2009; Guedes et al., 2013). These beverages are

receiving notable attention and has potential in the market. In addition to their appetizing feature, they are extremely nutritious and energetic, being especially useful in areas where there is lack of food, which is leading to certain nutrients' deficiencies (Baccouche et al., 2013).

Some Brazilian food companies are developing products based on whey nutrients and fruit juice, which are categorized as "bebidas compostas de fruta" (Brasil, 2009; Brasil, 2013). These beverages are convenient and packed in Tetra Pack® packaging. However, they present in the composition various food additives such as flavouring, acidulants, stabilizers, preservatives, colorants and thickeners. Currently, consumers prefer healthier, fresh and palatable food, free of additives, which stimulates the search for more natural products. For this reason, research in food industry aims the development of innovative products with these characteristics. The purpose of this study was to develop a whey-based fruit beverage, and compare the proximate composition and mineral content of experimental and commercial brands of whey-based fruit beverages.

2. MATERIAL AND METHODS

2.1 Raw Materials and Commercial Brand

Pasteurized milk was used to produce Minas frescal cheese. The whole whey was recovered. Frozen grape juice was elected as the flavoring agent and purchased at a municipal market in Rio de Janeiro, RJ. Cheese whey and grape juice were mixed following the proportion 70:30% (v/v) for beverage formulation. Sucrose (4.8%) and citric acid (in proportion to reach pH=3.8) were added as sweetener and acidulant/preservative ingredients, respectively. Part of the raw materials was stored under freezing (-18 ± 1 °C) up to the moment of laboratory analyses. The commercial brand, also with grape flavor, was obtained from a supermarket in Curitiba, PR and sent by post to Rio de Janeiro, under room temperature.

2.2 Determination of Proximate Composition and Mineral Content of Whey-based Fruit Beverages

The proximate and mineral composition of raw materials were analysed following the AOAC (2005) procedures. Moisture content (g/100 g) was determined by drying in vacuum oven at 70°C, fat (g/100 g) by *Monjonier* extraction in whey (AOAC, 2005) and by automatic fat extraction system in grape juice. Protein content was analysed by the *Kjeldahl* method, multiplying by a factor of 6.38 for cheese whey and 5.75 for grape juice. The carbohydrate content was calculated by difference. The ash content was determined by a gravimetric method, incinerating samples at 550°C (AOAC, 2005). For the determination of mineral content, it was performed microwave digestion with inductively coupled plasma optical emission spectroscopy (ICP-OES) according to AOAC (2005). The following micronutrients were analyzed: sodium, magnesium, potassium, phosphorus, calcium, manganese, copper, iron, zinc, aluminum, chromium, cobalt, selenium, lead and molybdenum. Results were expressed in mg/100g or µg/100g.

From the results of the raw materials analyses, the proximate composition and mineral content of the experimental whey-based fruit beverage were calculated. The information related to the commercial brand was obtained in the product label. For comparison, Daily Recommended Intake (DRI) (Brasil, 2003; Brasil, 2005) was calculated for the experimental sample considering the same volume of the commercial beverage (330 g).

3. RESULTS AND DISCUSSION

The characterization of the experimental and commercial brand of whey-based fruit beverages, as well as the values for DRI are presented in Table 1.

Table 1 - Mean values for proximate composition and mineral content of whey-based fruit beverages and values for DRI.

Item	Experimental beverage	DRI ^a (%)	Commercial beverage	DRI ^a (%)
Energy ^b (Kcal/100g)	43.44 (602 kJ)	7	47.58 (659 kJ)	8
Moisture (g/100g)	89.54	-	-	-
Fat ^c (g/100g)	0.64	4	0.00	0
Protein ^c (g/100g)	0.63	3	1.00	4
Ash (g/100g)	0.40	-	-	-
Carbohydrate ^c (g/100g)	8.79	10	10.90	12
Sodium ^c (mg/100g)	32.48	4	40.36	6
Potassium (mg/100g)	106.37	-	100	-
Magnesium (mg/100g)	7.74	10	6.97	9
Phosphorus (mg/100g)	29.19	14	36.36	17
Calcium (mg/100g)	29.23	10	27.27	9
Manganese (µg/100g)	80	11	-	-
Cooper (µg/100g)	60	22	-	-
Selenium (µg/100g)	70	679	3.33	32
Zinc (µg/100g)	20	1	-	-
Iron (µg/100g)	40	1	-	-

^aDaily Recommended Intake (DRI) for adults (Brasil, 2005); ^bBarros et al. (2010); ^cBrasil (2003)

The experimental beverage presented proximate composition and mineral content similar to the commercial brand. Besides, it has presented the best contribution to the DRI with respect to mineral content, because the experimental whey-based fruit beverage has shown lower sodium content as well as higher manganese, copper, zinc and iron among the mineral constituents, which were absent or not cited in the commercial beverage.

The experimental beverage also presented high concentration of selenium, which was related to the high content of this mineral detected in cheese whey in previous studies. The selenium concentration (1.034 mg/L and 103.4 g/100g) in cheese whey was higher than the average content reported by Ferreira et al. (2002) for samples of pasteurized cow milk (1.9 mg/100g) and Minas fresh cheese (9.9 mg/100g). It suggests that these results are related to the animal feed. As in Brazil most land has mineral deficiency, farmers adopted the mineral supplementation of the herd. However, the practice has been carried out indiscriminately, as it should be based on the unique provision of the mineral deficient (Peixoto et al., 2005). According to Tokarnia et al. (2000) supplementation should only be given in the case of notoriously deficient minerals in Brazil: sodium, phosphorus, copper, cobalt and only occasionally selenium and zinc.

However, the value of the tolerable upper limit (Tolerable Upper Intake Level) for selenium in adults is 400 mg/day. Thus, the ingestion of only one portion of the experimental beverage (330g) would not cause health hazards associated with the risk of selenosis because it would present 231 µg of the mineral. It should be emphasized that this characteristic of the final product was estimated by the composition of the raw material.

4. CONCLUSIONS

Experimental and commercial whey-based fruit beverages presented similar proximate and mineral composition, except for the high content of selenium, which could be attributed to the proximate composition of whey. The production of this type of product can be a viable alternative to add whey to the human food chain in a palatable form, being a good source of nutrients.

5. ACKNOWLEDGMENTS

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