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Sensorial and fatty acid profile of ice cream manufactured with milk of crossbred cows fed palm oil and coconut fat

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ABSTRACT

This work was carried out to study the nutritional quality of milk of cows fed palm oil (PAL) or coconut fat (COC), and the use of that milk as raw material for ice cream production. Three treatments were tested with 23 healthy cows: control (CON), PAL, and COC. The milk was collected at d 21 and 36 of the experimental diet. Proximate composition (moisture, ash, fat, protein, and carbohydrates) and fatty acid composition were evaluated on milk and ice cream, and sensorial analysis, color (lightness, green/red, and blue/yellow), overrun, and texture were evaluated on the ice cream. Fatty acids present in milk and ice cream were determined by gas chromatography. Sensory analysis results showed that the ice cream acceptability index was above 70%. No difference was observed for proximate composition in milk and ice cream. Chromatographic analysis showed an increase in saturated fatty acid concentration in CON and lower levels in PAL; polyunsaturated fatty acid concentration was higher in PAL and lower in CON, in milk and ice cream; monounsaturated fatty acid concentration in milk was higher in PAL and lower in CON but no difference was found in ice cream. Comparing n-3 content in milk and ice cream, we observed that PAL had higher levels than CON and COC. The results indicate that it is feasible to add sources of fat to the animal feed for fatty acid composition modulation of milk and ice cream.
Key words: dairy product, conjugated linoleic acid, fatty acid, iced-cold food

INTRODUCTION

During the past few years, some technological advances have been made regarding dairy products, reflecting the diversity and quality of what is nowadays consumed. This was attained through an FA modulation on diets offered to dairy cows. Some of these FA are beneficial to human health, which makes them important as daily dietary supplements.

In many studies, the overconsumption of high-fat foods has been linked to the increasing incidence of obesity (Cadena et al., 2012). According to Caroprese et al. (2013), dietary recommendations indicate a reduction of fat intake, in terms of saturated and *trans* FA, and fat of animal origin.

A healthy fat composition of milk and derivatives are required to balance a diet, due to the presence of essential FA and vitamins, usually the fat-soluble ones (Chen et al., 2004). The high percentage of short- and long-chain FA is associated with low-density lipoprotein synthesis, responsible for cardiovascular diseases (Funck et al., 2006). However, low levels of MUFA and PUFA are found in milk. Conjugated linoleic acid is an important PUFA, which, even in low concentrations, improves health functions, such as reduction of coronary disease incidence, increase in high-density lipoprotein concentration, and reduction of body fat (Arbonés-Mainar et al., 2006).

Some FA are essential to human body normal function. They are not produced in the amounts the organism needs, so they must be in the human diet. An example of such FA is monolaurin, which has antiviral properties and is found in coconut fat (**COC**; Machado et al., 2006). Palm oil (**PAL**) has large industrial application and is one of the major natural sources of carotenoids (Nozière et al., 2006).

The choice of ice cream is because according to Karaman et al. (2014), this product is commonly enjoyed by people of all ages due to its cooling effect and the nutritive value of ice cream is high, as it is a milk-based dessert. Development of new ice cream formulations that are highly enjoyed by consumers is one of the driving forces of ice cream manufacturers. Ice cream is a great energy source, of which the content is almost totally assimilated (Marshall et al., 2003).

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Many authors have developed and evaluated ice cream (Cadena et al., 2012; Ferraz et al., 2012; Harwood et al., 2013; Karaman et al., 2014); however, little information exists about FA profile modification and its influence in final product acceptance. An ideal ice cream should correspond to the trust limits concerning quality criteria for taste, body, texture, melting characteristics, color, packing, microbial content, and composition (Marshall et al., 2003).

The objective of this study was to feed a diet supplemented with PAL or COC to 23 dairy cows and obtain the milk in 2 periods (at d 21 and 36), produce ice cream from the collected milk, and carry out physicochemical and sensorial analyses on the products.

MATERIALS AND METHODS

Animals, Experimental Design, Dietary Treatments, Milk Sampling, and Analysis

The experiment was realized at Marques' Farm (a commercial farm in Mirador, Paraná State, Brazil; (23°15′22″ S, 52°46′28″ W) during December (summer season). Three different diets were fed to cows according to Corradini et al. (2013).

Experimental diets were fed to 23 healthy crossbred dairy cows (Holstein × Zebu) by d 60 of their third lactation. Cows were milked daily and were randomly distributed in 3 groups of 3 isoenergetic diets: control (CON; 8 cows), PAL (8 cows) and COC (7 cows). Concentrate was offered to the cows once per day after milking, and then cows remained in pasture (*Brachiaria decumbens*). The first milk sampling was carried out at d 21 (period 1) and the second at d 36 after the beginning of the experiment (period 2).

The physicochemical analyses (moisture, fat, protein, ash, lactose, acidity, and total dry extract) of milk were conducted in an Ekomilk Ultrasonic Milk Analyzer (Ekomilk total; Eon Trading Inc., Haskovska, Bulgaria). Milk samples were analyzed at the Milk Clinic in Piracicaba (São Paulo, Brazil), where total bacteria count (**TBC**) and SCC were set with a bacteria counter with flow cytometry. Milk samples that did not meet the specifications of Regulation 62 (MAPA, 2011) were ruled out. The collected milk was transported in stainless steel receptacles under refrigeration to the State University of Paraná (UEM; Maringá, Paraná, Brazil), where the ice cream was immediately processed.

Ice Cream Manufacture

The ice cream was produced separately by treatment, by sampling day and by cow: 23 ice creams for the first collection (d 21) and 23 ice creams for the second collection (d 36). This procedure was carried out in the Food Engineering Milk and Derivatives Laboratory at the State University of Maringá (UEM). The ice cream was composed of 1.48% base powder, 74.07% milk, 19.52% sugar, 4.44% fat, and 0.49% stabilizer. After each process, the equipment was washed and sanitized. After processing, samples were identified and stored at a temperature of −18°C.

Ice Cream Physicochemical Analysis, Overrun, and Microbial Analysis

Centesimal composition analyses were made of moisture, protein, and ash (AOAC International, 1998), fat (Bligh and Dyer, 1959), and carbohydrates by difference. The physicochemical analyses were carried out right after production at the Food Engineering Laboratory at the State University of Maringa (UEM). All determinations were made in duplicate. The volumes for mixture samples and final aerated products were measured to set the overrun calculated according to Silva Junior and Lannes (2011).

Samples were microbiologically evaluated in duplicate. Samples were randomly separated (between 2 periods) and, at this stage, the same samples were used for sensorial analysis. The presence of thermotolerant coliforms, coagulase-positive *Staphylococcus* spp., and *Salmonella* spp. were investigated according to Regulation 62 (MAPA, 2011).

Color and Texture Analysis

Color was evaluated through a portable colorimeter (Minolta CR10; with an integrating sphere and viewing angle of 3°, D3 lighting, and illuminant D65; Konica Minolta Business Solutions do Brasil Ltda., Manaus, Amazonas, Brazil). The system used was the International Commission on Illumination (CIE) L*a*b* system, where **L*** represents luminosity on a scale from 0 (black) to 100 (white), **a*** represents a tone scale varying from red (positive values) to green (negative values), and **b*** represents a scale from yellow (positive values) to blue (negative values). Color saturation rate (**C***) and tone angle (**H***) were obtained according to Sousa et al. (2003). All determinations were made in duplicate.

Texture analysis was carried out in a Stable Micro Systems TA.XT*plus* Texture Analyzer (Texture Technologies Corp., Godalming, UK) in triplicate. According to Silva and Bolini (2006), the testing characteristics were as follows: accessory probe: 36 mm, mode: strength measured in compression, pretest speed: 2.0 mm/s, test speed: 3.0 mm/s, posttest speed: 7.0 mm/s, and distance: 10 mm.