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Development of a Milk Drink Added of Conjugated Linoleic Acid: Use of a Sensory Evaluation

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Abstract: Three sensory tests had been applied to evaluate a chocolate flavor milk drink added of Conjugated Linoleic Acid (CLA) aiming at the selection of a final formulation with the best sensory characteristics. Initially, the triangular test with the samples added of CLA (CLABE) or canola (CANBE) were assessed by an untrained sensory panel comprising 20 assessors. An affective test with 66 probable milk drink consumers was carried out with CLABE or CANBE. In the third stage, 100 assessors had evaluated the sensory acceptance and the purchase intention of two chocolate flavor milk drinks added of 1.25% (1.25% CLABE) and 2.5% (2.5% CLABE) of CLA. In the triangular test, the assessors noticed the difference between prepared drinks ($p < 0.5$). In the acceptance test, the CANBE was preferred to CLABE. However, 53% of the interviewed people affirmed the interest in increasing the consumption of a milky product able to reduce body weight. In the acceptance test applied in the third stage, 1.25% CLABE was preferred to 2.5% CLABE. No statistic difference was observed between the two drinks for the purchase intention carried out at the same time of the sensory evaluation. However, the evaluation of this parameter almost doubled, passing from 16 to 31% for the point certainly I would buy, when the assessors was informed that the CLA added drink could help in the reduction of the body weight.

Key words: Conjugated linoleic acid, milk drink, sensory evaluation, acceptance

INTRODUCTION

The Conjugated Linoleic Acid (CLA) comprises a group of positional and geometric isomers derived from the linoleic acid (C16:2-6) (Riserius *et al.*, 2001) produced by bacterial biohydrogenation in the ruminant gut (Jones *et al.*, 2005). The first observation of health benefits offered by CLA was as an anticancer activity, by Pariza and collaborators in the decade of the seventies. Other effects include changes in body composition, reduction of atherosclerosis, prevention and treatment of mellitus diabetes, among others (Bauman *et al.*, 2001; Whigham *et al.*, 2004).

The tendency of reducing the consumption of high fat meats and of skim milk leads the loss of the major portion of CLA (Ip *et al.*, 1995; Willians, 2000). The development of

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products shows close relationship with consumption needs and trends and for that reason, when a food product is developed some factors like nutritional value, satisfaction and acceptance by consumers have to be taken into account. Consumers increasingly demand products that possess positive nutritional qualities, while simultaneously having appealing sensory properties. New and healthy foods need to taste good to achieve success in the market place (Martens *et al.*, 2005). Developing and manufacturing of these products is a continuous challenge for the dairy industry.

Milk drinks comprise a series of products manufactured with milk and whey and results from the mixture of milk (raw, pasteurized, sterilized, UHT, reconstituted, concentrated, powder milk, whole milk, partially skimmed or semi-skimmed and totally skimmed) and whey (liquid, concentrated or powder) with or without addition of food products or food substances, vegetal fat, fermented milk, selected dairy ferments and other dairy products. The milky base should represent at least 51% mass/mass (m/m) of the total ingredients of the product. Milk drinks may contain in its formulation, besides whey, milk and traditional lactic bacteria, acidulates, flavors, acidity regulators, stabilizers, thickening agents, emulsifiers, color agents, conservatives, fruit pieces, pulp or juices and honey.

In this context, the goal of the present study was to develop a milk drink added of CLA and to study its sensory acceptance and purchase intention aiming at the selection of a final formulation with the best sensory characteristics.

MATERIALS AND METHODS

This research project was conducted in Universidade Federal de Minas Gerais (UFMG), from August, 2007 to 2008.

Materials

For the production of the milk drink it was used skim milk fluid, sugar, chocolate powder and canola oil, purchased in a supermarket in Belo Horizonte-MG, whey powder Kerrylac 700 donated by Kerry do Brasil Ltda (Três Corações, Brazil), resistant starch, provided by Refinações de Milho do Brasil LTDA (Guaranhuns, Brazil), potassium sorbate, acquired the Plury Química Ltda (Diadema, Brazil) and conjugated linoleic acid (CLA) in oil, (Clarinol® G 80, with 80% of CLA) kindly provided by Lipid Nutrition (Wormerveer, Netherlands). For the stirring, a household blender was used (Arno, Magiclean, Sao Paulo, Brazil).

Methods

Preparation of Milk Drinks

Initially, the whey powder was diluted in water in order to obtain 0.8% of protein. Then, the serum diluted skimmed milk fluid (70%) was added giving rise to a base milk drink. Sugar (10%), chocolate powder (7%), resistant starch (2%) and preservative potassium sorbate (0.45%) was added to this drink forming chocolate flavor milk drink.

For the first and second stages, 5 g of CLA or canola oil were added to 200 mL of chocolate flavor milk drink and this mixture was stirred in the blender for 3 min. For the third stage 2.5 or 5 g of CLA were added to 200 mL chocolate flavor milk drink, obtaining a concentration of 1.25 or 2.5%, respectively. Then, the mixture was stirred in the blender for 3 min. The preparation scheme of the milk drinks is shown in Fig. 1.

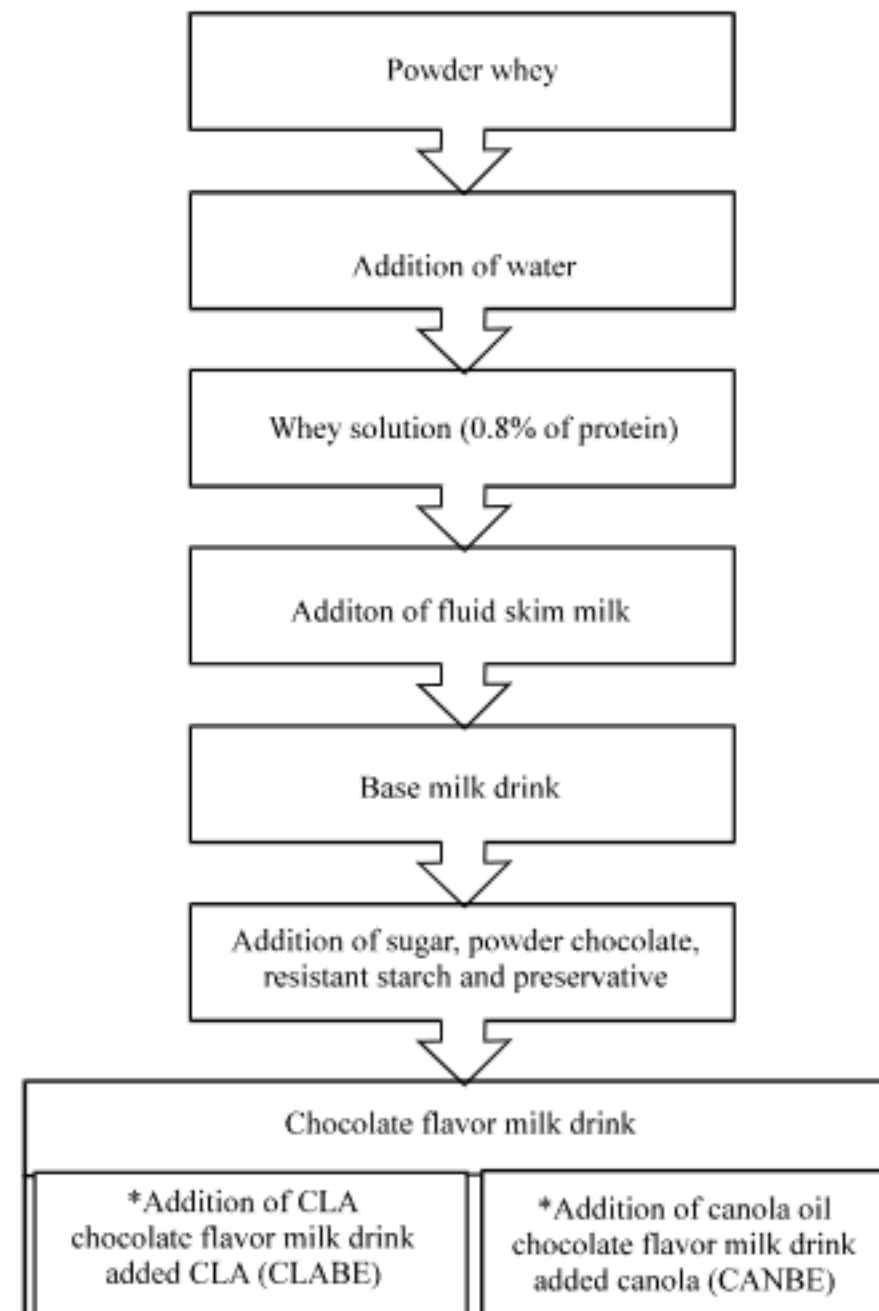


Fig. 1: Preparation scheme of the chocolate flavor milk drinks added of CLA (CLABE) or Canola (CANBE)

Sensory Analysis of Milk Drinks

The sensory analysis of the milk drinks was carried out in 3 phases. In the first one the triangular test was applied for similarity (Meilgaard *et al.*, 1991). In the second one, the sensory acceptance (Stone and Sidel, 1993) was applied to milk drink added of CLA (5%) or canola oil (5%). At the third phase, the same sensory acceptance was employed to milk beverages with addition of two concentrations of CLA, 1.25 and 2.5%.

Tests were carried out in a laboratory of sensory analysis equipped with individual cabinets, using white light. In all phases, participants signed a term of free and clarified agreement, according to guidance from the research ethics committee of UFMG (Universidade Federal de Minas Gerais) and they filled in a questionnaire on the consumption of milk drinks.

Sensory Evaluation

Triangular Test for Similarity-First Phase

Samples of milk drinks (CLABE or CANBE) were served (20 mL at 10°C) simultaneously in a randomized and balanced form, according to Ferreira (2000). Value of $\beta = 0.05\%$ and $p_a = 0.20$ were adopted, i.e., aiming at ensuring, within a 95% confidence level, that no more than 20% of the population is able to detect a difference among the samples. The data were also analyzed by normal approximation of the binomial test to determine the true proportion

of the assessors who were able to recognize differences among samples within the confidence interval of 95% (Meilgaard *et al.*, 1991). The upper point of the confidence interval was calculated by Eq. 1. The test was applied to 20 assessors informed about the use of the test, with six replications. The subjects were mostly females (75%) and with age between 18 and 35 years (70%).

$$P_{\max(95\%)} = [1.5(xn)-0.5] + z_{\beta} [2.25(xn)(1-(xn))/n]^{1/2} \quad (1)$$

Where:

x = Observed number of correct answers

n = Number of answers

z = Upper percent point of distribution of t-Student (tabled) (Meilgaard *et al.*, 1991)

Test of Acceptance-Second Phase

Global acceptance of CLABE was evaluated in comparison with CANBE by means of a group of 66 potential consumers of milk drink, untrained, university students, mostly (95.4%) women, with age between 18 and 25 (70%), selected on a basis of availability, interest and habit to consume dairy beverages. A hedonic scale of 1 to 9 points was used in which point 1 corresponded to a dislike extremely and point 9 corresponded to like extremely. In the same form a scale was included for intention to purchase structured with 5 points, in which 1 corresponded to certainly would buy and 5 to certainly would not buy. The samples were presented in a monadic sequential form, using a statistical design of complete balanced blocks, served at 10°C, in a volume of 20 mL (Stone and Sidel, 1993).

Test of Acceptance-Third Phase

Global acceptance of the milk drink with addition of CLA (CLABE) in two concentrations, 1.25% (1.25% CLABE) and 2.5% (2.5% CLABE) was evaluated. The test was applied to a group of 100 potential consumers of milk drink in a community of a university center involving students, professors and staff. They were a majority of women (76%), from 18 to 25 (69%), with incomplete college education (81%). The selection was based on availability, interest and habit to consume dairy drinks. A hedonic scale from 1 to 9 was used, in which 1 would correspond to dislike extremely and 9 to like extremely. In the same form a 5 point scale was included to assess the intention to purchase. Point 1 indicated certainly would buy and point 5 corresponded to certainly would not buy. The samples were presented in a monadic sequential form, with a statistical design of complete balanced blocks. Each sample was served at 10°C, in a volume of 20 mL (Stone and Sidel, 1993).

After the sensory evaluation, the assessors were requested to answer a question about their intention to purchase the product, in case it showed the property to contribute to body weight loss.

Statistical Analysis

All experiments were evaluated by analysis of variance (ANOVA unique factor) and Duncan test at 5% probability was used to determine the difference between the averages found.

RESULTS AND DISCUSSION

Triangular Test for Similarity

In this test the sensory team identified a difference ($p < 0.5$) between the chocolate flavor milk drink with addition of CLA and the one with canola, as the observed

number of correct answers for different samples within each arrangement was higher than the maximum tabled value for the adopted criteria.

When data were analyzed by normal approximation of the binomial test, in order to determine the true proportion of the panel of assessors who could distinguish differences between samples within the confidence interval of 95%, it was concluded that 60% of the population were able to differentiate the CLA flavor used at 2.5% in relation to canola in the chocolate flavor milk drink (Fig. 2).

When participants were asked, in the questionnaire, if they would increase their consumption of milk drink that would help to lose weight, 55% replied positively thus confirming consumer interest for products that offer some benefit to health (Brandao, 2002).

No research was found in the literature in which the sensory analysis was used to evaluate the similarity among non-fermented milk drink with the addition of CLA or other oils. However, some authors used the triangular test to evaluate the shelf life of cow milk and its derivatives that had the CLA content increased by alteration in animal diets (Jones *et al.*, 2005; Lynch *et al.*, 2005). In these studies, the triangular test was effective to identify the taste of oxidized oil in milk and butter.

Sensory Test of Acceptance-Second Phase

The results of sensory evaluation for acceptance and intention to purchase for the milk drinks with addition of CLA (CLABE) or canola (CANBE) are presented in Table 1. The CLABE showed less acceptance ($p<0.05$) than the CANBE.

The fact that CLA presents characteristic odor and taste as compared to canola, may explain the greater acceptance of CANBE in relation to CLABE. Ramaswamy *et al.* (2001) found good acceptance for cow milk with increased CLA content by modification of cattle diet that varied from 0.56 to 2.3 g of CLA per 100 g of fat, values much smaller than the CLA content of the milk drink prepared in this study, which was of 62 g of CLA per 100 g of fat.

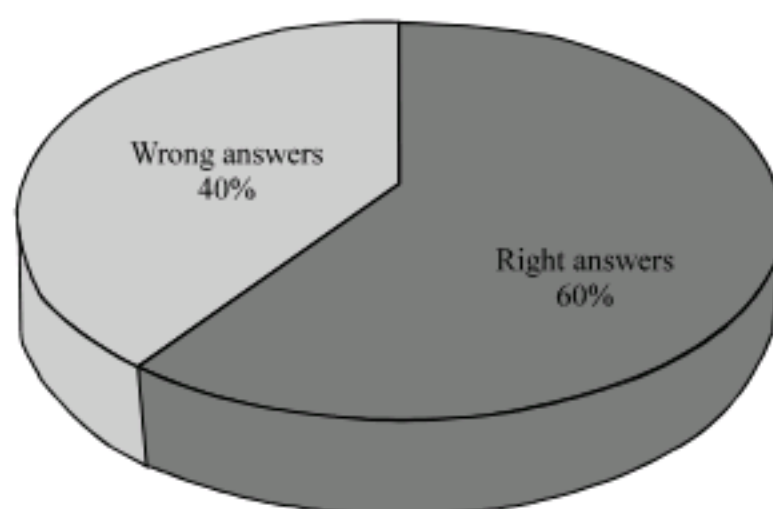


Fig. 2: Percentage of the population capable to differentiate the CLA flavor in relation to canola in chocolate flavor milk drinks, calculated by normal approach of the binomial test

Table 1: Acceptance and intention to purchase for samples of milk drink added of CLA or canola

Sample	Acceptance	Intent to purchase
CANBE	7.01±2.27a	2.79±1.37b
CLABE	4.73±2.34b	3.45±1.29a

CANBE: Chocolate flavor milk drink added of canola. CLABE: Chocolate flavor milk drink added of CLA. Values expressed as Mean±SD. For acceptance, value 1 corresponds to dislike extremely and value 9 like extremely. For intent to purchase value 1 corresponds to certainly would buy and value 5 corresponds to certainly would not buy. Different letter(s) are significantly ($p<0.05$) for the same line

Regarding the intention to purchase, the CANBE was also preferred to CLABE. However, the assessors were not informed about the health benefits of CLA. In this phase, potential consumers of the beverages were asked if they would increase their consumption of a dairy product that would help in weight reduction and 53% replied affirmatively. Ramaswamy *et al.* (2001) found in their research that 56.6% of consumers would pay more for milk with increased CLA content, a similar result of the present study. Nevertheless, differently from this study, these researchers informed to consumers about the beneficial effects of CLA for health, before the test.

Figure 3 shows the frequency of acceptance levels expressed by the assessors on the basis of an hedonic scale, varying from like extremely to dislike extremely. It may be observed that, despite of the lower acceptance of the CLABE in relation to CANBE, the highest frequencies expressed for CLABE were at like moderately option which indicates that a reformulation of this beverage by reducing CLA content might increase its acceptance. In fact, in the sensory analysis, tests are carried out with the aim of directly assessing consumers opinion thus facilitating the detection of product characteristics that need to be reformulated (Ferreira, 2000; Barboza *et al.*, 2003).

Sensory Test of Acceptance-Third Phase

Taking into account the result obtained in the previous item (Fig. 3), a chocolate flavor milk drink was prepared with a reduced CLA content (from 2.5 to 1.25%) on which the acceptance test was applied in order to compare these two drinks.

The results obtained for this test are presented in Table 2. It may be observed that 1.25% CLABE showed better acceptance than 2.5% CLABE ($p<0.05$) indicating that, in spite of the beneficial effects for health, the addition of CLA in oil form, from a technological viewpoint, must be done with caution to avoid a negative interference in the sensory characteristics of the product and therefore in its acceptance.

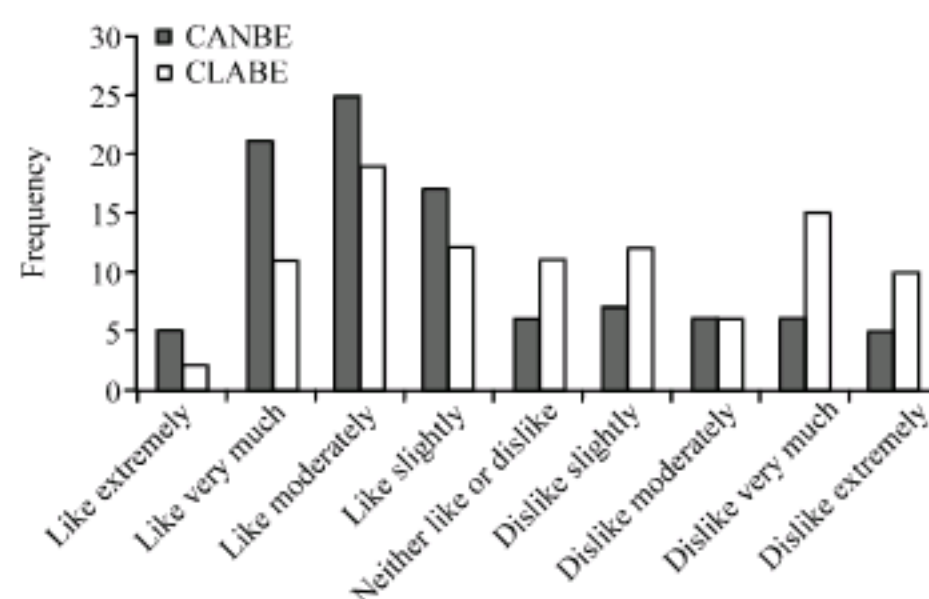


Fig. 3: Frequency of answers related to acceptance of chocolate flavor milk drink added of CLA (CLABE) or canola (CANBE)

Table 2: Acceptance and intention to purchase for samples of milk drink added of CLA

Sample	Acceptance	Intent to purchase
1.25% CLABE	6.20±1.82a	2.79±1.11a
2.5% CLABE	5.78±1.90b	3.04±1.21a

1.25% CLABE: Chocolate flavor milk drink added of 1.25% of CLA. 2.5% CLABE: Chocolate flavor milk drink added of 2.5% of CLA. Values expressed as Mean±SD. For acceptance, value 1 corresponds to dislike extremely and value 9 corresponds to like extremely. For intention to purchase value 1 corresponds to certainly would buy and value 5 corresponds to certainly would not buy. Different letter(s) are significantly ($p<0.05$) for the same line

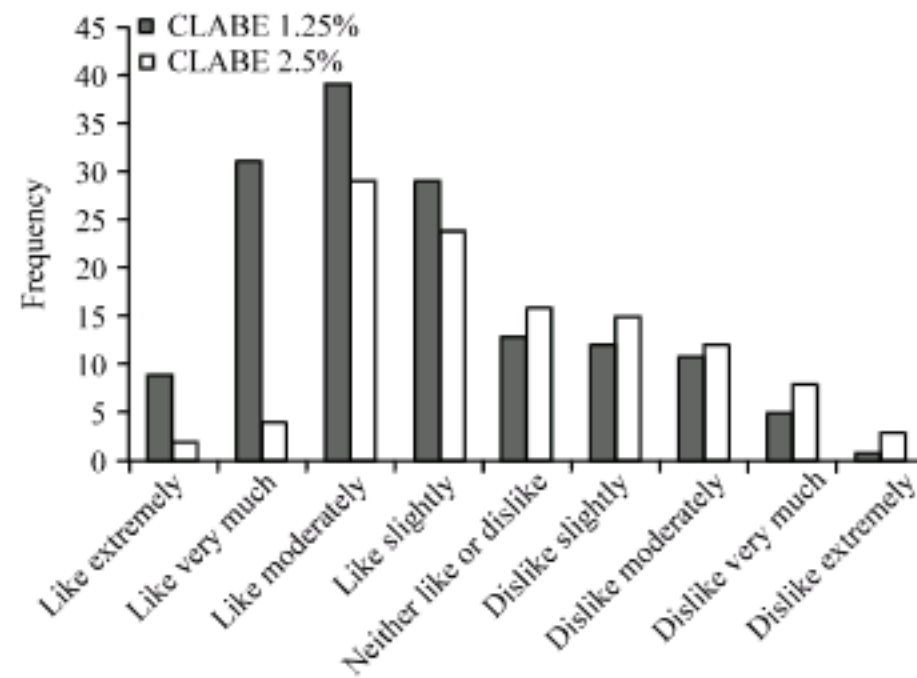


Fig. 4: Frequency of answers related to acceptance of chocolate flavor milk drink added of 1.25% (CLABE 1.25%) or 2.5% (CLABE 2.5%) of CLA

No data were found in the literature regarding the acceptance of CLA added milk drinks. On the other hand, Ramaswamy *et al.* (2001) found good acceptance for cow milk with increased content of CLA by modification of cattle diet which varied from 0.56 to 2.30 g of CLA per 100 g of fat. Such values are much lower than the CLA content of the milk drink prepared in this work, which varied from 31 to 62 g of CLA per 100 g of fat.

Figure 4 shows the frequency of the levels of acceptance expressed by the assessors, based on an hedonic scale, varying from like extremely to dislike extremely. It can be observed that, despite the lower acceptance of 2.5% CLABE in relation to 1.25% CLABE, the highest frequencies of expression for both beverages were for liked moderately.

Regarding the intention to purchase, no significant difference was observed between the results obtained for the two drinks (Table 2). As in the previous two phases, assessors were asked if they would increase the consumption of a dairy product that would help weight reduction and 53% replied affirmatively.

After finishing the sensory assessment, it was requested to the volunteers to answer a question about their intention to purchase the product in case it showed the property to help reducing body weight. At this moment, the evaluation of this parameter nearly doubled, going from 16 to 31% in the option of certainly would buy. This result is in accordance with the affirmative that consumers' tendency is to search for products that would improve life expectation and quality, this information being corroborated by the worldwide increase in consumption of functional products (Brandao, 2002).

CONCLUSION

The addition of 2.5% of CLA in oil form, to chocolate flavor milk drink was perceived by the assessors with the application of the triangular test for similarity. The majority of the population showed preference for the chocolate flavor milk drink added of canola (CANBE) as compared to the CLA added beverage (CLABE). Nevertheless, 53% of the interviewed group affirmed their interest in raising their consumption of a dairy product that would help to reduce weight. CLABE with 1.25% of CLA showed better acceptance than that with 2.5%, but both drinks presented the same intention to purchase. This parameter doubled after the information to the subjects about the effect of CLA in the reduction of body weight.

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