Difference thresholds for added sugar in chocolate-flavoured milk: Recommendations for gradual sugar reduction

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ABSTRACT

Reducing the concentration of added sugar in processed foods is one of the most realistic strategies to reduce the intake of this nutrient in the short-term. In order to be effective, gradual sugar reduction strategies need to determine the maximum sugar reduction that can be unnoticed by consumers. In this context, the present work aimed at providing recommendations for gradual sugar reduction in chocolate-flavoured milk by determining difference thresholds for added sugar and evaluating consumers' sensory and hedonic perception of reduced-sugar products. Five studies were conducted with 50 consumers to determine five sequential difference thresholds. In each study consumers completed six paired-comparison tests. Each pair was composed of a reference chocolate-flavoured milk and a sample that was reduced in added sugar from the reference. Difference thresholds, corresponding to the smallest reduction in sugar concentration that is noticed by consumers, were determined using survival analysis. Then, a study was carried to with 100 consumers to evaluate their sensory and hedonic perception of chocolate-flavoured milk samples with different added sugar concentrations. Results suggested that sequential sugar reductions can be set at 6.7% without affecting consumers' sensory and hedonic perception. Sugar reduction in chocolate-flavoured milk without affecting consumers' perception seems feasible and easy to implement. The approach of the present work could be extended to design recommendations for gradual reduction of the added sugar concentration of other industrialized products, contributing to the development of more healthful products that meet current nutritional recommendations.

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1. Introduction

Sweetness is a natural cue for edibility and energy-rich foods (Birch, 1999). Humans have an innate preference for sweet taste, which has motivated the food industry to add sugar to processed products to increase the pleasure of eating and consequently their product sales (Yebra-Biurrun, 2005). According to the Pan American Health Organization (2016), the majority of industrialized sweetened products commercialized in Latin American countries, such as breakfast cereals, sweetened milk, yogurt, ice-creams and sweetened beverages, contain an excessive amount of added sugar.

Sugar has become a major hidden source of calories in the diet and its intake has been strongly associated with the growing prevalence of several negative health conditions such as obesity, type 2 diabetes and dental caries (Johnson et al., 2009; Morenga, Mallard, & Mann, 2013; Popkin & Nielsen, 2003). This situation makes it necessary to develop strategic actions aimed at reducing sugar consumption worldwide (Lustig, Schmidt, & Brindis, 2012).

Considering the contribution of added sugar to total daily energy intake worldwide, one of the most realistic strategies that can be implemented to gradually reduce sugar consumption is to reduce the concentration of added sugar added of processed products (MacGregor & Hashem, 2014). This type of strategy has been successfully implemented in the UK for reducing salt consumption (Wyness, Butriss, & Stanner, 2011). According to the English Department of Health a 30 to 40% reduction in added sugar concentration can reduce calorie intake an average of 100 kcal per day per person, which could be effective in preventing obesity and diabetes (Department of Health, 2011).

The idea underlying gradual sugar reduction is to slowly and progressively reduce the sugar content of food products, so that consumers gradually get accustomed to products with lower sugar concentrations without noticing the changes (MacGregor & Hashem, 2014). By setting incremental targets for each food category with a specified deadline, a coordinated action among industries can reduce sugar intake without affecting the sales of commercial products.

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In order to be effective, gradual sugar reduction strategies need to determine the maximum sugar reduction that can be unnoticed by consumers. Therefore, information about consumer perception of products with reduced sugar content is a key tool for the establishment of targets for sugar reduction and for encouraging the industry to engage in sugar reduction programmes (Civille & Oftedal, 2012). However, few studies have evaluated the impact of lowering sugar concentration on consumer sensory and hedonic perception of processed products (Biguzzi, Schlich, & Lange, 2014; Chollet, Gille, Schmid, Walther, & Piccinali, 2013; Hoppert, Zahn, Puschmann, Ullmann, & Rohm, 2012; Pineli et al., 2016).

One of the most useful approaches to establish recommendations for sugar reduction on food products is the estimation of difference thresholds for sweetness, which are the smallest change in sugar concentration that causes a change in sweetness perception (Lawless & Heymann, 2010). Difference thresholds for sugar can be experimentally estimated as the smallest change in sugar concentration that causes a change in sweetness intensity that is perceived by 50% of the individuals (Boring, 1942). According to Weber's law, difference thresholds are a constant proportion of the stimulus intensity (Lawless & Heymann, 2010). Therefore, difference thresholds for a specific product with a particular sugar concentration could be used to determine the gradual sequential sugar reductions that can be implemented without consumer awareness. This approach has been recently applied by Bobowski and Vickers (2012) to salt reduction in water and broth.

Chocolate-flavoured milk is a popular product in many countries (Manners & Craven, 2003). Although chocolate-milk has similar nutritional characteristics than regular milk, the sugar content of commercial products has raised concerns that have led to banning chocolate-flavoured milks from school lunch systems in the USA (Hoag, 2011; Murphy et al., 2008). However, chocolate-flavoured milk consists of a nutritious alternative to soft drinks and fruit drinks, particularly for school-aged children, adolescents and young adults (Johnson, Frary, & Wang, 2002; Reedy & Krebs-Smith, 2010). Therefore, an improvement in the nutritional quality of chocolate-flavoured milk by reducing the added-sugar content of commercial products seems necessary (Cheese Market News, 2012).

In this context, the present work aimed at providing recommendations for gradual sugar reduction in chocolate-flavoured milk by determining difference thresholds for added sugar and evaluating consumers' sensory and hedonic perception of reduced-sugar products.

2. Materials and methods

2.1. Formulation of chocolate-flavoured milk

Chocolate-flavoured milk samples were formulated using UHT whole milk (Conaprole, Uruguay), 5.93–9.00% commercial sugar (Alcoholes del Uruguay S.A., Bella Unión, Uruguay), 2.5% alkaline cocoa powder (ARYES Aroma and Essences, Montevideo, Uruguay), 0.08% carrageenan (Ticaloid® 780 Stabilizer — Texture Innovation Center, TIC GUMS, Philadelphia, USA).

Chocolate-flavoured milk samples were prepared using a Thermomix TM 31 (Vorwerk Mexico S. de R.L. de C.V., Mexico D.F., Mexico). The solid ingredients were mixed with the milk, previously heated to 70 °C for 3 min. The dispersion was mixed for 1 min under gentle agitation (100 rpm), kept to 70 °C for 4 min and cooled to 20 °C in iced water. Then, the mix was placed in 1000 mL glass containers, the mix was manually agitated for 30 s and stored under refrigeration temperature (4 °C ± 1 °C) until their evaluation. Samples were served at 8 °C in identical plastic cups, coded using three-digit numbers, presented in monadic sequence following an experimental design that was balanced for order and carry-over effects (Williams' Latin Square).

2.2. Estimation of difference thresholds

Five sequential difference thresholds were determined as follows. In the first study, the difference threshold for sugar in chocolate-flavoured milk with an added sugar concentration similar to commercial products available in the Uruguayan marketplace (9%) was determined. In the second study, the difference threshold for sugar in chocolate-flavoured milk that was reduced in added sugar according to the threshold determined in the first study was estimated. This pattern was repeated until five difference thresholds were determined.

The studies involved a total of 250 consumers (68% female; 18–29 years old). Each of the five studies was carried out with a group of 50 consumers. All participants were recruited among students of the Universidad de la República (Montevideo, Uruguay) according to their frequency consumption of the product (at least once a week), interest and availability to participate in the study. The consumer sample intentionally comprised young people as they are, together with children, the main target consumers of the product. Participants signed an informed consent form and received a small gift for their participation.

In each study consumers completed six paired-comparison tests. Each paired comparison was composed of a reference chocolate-flavoured milk, corresponding to a specific added sugar concentration, and a sample that was reduced in added sugar from the reference. The reference remained constant in each study, while the sugar reduced sample increased over the series of 6 paired-comparisons. Therefore, the difficulty of the paired comparisons decreased with test progression, i.e. the first paired-comparison in a study was more difficult for consumers than the last one. Different reference samples were considered in each study. The sugar concentration of the reference and the sugar-reduced samples in each of the studies is shown in Table 1. Sugar concentrations in each of the studies were selected by pilot testing.

Consumers were asked to taste each of the samples in a pair and to select the sweeter one by choosing the corresponding number. Samples in each pair were presented following a balanced design. Testing took place in a sensory laboratory designed in accordance with ISO 8589 (ISO, 2007), under artificial daylight and temperature control (22 °C). Data collection was performed using Compusense-at-hand (Compusense Inc., Guelph, Canada).

2.3. Consumers' sensory and hedonic perception of chocolate-flavoured milks with different added sugar concentration

After difference thresholds were determined, a study was carried out to evaluate consumer sensory and hedonic perception of chocolate-flavoured milk samples with different added sugar concentrations. The following nine samples were considered: the reference samples considered in the difference threshold studies (Table 1), the sample with the sugar concentration determined in Study 5 (6.40%) and three additional samples. The added sugar concentration of these three last samples was intermediate between the concentration of the reference sample and the reduced ones, according to the thresholds determined in Studies 1, 3 and 5.

One hundred consumers participated in the test (74% female; 18–25 years old). As in the previous study, the consumer sample intentionally comprised young people recruited from University students. Consumers were asked to try the samples and to indicate their overall liking using a 9-point hedonic scale (1 = dislike very much, 9 = like very much) and to answer a check-all-that-apply (CATA) question composed of nine sensory characteristics: bitter, rough, chocolate, thick, sweet, fluid, greasy, milk flavour, and vanilla. The terms of the CATA question were selected based on results from previous consumer studies using open-ended questions.

Samples were presented following an experimental design that was balanced for order and carry-over effects (Williams' Latin Square design). Data were collected on laptops using Compusense at-hand (Compusense Inc., Guelph, Ontario, Canada). Testing took place in a sensory laboratory, as described in the previous section.

Table 1
Sugar concentration and sugar-reduction percentage (between brackets) of chocolate-flavoured milk samples considered in the five studies in which sequential difference thresholds for sugar were determined.

Study	Reference sample	Sugar reduced samples					
		1	2	3	4	5	6
1	9.00	8.70 (3.3)	8.40 (6.7)	8.10 (10.0)	7.80 (13.3)	7.50 (16.7)	7.20 (20.0)
2	8.30	8.05 (3.0)	7.80 (6.0)	7.55 (9.0)	7.30 (12.0)	7.05 (15.1)	6.80 (18.1)
3	7.80	7.60 (2.6)	7.30 (6.4)	7.10 (9.0)	6.80 (12.8)	6.60 (15.4)	6.30 (19.2)
4	7.25	7.00 (3.4)	6.80 (6.2)	6.50 (10.3)	6.30 (13.1)	6.00 (17.2)	5.80 (20.0)
5	6.83	6.68 (2.2)	6.53 (4.3)	6.38 (6.6)	6.23 (8.8)	6.08 (11.0)	5.93 (13.2)

2.4. Data analysis

2.4.1. Estimation of difference thresholds

Difference thresholds were estimated using survival analysis, following a modification of the procedure proposed by Alcaire et al. (2014) for estimating equivalent sweetness in orange juice.

For each of the studies, the response of each consumer in each of the paired comparisons was coded as "Yes" if the reference was identified as the sweetest sample and "No" if the sugar-reduced sample was selected. It was argued that a consumer would always give a "Yes" answer to the paired comparison if sugar reduction was higher than his/her difference threshold. Therefore, for each consumer the difference threshold can be estimated as the sugar reduction percentage at which a consumer starts to continuously answer "Yes", i.e. the concentration at which he/she consistently perceives the sugar-reduced sample as less sweet than the reference.

This approach acknowledges the existence of censored data (Hough, Langohr, Gómez, & Curia, 2003). Because of the discrete nature of the sugar-reduction percentages evaluated by consumers, the exact sugar reduction at which each consumer starts perceiving the sugar-reduced samples as less sweet than the reference cannot be determined. Therefore, difference thresholds can only be estimated as an interval defined between the immediate lower concentration at which the consumer perceives the sugar-reduced sample as less sweet than the reference for the first time (i.e. gives the first "Yes" answer) and the first concentration at which he/she starts consistently answering "Yes".

Table 2 shows the responses given by three consumers in the first study, when comparing a reference chocolate-flavoured milk with 9.00% added sugar to six sugar-reduced samples. Consumer 1 started answering "Yes" to the paired comparisons (perceiving the sugar-reduced sample as less sweet than the reference) when sugar reduction was 6.7 or higher, which indicates that the difference threshold is somewhere between 3.3% and 6.7%. Consumer 2 provided the first "Yes" answer when sugar reduction was 6.7% and gave consistent "Yes" answers when sugar reduction was equal or higher than 13.3, suggesting that the difference threshold for this consumer was located between 3.3% and 13.3%. Meanwhile, for the third consumer the first "Yes" answer was observed for the sample with 3.3% sugar reduction, while consistent responses were obtained when sugar reduction was equal or higher than 16.7%. This suggests that the difference threshold of this consumer was located in the interval defined by the reference (0%) and 16.7%.

Survival analysis methodology was used to determine the difference threshold in each of the studies. A random variable R can be defined as

the sugar reduction percentage at which an assessor starts consistently perceiving the sugar-reduced sample as less sweet than the reference, which corresponds to the difference threshold. The rejection function $F(r)$ can be defined as the probability of a consumer having his/her difference threshold at sugar-reduction percentage lower or equal than r, that is $F(r) = P(R \leq r)$.

The likelihood function, which is used to estimate the rejection function, corresponds to the joint probability of the given observations of the n assessors (Klein & Moeschberger, 1997). This function is a mathematical expression that describes the joint probability of obtaining the data actually observed on the assessors in the study, as a function of the unknown parameters of the model being considered.

A parametric model was used to estimate the rejection function and other quantities of interest. Choosing a lognormal distribution for F (Hough et al., 2003):

$$F(r) = \phi\left(\frac{\ln(r) - \mu}{\sigma}\right)$$

where $\phi(\bullet)$ is the standard normal cumulative distribution function and μ and σ are the model's parameters.

The parameters of the distribution (μ and σ) were obtained by maximizing the likelihood function for the given experimental data. Since there are no statistical tests to compare the goodness of fit of different parametric models used for interval-censored data, visual assessment of how parametric models adjust to the non-parametric estimation was used to choose the most adequate model. Logistic, Weibull, lognormal and log-logistic distributions were considered (Hough et al., 2003).

After the parameters were calculated, the percentage of consumers having their difference threshold lower than sugar reduction percentage was graphed. Difference thresholds for each sample were determined as the sugar-reduction percentage at which 50% of the consumers had their difference thresholds. Calculations were performed using the R scripts provided by Hough (2010).

2.4.2. Overall liking and CATA data

Linear mixed modelling was performed to evaluate the existence of significant differences in overall liking scores among samples. Sample was specified as fixed effect, whereas consumer was specified as a random effect. Tukey's test was used for post hoc pairwise comparisons of sample means, at a significance level of 5%.

The frequency of use of each CATA term was determined by counting the number of consumers who used that term to describe each sample. Cochran's Q test (Manoukian, 1986) was carried out separately to identify significant differences among samples on each of the sensory terms.

All data analyses were carried out using R software version 3.1.1 (R Core Team, 2014).

3. Results

3.1. Difference thresholds

When survival analysis was used to model the percentage of consumers having difference thresholds lower than each sugar-reduction

Table 2
Example of responses of three consumers when completing six pairs of chocolate-flavoured milk in Study 1.

Consumer	Sugar-reduction with respect to the reference (%)					
	3.3	6.7	10.0	13.3.	16.7	20.0
1	No	Yes	Yes	Yes	Yes	Yes
2	No	Yes	No	Yes	Yes	Yes
3	Yes	No	Yes	No	Yes	Yes

"Yes" indicates that the reference sample was perceived sweeter than the sugar-reduced sample, whereas "No" indicates that the sugar-reduced sample was perceived sweeter than the reference.

percentage, the lognormal distribution showed the best fit in all studies. As an example, Fig. 1 shows the percentage of assessors with difference thresholds lower than each sugar-reduction percentage. As shown, a good fit to the experimental data was obtained for the lognormal model.

Average difference thresholds in each of the studies were determined considering as the sugar-reduction percentage at which 50% of the consumers had their difference threshold. Table 3 shows the difference thresholds for each of the studies and their corresponding confidence intervals. As shown, difference thresholds ranged from 5.74% to 7.77% of the added sugar concentration of the reference sample. According to the 95% confidence intervals difference thresholds did not significantly change when the added sugar concentration of the reference sample changed, suggesting that sugar reductions in the different studies could be regarded as a constant proportion of the original stimulus. Across the five studies, the Weber fraction corresponded to an average of 6.66% of the added sugar concentration of the reference sample.

3.2. Sensory and hedonic perception of sugar-reduced chocolate-flavoured milk

Sugar reduction did not significantly affect overall liking scores (p = 0.08). As shown in Table 4, average overall liking scores ranged from 5.4 to 6.1 for all samples.

Regarding the sensory characteristics of samples, significant differences in the frequency of use of the terms of the CATA question among samples with different sugar concentration were only identified for the attributes chocolate flavour, sweet and bitter. As shown in Table 4, sugar reduction caused a significant decrease in the frequency of use of the terms chocolate flavour and sweet and a significant increase in the frequency of use of the term bitter. Although CATA questions do not directly measured attribute intensity, Ares et al. (2015) showed that the frequency of use of CATA terms tends to be linearly correlated with attribute intensity. Therefore, results from the present work indicate that a reduction from 9.00% to 6.40% in added sugar concentration in chocolate-flavoured milk caused a decrease in sweetness and chocolate flavour intensity, as well as an increase in bitterness intensity. It is interesting to note that changes in the frequency of use of the above mentioned terms were observed at different sugar reduction percentages. Changes in sweetness and bitterness tended to occur before changes in chocolate flavour (Table 4).

As expected, samples that differed in less than the difference threshold (9.00% vs. 8.50%, 7.80% vs. 7.40% and 6.80% vs. 6.50%) were perceived as very similar by consumers (Table 4), which confirms that sugar reductions smaller than the difference threshold would not affect consumers' sensory perception of the products.
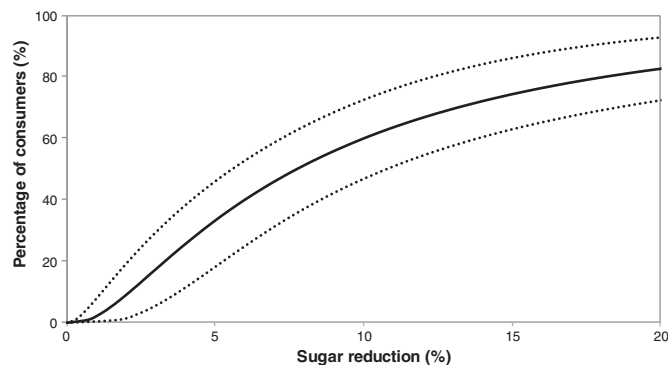

Fig. 1. Percentage of consumers with difference threshold equal or lower than each sugar reduction percentage in Study 1, in which the reference chocolate-flavoured milk was formulated with 9% added-sugar. Dotted lines indicate 95% confidence interval.

4. Discussion

The present work aimed at providing recommendations for sugar reduction in chocolate-flavoured milk. Five sequential difference thresholds for sugar were determined, ranging from 9.00% to 6.83%. As shown in Table 3, difference thresholds did not significantly differ for the five reference products (Table 3), which supports Weber's law. This indicates that added sugar concentration can be reduced an average of 6.66%, regardless of the specific sugar concentration of the chocolate-flavoured milk. This threshold is similar to that reported by other authors in dairy-based emulsions (Hoppert et al., 2012), cakes (Chang & Chiou, 2006) and orange nectar (Pineli et al., 2016).

The thresholds determined in the present work can be regarded as conservative for sugar reduction as it is likely that consumers would only perceive larger differences between samples in a real-life setting. In the present work consumers were asked to try two samples with different sugar concentration, one right after the other, and to indicate the sweetest one. However, in a real life setting if the sugar concentration of a commercial product is changed, consumers would have to compare the reformulated product with their previous sensory experiences with the regular product, stored in their memory. In this situation consumers are expected to perceive smaller differences than those identified in the present study.

As shown in Table 4, reducing added sugar in chocolate-flavoured milk from 9.00% to 6.40% led to changes in three sensory product characteristics: sweetness, chocolate flavour and bitterness. Although these changes were particularly relevant between samples with the highest and lowest added sugar concentration, when differences in sugar concentration were equal or larger than the difference threshold consumers tended to perceive differences in their sensory characteristics.

Interestingly, no significant differences in overall liking were found among samples with different added sugar concentration (Table 4). Therefore, a reduction of 28.9% in added sugar did not cause a significant change in consumers' hedonic perception of chocolate-flavoured milk. This result is in agreement with Oliveira et al. (2015), who reported that reducing 20% added sugar did not cause significant differences in liking in chocolate-flavoured milk. Similarly, Li, Lopetcharat, Qiu, and Drake (2015) reported that sugar reduction under 30% did not change consumer acceptance. However, Chollet et al. (2013) reported a decrease in consumers' overall liking with sugar reduction in yogurt. According to their results a decrease of 30% in added sugar in strawberry and coffee flavoured yogurts caused a significant decrease in overall liking. These results suggest that a recommendation for sequential sugar reduction is product specific and stress the need to conduct studies to determine difference thresholds in different product categories for establishing recommendations for gradual sugar reduction in processed products.

Assuring that sugar reduction does not negatively impact consumers' liking is one of the most important challenges for assuring the success of sequential reduction strategies. In this sense, Markey, Lovegrove, and Methven (2015) recently compared consumers' liking of regular and sugar-reduced for several product categories (beans, jam, milk chocolate, cola drink and juice) in the UK market. They reported that sugar-reduced products showed lower overall liking, as well as appearance, flavour and texture liking than their regular counterparts.

One of the aspects that deserves further exploration when implementing sequential gradual sugar reduction in food products is deciding if consumers should be informed or not about the reduction. Information can largely affect consumers' expectations and perception of products (Deliza & MacFie, 1996; Theunissen, Polet, Kroeze, & Schifferstein, 2000). In this sense, Chiou, Yeh, and Chang (2009) reported that difference thresholds were lower when consumers were exposed to health-related labels. Besides, Vazquez et al. (2009) reported that information on salt reduction had a negative influence on willingness to purchase for consumers not concerned about their sodium intake. Therefore, it could be hypothesized that information about sugar

Table 3
Difference thresholds[a] and 95% confidence intervals for added sugar in chocolate-flavoured milks with respect to references with different added sugar concentration in five consumer studies.

Study	Added-sugar concentration of the reference (%)	Difference threshold, expressed as added sugar concentration (%)	Difference threshold, expressed as sugar reduction percentage from the reference sample (%)	95% confidence interval
1	9.00	8.30	7.77	5.59–10.80
2	8.30	7.80	6.31	4.66–8.53
3	7.80	7.25	6.99	4.77–10.26
4	7.25	6.83	5.74	4.11–8.02
5	6.83	6.38	6.47	4.87–8.59

[a] Difference thresholds are expressed as added sugar concentration in the chocolate-flavoured milk and sugar reduction from the reference sample.

reduction on dairy products can have a negative effect on consumers' hedonic perception. This effect can be particularly relevant for adolescents since they might be not willing to compromise on taste for potential health benefits (Verbeke, 2006). Further research should be carried out to evaluate the influence of sugar reduction information on sensory and hedonic perception of consumers of different age groups.

In closing this section, it is important to highlight the limitations of the present study that hinder generalization of the results. First of all, sensory perception is a multimodal phenomenon (Verhagen & Engelen, 2006), which implies that difference thresholds depend on the other sensory characteristics of the product (e.g. chocolate flavour, thickness). For this reason, the difference thresholds determined in the present work might change between chocolate flavoured-milks with different formulation. Furthermore, in the present work the recommendations to reduce added-sugar in chocolate-flavoured milk were collected with young adults (18–25 years old). Therefore, considering that school-aged children are frequent consumers of this type of product, further studies are necessary to determine how they perceive sugar reduced products. Differences in taste sensitivity between children and adults have been reported (Popper & Kroll, 2011). In particular, several authors have reported that children are less sensitive to sweetness than adults (De Graaf & Zandstra, 1999; James, Laing, & Oram, 1997; Kimmel, Sigman-Grant, & Guinard, 1994) suggesting that the difference thresholds estimated in the present work can be regarded as conservative and might be safe if implemented with products targeted at children.

5. Conclusions

Results suggest that sugar reduction in chocolate-flavoured milk without affecting consumers' product perception seems feasible and easy to implement. Considering a constant Weber fraction of 6.66%, added sugar concentration in one-year time can be reduced 12.9% by

implementing two sequential reductions. If this same strategy is implemented during three years would allow to meet the recommendations of the UK Department of Health to reduce added sugar by 30–40% with no substitution. In the case of the chocolate-flavoured milk samples considered in the present study, this reduction would not lead to a significant change in consumers' sensory and hedonic perception.

The approach of the present work could be implemented to design recommendations for gradual reduction of the added sugar concentration of other commercial dairy products, as well as products targeted at children (e.g. fruit juices), contributing to the development of more healthful processed products that meet current nutritional recommendations.

Acknowledgements

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Table 4
Overall liking scores and percentage of consumers who used each of the terms of the CATA question for nine chocolate-flavoured milk samples with different added sugar concentration.

Parameter	Sugar concentration (%)								
	9.00[#]	8.50	8.30[#]	7.80[#]	7.40	7.25[#]	6.83[#]	6.50	6.40[#]
Overall liking	5.9[a]	6.1[a]	6.1[a]	6.0[a]	5.7[a]	5.9[a]	5.7[a]	5.6[a]	5.4[a]
Chocolate[*]	76	74	72	74	78	74	68	62	50
Sweet[*]	90	86	72	64	68	58	54	48	36
Fluid[ns]	48	36	44	42	50	42	50	54	56
Milk flavour[ns]	36	38	38	36	38	46	38	50	60
Thick[ns]	34	44	30	42	38	40	34	26	20
Bitter[*]	12	22	22	38	26	34	38	38	42
Vanilla[ns]	32	34	28	24	26	20	22	28	22
Greasy[ns]	24	24	30	28	28	24	22	26	20
Rough[ns]	18	22	24	20	16	16	34	28	30

[#] Samples included in the difference threshold study. Identical superscripts indicate that average overall liking scores are not significantly different according to Tukey test ($p > 0.05$).

[*] The frequency of use of CATA question terms significantly differed among samples ($p < 0.05$).

[ns] Revealed that they did not significantly differ among samples.

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