

# The impact of sugar distribution on sweetness of sugar reduced cookies

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## Background

A decrease in dietary sugar intake is strongly associated with a decrease in body weight. Next to multiple structural functionalities of sugar in sweet bakery products it provides sweetness. In this explorative study with sugar reduced cookies, sugar was not substituted with non-nutritive sweeteners, but the sugar was unevenly distributed in the filling.

## Objective

To study if in cookies with lowered sugar content and in which the sugar was unevenly distributed in the filling

- expectations based on a first bite might override lower sweetness as a result of lower sugar concentrations in subsequent bites,
- a recency effect from the last bite plays a role.

## Method & Results

### Method

On top of small elongated biscuits (with the same sugar content throughout the study) three equally sized drops of a chocolate flavored butter creme filling was applied (Figure 1). The sugar content of the fillings varied, according to the scheme in Figure 2 (% indicate the amount of sugar per bite as compared to the filling of the reference **A**).

The cookies were presented in randomized order to 86 participants. Participants were instructed to eat the cookies in three equal bites and to swallow after each bite. After consumption of the cookie in full, sweetness was rated on a VAS-scale.

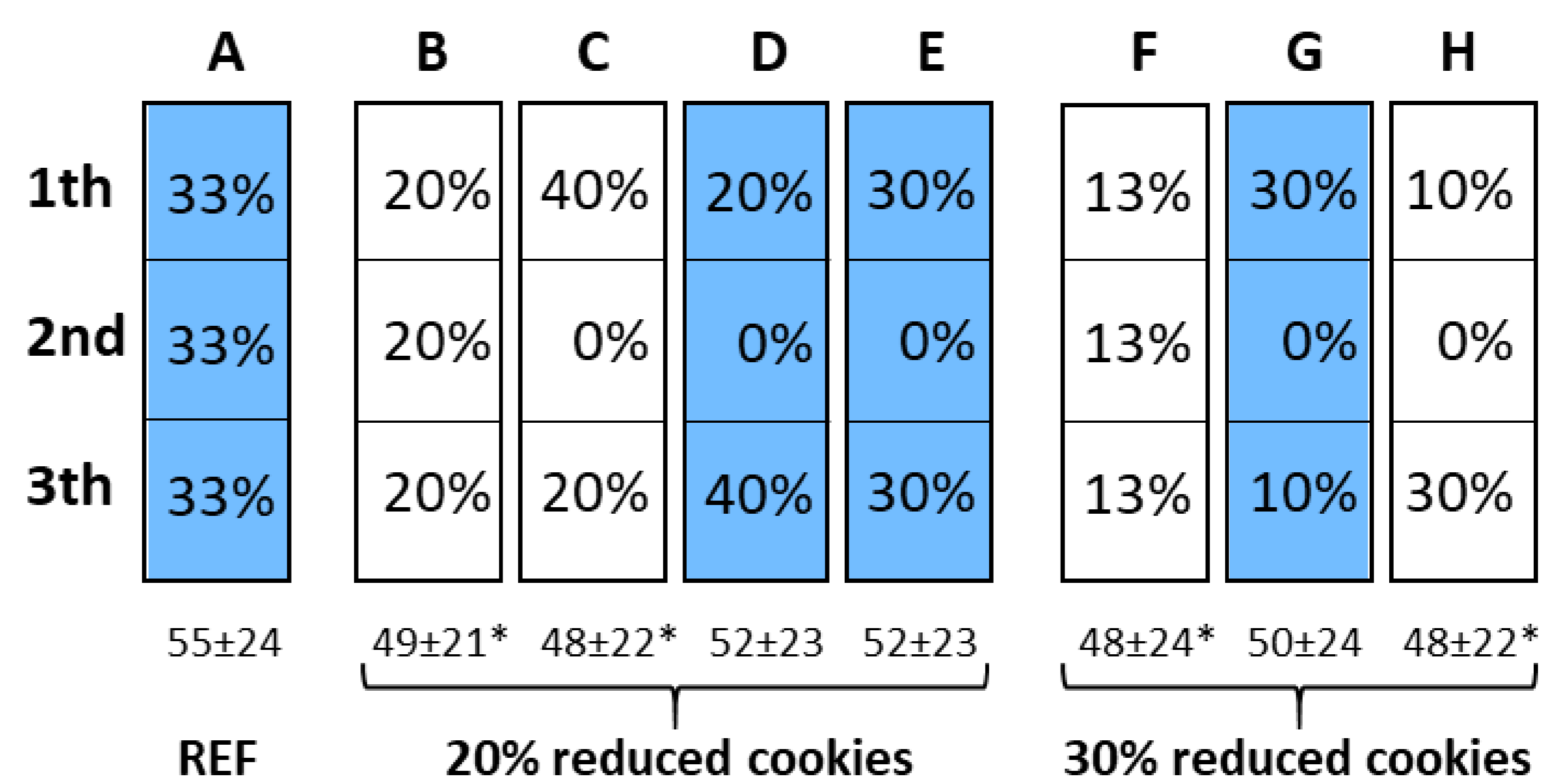


**Figure 1.** Applying three equally sized drops of a chocolate flavored butter creme on top of small elongated biscuits

Repeated measures ANOVA was performed with pairwise comparisons (Bonferroni corrected).

### Results

The means  $\pm$  SD values for sweetness are indicated in Figure 2. Cookies **B**, **C**, **F** and **H** significantly differed from reference **A** but **D**, **E** and **G** did not differ.



**Figure 2.** Distribution of the sugar in the filling, from 1<sup>st</sup> bite (top), 2<sup>nd</sup> bit to 3<sup>th</sup> bite (bottom) and mean values of sweetness scores. \* indicates a significant difference as compared to REF.

Like indicated in previous studies (increasing salty taste, Dijksterhuis et al. 2014; decreasing bitterness, Le Berre et al. 2013), it also appears possible to increase the total sweetness impression of a (model) product by relying on a 'first-bite-expectation' effect.

## Conclusions

- A differential distribution of sugar in the filling on a sugar reduced cookie is able to compensate for a reduction in total amount of sugar, moreover there was not a reduction in sweetness perception.
- However, this explorative study showed that this cannot be solely assigned to a perceptual expectation based on a first bite. Also the sweetness of the last bite seems to be involved, and possibly this is dependent of the level of sugar reduction.
- To explore the nature of this effect further, more research, also with other sweet products, is needed (cf. Woods et al. 2010).

### References

- Dijksterhuis, G.B., Boucon, C., Le Berre, E., (2014). Increasing saltiness perception through perceptual constancy created by expectation. *Food Quality and Preference*. 34, 24–28.
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- Woods, A.T., Poliakoff, E., Lloyd, D.M., Dijksterhuis, G.B., Thomas, A.T. (2010). Flavor Expectation: The Effect of Assuming Homogeneity on Drink Perception. *Chemosensory Perception*. 3: 174-181.

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