Shades of brown: food colorant influences perception of milk chocolate

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Introduction

It is widley known that food-consumption is a multisensual expierence[1]. Taste and olfaction for example are closely linked in gustatory perception. This is easily noticed if the nose ist held closed while eating. Also visual information can have crossmodal effects on taste and product expierence [2]. That's why expensive chocolate is packaged in the most valueable ways. The high quality of the product shall already be communicated by its wrapping. But what's about the food-color itself? Indeed ambiguous evidence have been found that food coloring influences taste and flavour perception[3]. However, can perception be fooled just by coloring a common milk chocolate? The present study supposes that a dark-chocolate like coloring leads to corresponding changes in the perception of taste, perceived quality and willingess to pay.

Methods

Participants tasted a milk chocolate having two shades of brown. Chocolate bars were carefully melted. Half of them were colored with taste- and odorless food colorant (figure 1) resulting in a dark-chocolate like brown; the other half was not colored (figure 2). To eliminate bite-resistance as possible discriminator between milk and dark chocolate, bars were coarsely grated after cooling down. Finally the chocolate was presented in small, transparent plastic cups which were delivered sequential-monadic. 49 respondents started with the uncolored sample (u), 54 started with the colored one (c). Participants neutralized their sense of taste between samples with mineral water and Matzen (crisp bread, made from only wheat flour and water). Additionally a few distracting math exercises had to be solved between samples. Hedonic response was measured on a 9-point scale, sensory product characteristics were measured on 5-point scales and monetary value as free estimation of 100 gr bar of chocolate. All measures were made using a self-response questionnaire presented on tablet-computers. A visual protection prevented collaboration between participants.

Fig. 1: Food colors used for this study

Fig. 2: Uncolored and colored chocolate

Fig. 3: Test area with tablet-computers and visual protection

Results

	mean value	t-value	p-value	Power	Cohen's d
liking of taste (9=very much)	u: 6.5, c: 7.0	t(102)=2.26	p<.05	73%	d=.22
sweetness (5=intense)	u: 4.0, c: 3.6	t(102)=-3.23	p<.001	94%	d=-.32
bitterness (5=intense)	u: 1.4, c: 1.9	t(102)=4.8	p<.001	99%	d=.47
cocoa (5=intense)	u: 2.6, c: 3.2	t(102)=6.45	p<.001	99%	d=.64
of high quality (5=agree)	u: 2.9, c: 3.5	t(102)=4.88	p<.001	99%	d=.48
willingness to pay (€)	u: 1.46, c: 1.75	t(102)=4.13	p<.001	99%	d=.41

All participants neither disrelished chocolate nor were they limited in their gustatory and olfactory capabilities. Thus N= 103 valid data records were analyzed. 65% participants were female, 34% male and one person classified his sex as diverse. The average age was 29 years, most test persons were students (35%), followed by employees (30%) and pupils (20%). Significance was tested one-sided by paired-sample t-tests. The perceived differences between the differently colored chocolate were significantly in line with our hypotheses. Although both products were the same (except color), the dark brown sample was perceived as less sweet, more bitter, higher in cocoa content and of higher quality. Furthermore the recorded willingness to pay is significantly higher for the colored chocolate. Five of six measured dimensions show excellent statistical power. Only the dimension "liking of taste" shows a lower statistical power (73%). Mostly medium and strong effects (Cohens'd) were observed. First position effect was only observed if the colored chocolate was given first, though not for all measured dimensions. The missing of a first position effect, if the uncolored chocolate was given first, highly indicates, that the results of this study can be transferred on a monadic test design.

Discussion

The results support findings regarding crossmodal intensity perceptions and expectations. Besides perceptual priming, even conceptual priming (milk vs. dark chocolate) by color can be discussed. The colored, dark brown sample seems to trigger specific expectations originating from earlier consumption experiences. What looks like dark chocolate has to taste like dark chocolate. This study only tested the effect of a milk and a dark chocolate coloring. Further research could investigate, which degree of dark color is needed to record first effects. Furthermore the results underline the importance of a multisensual concruence in product presentation. More expensive chocolate, with higher cocoa content should communicate his attributes already by its color and not only by its wrapping.

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[3] Spence, C., Levitan, C.A., Shankar, M.U., & Zampini, M. (2010). Does Food Color Influence Taste and Flavor Perception in Humans?, Chemosensory Perception, 3 (1), 68-84.

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