Influence of color, shape and damages on consumer preferences and perceived sensory attributes on sub-optimal apples

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Introduction
Sustainable food production and consumption are key elements today. About one third of food produced for human consumption is wasted. It has been found that 15% of all fresh and consumable food is discarded before it comes for sale in supermarket/stores (Broyd, 2008) and producers discard up to 30% of fruit and vegetables because of aesthetic imperfections (WRAP, 2009; Rohm et al., 2017). Consumers are responsible for the largest amount of food waste throughout the supply chain; part of this is indirect by e.g. discarding food based on visual imperfection. The unwillingness to purchase and consume sub-optimal food products is thought to be an important cause of food waste; however, the reasons behind it are still insufficiently studied. Our research addresses the question of how combinations of color, shape and damage of apples influence consumer liking and sensory profiling.

Method
Based on a cubic design (figure 1) of visual appearance (color (red-to-green); shape (normal-to-odd); damage (none-to-damage)) with a total of eight combinations ranging from optimal to sub-optimal in all three dimensions, a total of 130 participants (68% women and 32% men) between 20-80 years (mean 50 years), participated in a laboratory study. An image for each apple type from the cubic design was presented in a blind tasting session together with random selected, peeled and sliced apple slices. The sensory perception was evaluated by thirteen flavor and texture attributes on a 7-point scale running from “does not exist”, to “exists to a large extent”. Liking was then evaluated on a 7-point hedonic scale. The tasted samples included randomized variation of different apple varieties, peeled, sliced and served in neutral cups. Since the apples varied we could investigate if the picture had an impact of how the consumers experienced the apple within a certain category as well as the level of liking connected to the sensory experience. The study took place at Dept. of Agrifood and Bioscience, RISE - Research Institute of Sweden, in Gothenburg in 2017.

Results
In a multiple comparison test using Anova and Tukey-Kramer (p=0.05), all apples with at least 2 out of 3 sub-optimal properties ([011], [101], [110] and [111], these are marked with * in table 1., have significantly lower liking than the most optimal apple [000]. The only significant difference in attribute values is that the most optimal apple [000] has less perceived earthiness than the apple with shape and damage imperfections [011] (p=0.040). Further, the most optimal apple [000] was perceived as sweeter, crispier and less bitter than all other apples, however none of these differences were significant.

There were tendencies of green apples perceived as less sweet, and the highest average score for bitterness was observed for a combination of green color, bad shape, and damage [111].

Discussion
The current research addressed the question of how combinations of different visual aspects of color, shapes and damages of apples influence perceived sensory attributes and consumer preferences. Visual sub-optimality, even presented to consumers in pictures, have an effect on how an apple is perceived and liked where different sub-optimality (color, shape and damage), all had a negative effect, however combinations of aspects had larger negative impact than one aspect alone.

The overall goal was to increase the awareness of sub-optimality from a consumer perspective. However, pictures were served with randomly selected apples, with a random variety in sensory characteristics whereby sensory attributes was expected to not significantly differ between groups. The results show that this goes for all attributes but earthiness and with a tendency for differences regarding crispiness, sweetness and bitterness.

References