Food Quality and Preference 22 (2011) 620–627

Contents lists available at ScienceDirect

Food Quality and Preference

journal homepage: www.elsevier.com/locate/foodqual

Preference, liking and wanting for beverages in children aged 9–14 years: Role of sourness perception, chemical composition and background variables

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ARTICLE INFO

Article history:
Received 24 February 2010
Received in revised form 8 March 2011
Accepted 14 March 2011
Available online 21 March 2011

Keywords:
Children
Preference
Liking
Wanting
Sourness perception
L-PLS regression
Food habits

ABSTRACT

The purpose of the study was to examine the relationship between children's liking or wanting perception of sourness and food behavioural data in two types of beverages. In total 239 children (9–14 years old) evaluated apple juice and fruit drink in a design with 4 different dry matter concentrations. Multiple ranking was used to determine preference and perception of sourness, and a 5-point facial rating scale was used to assess liking and wanting. Children filled in questionnaires and BMI were registered. Multiple ranking showed that children on average had a high preference for versions of beverages perceived as less sour ($p = 0.05$). A PCA on rating data (liking and wanting, respectively), segmented the children in 3–4 segments. A minor segment of children with high liking and wanting for the apple juice perceived as most sour was obvious. L-PLS regression revealed visually clear correlations between chemical measurements, liking, wanting and behavioural data.

1. Introduction

Childhood obesity is increasing worldwide (WHO, 1999). To minimise this development, it is important to understand what drives children's preferences as their food intake to a great extent is predicted by their preferences (Birch, 1979; Drewnowski, 1997, Drewnowski & Hann (1999); Baxter & Thompson, 2002; Cooke & Wardle, 2005; Liem & Zandstra, 2009; Perez-Rodrigo, Ribas, Serra-Majem, & Aranceta, 2003; Resnicow et al., 1997). Most children have a high preference for sweetness, which has been shown to be positively related to a high consumption of sugar-containing foods (Cooke & Wardle, 2005; Pangborn & Giovanni, 1984). Sweetness is associated with a high energy density, and consumption of high energy-dense foods can disrupt the energy balance causing obesity (Havermans & Jansen, 2007). As most beverages are sweet, high in energy density and heavily consumed by children, it will be advantageous to develop beverages that are less sweet and furthermore increase children's preferences for these beverages. Research has shown that perception of sweetness increases when sugar concentration increases (de Graaf & Zandstra, 1999; Zandstra & de Graaf, 1998) and Hewson, Hollowood, Chandra, and Hort (2008) illustrated that increased sugar in a model beverages system resulted in suppression of sourness perception. Baldwin, Goodner, and Plotto (2008) has shown a decrease in sour taste when sugar concentration in tomato puree is increased. Based on this, it was hypothesised that a decrease in sourness perception will occur when dry matter concentration is increased. To the authors knowledge no one has studied children's perception of sourness related to changes in dry matter content in beverages. Elucidating sourness perception is very important as sourness is a major reason for children rejecting food. To succeed in developing less sweet beverages for children, a study of children's perception of sourness is required.

Moreover, research has shown a decrease in children's preferences when acid concentration increases (Liem & Mennella, 2003). Liem and Mennella (2003) investigated the degree of sourness most preferred in children aged 5–9 years. They showed that generally preferences increased with decreasing levels of citric acid. However, more than one third of the children preferred extremely high degrees of sour taste. This third also experienced a greater variety of fruits, even lemons, when compared with other children (Liem & Mennella, 2003). Based on these findings, it was hypothesised that a relationship exists between children's food habits, liking and perception of sourness in beverages and fruits in general. If high preference for foods with high sourness is related to high consumption of fruits, it will, from a health aspect, be beneficial to change children's preferences making them accept more sour products.

The terms "preference" and "liking" are in many cases used interchangeably, and often preference is misused as a synonym

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doi:10.1016/j.foodqual.2011.03.005

for liking (Mela, 2001). It is important to make a distinction between the two terms, as the sense of the two terms is different. Preference indicates that among two or more products, one product is preferred over another, whereas liking refers to an immediate qualitative, hedonic evaluation of a product without a direct comparison to other products (Mela, 2001). In the present study both children's preferences and likings was examined. Research indicates that not only liking but also wanting plays an interdependent role in food choice and consumption in adults (Finlayson, King, & Blundell, 2007; Mela, 2006), which highlights the importance of a distinction between liking and wanting. Wanting is the intrinsic motivation to engage in eating a food, now or in the near future (Mela, 2006). Liking is a contributor to wanting, which presumable carries a component of anticipated pleasure, but liking is not enough to predict wanting (Mela, 2001). Studies focussing on children's liking and wanting as separate pathways for food choice are scarce. To the authors knowledge only one study has investigated both liking and wanting separately as pathways for children's food choice (Liem & Zandstra, 2009). Here it was concluded that the effect of liking on food choice is consistently larger than the effect of wanting.

Changing children's liking and wanting for beverages towards a more sour direction requires knowledge about the effect of sourness on liking and wanting. In this study children's liking and wanting for beverages with high energy density such as apple juice and fruit drink will be determined, as these are significant components of the daily intake of drinks. It is hypothesised that a relationship between children's liking and wanting for beverages varying in perceived sourness exists. Moreover it is hypothesised that there is a segment of children who likes and wants beverages with lower dry matter content than what is found in beverages available on the market today.

Therefore the objective was to examine:

1. Children's preference by multiple ranking.
2. Children's liking by rating.
3. Children's wanting by rating.
4. Children's perception of sourness by multiple ranking.

for two types of beverages, apple juice and fruit drink, varying in dry matter content, and to study the correlation between liking for the product and perception of sourness. Additionally, the children answered a questionnaire containing various background information and children's weight and height were registered. A multivariate correlation between the various data was aimed to improve the understanding of children's liking and wanting for beverages varying in sourness.

2. Materials and methods

2.1. Children

A local public school in DK-5792 Aarslev, Denmark, was contacted by letter and invited to participate in a study on children's liking for apple juice and fruit drink. Two hundred and thirty-nine children, 107 girls and 132 boys aged 9–14 years (mean age = 12.3 years) were recruited, and 195 of these completed the study, which required answers to all questions. For further descriptions, see Table 1.

Parents received a consent form which included a clear description of the study. Only children who returned a form signed by their parents participated in the study. The study was exempted from the need of formal ethical approval according to the rules of the Danish ethical committee, since it did not involve any physical interference with the children. The children's participation in the test was voluntary.

2.2. Products

Two types of beverages, apple juice and a common Danish fruit drink made of a mixture of juices from 11 different fruits and berries (plum, grape, orange, elderberry, cherry, pineapple, lemon, pear, black currant and prune), were used in the experiment. The apple juices and the fruit syrups for production of the fruit drink were received from a Danish juice producer, Rynkeby Foods A/S. Due to low storability of the non-pasteurised apple juice and fruit drink samples, the samples were mixed each day. Children's perception of sourness at altered dry matter content was of strategic interest due to the health aspects of foods. A design of four samples, varying in dry matter content, was made for both beverages by a recipe from Rynkeby Foods A/S (see Table 2). The acid content in both beverages was kept constant (apple juice = 8 g malic acid/l; fruit drink = 3.4 g citric acid/l) in order to ensure that the intensity of sourness was caused by the variation in dry matter content.

The sensory characteristics of sample 3 for both apple juice and fruit drink matched the most popular product on the commercial Danish market produced by Rynkeby Foods A/S. Table 2 shows the chemical compositions of the apple juices and fruit drinks.

The apple juices were yellow, the fruit drinks were red, and there were no visible colour differences between the four samples of each product.

2.3. Sensory evaluation

The study went on for four days with involvement of 50–60 children per day. Each day the children were divided into three groups consisting of 20–25 children per group. During the 4 days, a total of twelve groups were tested. Three girls refused to perform the test, 25 children did not go through the test procedure, 15 children did not fully complete the questionnaire and 2 children refused registration of body weight and height. This resulted in a complete dataset consisting of 195 children. Twelve children from the first test day were asked to repeat the test on the last test day to study repeatability of the experiment. The test sessions took place in the assembly hall of the school, which was a familiar place for the children. A trained instructor introduced the experiment in detail to the groups. Questions to the instructor were allowed if they did not understand the instructions they were offered. Except for clarifying questions, the children were told to remain silent during the test. The children were seated at large tables with a distance of 2 m to the next child. The first group started at 8.30 a.m., and each test session lasted for approximately 45 min with small

Table 1
Description of participants. Mean data and standard deviations on gender, age, weight, height, BMI and BMI *z*-scores of the children from 4 to 8th grade participating in the study.

	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
Gender(boy/girl)	19/18	18/8	25/24	32/27	28/21
Age (years)	10.2 ± 0.59	11.0 ± 0.36	12.3 ± 0.64	13.0 ± 0.45	13.9 ± 0.31
Weight (kg)	38.2 ± 6.98	45.8 ± 7.39	49.5 ± 11.56	53.5 ± 10.22	56.8 ± 10.25
Height (m)	1.46 ± 0.07	1.54 ± 0.08	1.58 ± 0.09	1.63 ± 0.08	1.69 ± 0.08
BMI (kg/m^2)	17.8 ± 2.42	19.3 ± 2.34	19.6 ± 3.08	20.1 ± 3.04	19.9 ± 2.59