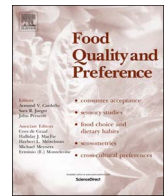




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# Food Quality and Preference

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## Different liking but similar healthiness perceptions of rye bread among younger and older consumers in Sweden



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### ABSTRACT

Rye breads, especially those with a chewy texture and sour flavor, have shown several health benefits but their consumption is lower among younger consumers than older. This study explores liking of commercial rye bread in younger and older consumers in relation to socio-demographics, childhood bread-eating habits and food choice motives. Further, sensory attributes are explored in relation to the consumers' concepts of a *rye bread* and *healthiness* in bread.

Nine commercial rye breads, previously profiled by descriptive sensory analysis were tasted by 225 younger (18–44 years) and 173 older (45–80 years) consumers. Internal preference mappings by principal component regression for each age group showed low liking for rye bread with a chewy texture and sour flavor in the younger consumer group. Based on the preference mappings, the age groups were separately clustered. Associations between clusters and background variables were studied using discriminant partial least squares regression. Liking of rye bread with a chewy texture and sour flavor in the younger consumer group was associated with e.g., more education, females, childhood bread consumption and the food choice motive *health*. In the older consumer group, it was related to e.g., more education and childhood bread consumption. Partial least squares regression 1 showed that the combination of sensory attributes such as a light color and soft texture led to the perception of bread being less healthy and not a rye bread, and a dark brown color, chewy texture, sour and bitter flavor to the perception of a *healthier* bread and *rye bread*.

### 1. Background

Bread made from rye has been shown in previous research to possess several health benefits and is often included in descriptions of healthy diets (Adamsson et al., 2012; Olsen et al., 2011). Both whole-grain and sifted rye bread with and without sourdough have, for example, shown beneficial effects on blood glucose levels and insulin regulation (Leinonen, Liukkonen, Poutanen, Uusitupa, & Mykkänen, 1999; Rosén et al., 2009). This is especially valuable in relation to the prevention and maintenance of non-communicable, chronic diseases such as diabetes (Augustin et al., 2015). However, for the bread to have health benefits, it also needs to be available, acceptable and eaten by consumers. In the EU there is no food standard for rye bread and it is not known what type of bread consumers may look for when choosing a rye bread. In a previous study, commercial rye breads in Sweden were shown to contain between 15 and 100% rye flour (Sandvik, Marklinder, Nydahl, Næs, & Kihlberg, 2016). Half of the samples indicated to produce beneficial effects on blood glucose levels and insulin regulation

by the in vitro measurement fluidity index. These breads were mainly characterized by a chewy, drier texture and a sour flavor.

Bread is a staple in the Swedish diet. In a national dietary food survey, 98% of participants reported having eaten bread (Sandvik, Kihlberg, Lindroos, Marklinder, & Nydahl, 2014). Due to the lack of a definition of rye bread and the high prevalence of mixed rye-wheat breads, it is challenging to determine how much rye bread is consumed in Sweden. However, there are data on rye flour. The average per capita consumption of rye flour in 2015 was 9 kg per person and year, and this figure has steadily been decreasing, from 15 kg per person and year in 1960 (BOA, 2016). Most of the rye is incorporated in varied amounts into either dry crisp or soft bread. Soft rye bread is in focus in the present study. Bread types with a high rye content have been shown to be more frequently consumed by older (45–80 years) rather than younger (18–44 years) consumers (Sandvik et al., 2014). Rye bread is often made with whole grain and, in addition to age, a lower consumption of whole-grain bread has also been associated with lower educational levels, children in the household and country of birth

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(Sandvik et al., 2014). Respondents born in a Nordic country other than Sweden were more likely to have higher consumption of whole-grain bread. An age-related difference has also been seen for the total intake of whole grain in several countries, where lower intake has been observed in younger age groups (Lang & Jebb, 2003). It is uncertain whether these age differences can be explained by changes in attitudes or motives during the course of life, or by a cohort effect whereby consumers born during a given period share experiences, memories and preferences (Lang, Thane, Bolton-Smith, & Jebb, 2003). Perceived quality is one important factor in food choice decisions and insights into the quality perceptions of rye bread of younger and older consumers could contribute to an understanding of previously identified consumption patterns (Grunert, 2006). The consumer's quality perception of bread is mainly determined by the dimensions taste and health and these dimensions are the focus here (Dewettinck et al., 2008). The present paper has a two-fold scope and addresses i) liking of commercial rye bread among younger and older Swedish consumers in relation to sensory attributes and selected consumer background variables and ii) the association between sensory attributes and consumers' perceptions of a rye bread and a healthy bread.

Only a few previous studies have focused on consumer liking of rye bread (Heiniö, Urala, Vainionpää, Poutanen, & Tuorila, 1997; Pohjanheimo, Paasovaara, Luomala, & Sandell, 2010) and none of these have explored the preferences of younger and older consumers. The majority of sensory preferences in humans are learned through repeated exposure to particular sensory events and their associated consequences (De Graaf, 2006). Food preferences have been described as being learned unconsciously and unintentionally, and preferences established in childhood have been shown to be important in predicting preferences later in life (Köster, 2009). The cultural and socioeconomic environment is viewed as playing a primary role in creating the opportunities and contexts for particular sensory experiences (Mela, 2001). The learning occurs throughout life and two forms of learning in adulthood have been described: *sensory learning* through, for example, exposure, and more conscious *cognitive learning* through, for example, advice, labeling and risk perception. The high robustness of preferences formed in childhood together with continuous lifelong learning would suggest that both a cohort effect (based on, for example, bread types available during childhood) and changes in attitudes and motives during the course of life could be associated with different preference patterns for rye bread. Hence, the association between liking and socio-demographics, childhood bread-eating habits and food choice motives are explored in the present study. The Food Choice Questionnaire (FCQ) is used to measure the perceived importance of nine motives for food selection in everyday food choices (Stephens, Pollard, & Wardle, 1995).

Prior to purchase, consumers infer quality expectations of a product from different cues (Grunert, 2005). It has been argued that the communicated impressions used in marketing need to be upheld throughout consumption and that the physical product should therefore be regarded not only as a source of sensory pleasure, but also as an information source (Grunert, 2015). A food name such as *rye bread* or perceived *healthiness* can be described as concepts which are evaluated by a mental checklist of components that the food, according to the consumer, should possess. These can be divided into propositional components, such as factual knowledge of how much rye a rye bread should contain, but also sensory components, which means an immediate recall of the look, taste, smell and texture of rye bread that the consumer has previously encountered (Smith, Møgelvang-Hansen, & Hyldig, 2010). Consumer perceptions of propositional and some sensory components of three food names have previously been studied from a labeling fairness perspective (Smith et al., 2013). In the present study, a further step has been taken by exploring how sensory profiles of Swedish commercial rye breads are related to the consumers' concepts of a rye bread and *healthiness* in bread.

The aim of this study is to compare liking of commercial rye bread among younger and older Swedish consumers in relation to socio-

demographics, childhood bread-eating habits and food choice motives, and to describe consumers' sensory perceptions of a rye bread and *healthiness* in bread.

## 2. Materials and methods

### 2.1. Overall study design

Nine commercial rye breads for which sensory profiles have previously been described (Sandvik et al., 2016) were included in a consumer test. Participants indicated liking and degree of agreement with the statements: "I would gladly eat this bread often", "This bread seems healthy" and "This is, in my opinion, a rye bread" for each sample. Sensory profiles of the samples and liking ratings were combined by internal preference mapping using principal component regression (PCR). This was performed separately for younger (18–44 years) and older (45–80 years) consumers and the consumers were then clustered. Associations between clusters and consumer background variables (food choice motives, childhood bread-eating habits and socio-demographics) were explored by discriminant partial least squares regression (DA-PLS). The association between the sensory profiles of the samples and degree of agreement with the statements "This bread seems healthy" and "This is, in my opinion, a rye bread" were separately explored by partial least squares regression 1 (PLS-1).

### 2.2. Rye bread sample selection and preparation

Sensory and health-related attributes of commercial bread selected to represent a wide variety of rye bread on the Swedish market were, in a previous study, characterized by general descriptive analysis (24 samples, 11 panelists, 15 attributes), chemical acidity and fluidity index (Sandvik et al., 2016). Fluidity index is an *in vitro* measure for predicting the quality of the blood glucose and insulin responses to bread (Östman, Rossi, Larsson, Brighenti, & Björck, 2006). For the present study, principal component analysis of the sensory data were used to visually select a representative subset of nine bread samples to be included in the consumer test, as similarly used by Helgesen and Næs (1995). The selected samples and their labels were: sample A3, in the present study labeled as *sour whole grain (WG) rye roll*, B2: *pumpernickel*, B4: *coarse sour rye bread*, C2: *sifted flat bread*, C4: *sifted syrup loaf*, D1: *wheat-rye malt loaf*, E2: *WG rye syrup roll*, E3: *wheat-rye toast bread* (i.e. bread for toasting) and F2: *sour sifted rye bread*. The ingredients and sensory characteristics of the nine samples included in the present study are shown in Tables 1 and 2. The composition of the included samples varied in for example, rye content (23–100%), whole grain content (0–100%), total sugars (1–10 g/100 g), pH (4.5–6.6) and Fluidity index (50–97) (Sandvik et al., 2016). Four samples in particular (*sour WG rye roll*, *pumpernickel*, *coarse sour rye bread* and *sour sifted rye bread*) displayed a lower fluidity index which indicates more beneficial effects on blood glucose and insulin levels, and these breads were mainly characterized by a chewy texture and/or sour flavor (Sandvik et al., 2016).

For the present study, data were collected on three consecutive days in a Swedish city with a population density of approximately 200,000 inhabitants. The samples were purchased the day they were delivered to the local supermarkets and stored at –18 degrees Celsius for a maximum of seven days. Prior to each testing day, the breads were thawed at room temperature in plastic bags on bread racks for eight hours. At separate workstations, the samples were cut into bite-sized rectangular pieces (approximately 2.5 × 5.5 cm) including both the crumb and the crust, and were then carefully wrapped in aluminum foil, concealing their appearance. The samples were labeled with randomly assigned 3-digit codes and placed in two transparent plastic boxes with a sealed lid. The serving order was randomized by computer and the samples in each box corresponded to the serving order of a specific questionnaire.

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