



# The consumer acceptance of novel vegetable-enriched bread products as a potential vehicle to increase vegetable consumption



D.A. Hobbs<sup>a,b</sup>, A. Ashouri<sup>a</sup>, T.W. George<sup>c</sup>, J.A. Lovegrove<sup>a,b</sup>, L. Methven<sup>a,\*</sup>

<sup>a</sup> Department of Food and Nutritional Sciences, The University of Reading, Whiteknights, PO Box 226, Reading, Berkshire RG6 6AP, UK

<sup>b</sup> Institute for Cardiovascular and Metabolic Research (ICMR), University of Reading, Whiteknights, PO Box 226, Reading, Berkshire RG6 6AP, UK

<sup>c</sup> Eccentricities Ltd., Frimley Green Road, Frimley Green, Camberley, Surrey GU16 6NA, UK

## ARTICLE INFO

### Article history:

Received 10 October 2013

Accepted 15 January 2014

### Keywords:

Beetroot

Bread

Consumer acceptance

Health information

Liking

## ABSTRACT

Currently UK fruit and vegetable intakes are below recommendations. Bread is a staple food consumed by approximately 95% of adults in western countries. In addition, bread provides an ideal matrix by which functionality can be delivered to the consumer in an accepted and convenient food. Therefore, enriching bread with vegetables may be an effective strategy to increase vegetable consumption. This study evaluated bread enriched with red beetroot, carrot with coriander, red pepper with tomato or white beetroot (40 g vegetable per 100 g) compared to white control bread (0 g vegetable) for consumer acceptance. Consumers ( $n = 120$ ) rated their liking of the breads overall, as well as their liking of appearance, flavour and texture using nine-point hedonic scales. Product replacement and purchase intent of the breads were rated using five-point scales. The effect of providing consumers with health information about the breads was also evaluated. There were significant differences in overall liking ( $P < 0.0001$ ), as well as liking of appearance ( $P < 0.0001$ ), flavour ( $P = 0.0002$ ) and texture ( $P = 0.04$ ), between the breads. However, the significant differences resulted from the red beetroot bread which was significantly ( $P < 0.05$ ) less liked compared to control bread. There were no significant differences in overall liking between any of the other vegetable-enriched breads compared with the control bread (no vegetable inclusion). The provision of health information about the breads did not increase consumer liking of the vegetable-enriched breads. In conclusion, this study demonstrated that vegetable-enriched bread appeared to be an acceptable strategy to increase vegetable intake, however, liking depended on vegetable type.

© 2014 Elsevier Ltd. All rights reserved.

## 1. Introduction

Non-communicable diseases are the main cause of death in most parts of the world. Fruit and vegetables are important components of a healthy diet and if consumed daily in adequate amounts (400 g per day) may prevent the development of major chronic diseases such as cardiovascular disease (CVD) and certain cancers (Temple & Kaiser, 2003; Willett, 1994). However, currently, only 31% of adults in the UK meet the daily recommendations (Bates, Lennox, Prentice, Bates, & Swan, 2012). According to the 2002 World Health Organisation report, low fruit and vegetable intake was associated with approximately 14% of gastrointestinal cancer deaths, 31% of ischemic heart disease deaths and 11% of stroke deaths globally (WHO, 2002). In addition, it has been estimated that 2.7 million lives could potentially be saved each year if fruit and vegetable consumption was sufficiently increased.

In some developed countries such as Australia, the UK and USA initiatives of fruit and vegetable promotion, such as the “5-a-day” campaign, have been in place for several years. Although these types of fruit and vegetable promotion interventions have increased fruit and vegetable consumption in the short term, they have not been successful in increasing fruit and vegetable intake in the long term (Pomerleau, Lock, Knai, & McKee, 2005).

Bread is a staple and economical food that is consumed by the majority of adults in western countries. In addition, bread provides an ideal matrix by which functionality can be delivered to the consumer in an accepted food. Bread products have been enriched with various functional components such as omega-3 fatty acids (Yep, Li, Mann, Bode, & Sinclair, 2002), soluble fibres (Morris & Morris, 2012), folate (Hertrampf et al., 2003) and plant sterol esters (Clifton et al., 2004). This suggests that bread may also be amenable to vegetable enrichment. Moreover, we found that consumption of 200 g of bread enriched with 100 g red or white beetroot significantly lowered blood pressure (BP) in healthy males (Hobbs, Kaffa, George, Methven & Lovegrove, 2012). The effects occurred in association with significant increases in urinary nitrate and nitrite concentrations. This highlights that bread is a suitable matrix for the delivery of bioactive nutrients from beetroot. However, the consumer acceptability of the bread products has not been investigated.

*Abbreviations:* BP, blood pressure; CVD, cardiovascular disease; FSA, food standards agency; NS-SEC, National Statistics Socio-economic Classification Guidelines; PCA, principal component analysis.

\* Corresponding author at: Department of Food and Nutritional Sciences, The University of Reading, Whiteknights, PO Box 226, Reading, Berkshire RG6 6AP, UK. Tel.: +44 118 378 8714; fax: +44 118 931 0080.

E-mail address: [l.methven@reading.ac.uk](mailto:l.methven@reading.ac.uk) (L. Methven).

Consumer expectations of food play an important role in sensory perception of food and the determination of food acceptability (Cardello, 1995). Furthermore, there are many factors that can affect food choice, such as economic, social and environmental factors, as well as knowledge of health and nutrition information. Kihlberg, Johansson, Langsrud, and Risvik (2005) examined four breads made with different types of flour and found that a health claim about cholesterol only became significant to the reported liking of the bread when information about flour origin was also provided (Kihlberg et al., 2005). Similarly, Annett, Muralidharan, Boxall, Cash, and Wismer (2008) investigated consumer acceptance of different flour types (organic and conventional) and the effects of health information (Annett et al., 2008). They found that health information in combination with sensory evaluation increased liking of bread made with organic flour, whereas environmental information had no effect (Annett et al., 2008). This highlights that although consumers and health professionals have displayed positive preferences towards functional foods, there is evidence to suggest that consumers differ in the extent to which they buy foods with functional benefits (Hellyer, Fraser, & Haddock-Fraser, 2012). Developing new fruit and vegetable-enriched food products, that meet consumer expectations and increase fruit and vegetable intakes is, therefore, of considerable importance.

We hypothesise that bread enriched with vegetables is acceptable to consumers and may, therefore, be used as a vehicle to increase vegetable intakes in the general population. The objectives of this study were (a) to investigate individual consumer liking of breads enriched with red beetroot, white beetroot, red pepper with tomato or carrot with coriander compared to white control bread (no vegetable enrichment); (b) to relate consumer liking to the sensory characteristics of the breads, quantified by a trained sensory panel; and (c) to assess the effect of provision of health information on the consumers anticipated liking of the bread products.

## 2. Materials and methods

### 2.1. Bread samples

Four breads enriched with 40 g of either white beetroot, red beetroot, carrot with coriander or red pepper with tomato per 100 g (vegetable inclusion replaced dough by 40% w/w) and control white bread (no vegetable enrichment) were evaluated in this study. The breads were enriched with red and white beetroot because previous studies have shown that these bread products have beneficial blood pressure lowering properties (Hobbs et al., 2012, 2013). Carrot with coriander and red pepper with tomato were chosen because these vegetables are popular vegetables consumed in the UK (Bates et al., 2012). The serving size of two slices (100 g) of bread was chosen to represent the average serving of bread. The nutritional composition of the breads can be seen in Table 1.

#### 2.1.1. Manufacturing process of vegetable-enriched bread products

The four vegetable-enriched breads and control bread (no vegetable enrichment) were manufactured in the UK by Eccentricities Ltd.,

**Table 1**  
Nutritional composition of the breads per 200 g serving evaluated in the study.

	WCtrl	RBB	WBB	RPTB	CCB
Energy (kcal/kJ)	516/2178	488/2062	496/2098	526/2224	538/2276
Carbohydrate (g)	93.2	89.4	82.2	93.4	96.4
Protein (g)	16.2	16.2	26.0	17.8	17.0
Fat (g)	8.6	7.2	7.0	9.0	9.4
Sodium (mg)	700	504	570	838	676

Values are means per 200 g of bread. 200 g or four slices bread provides one portion of vegetable. White control bread (WCtrl), red beetroot bread (RBB), red pepper with tomato bread (RPTB), white beetroot bread (WBB) and carrot with coriander bread (CCB). Nutritional analysis of bread products was carried out by Leatherhead Food Research (Randalls Road, Surrey, UK).

Camberley, Surrey, UK and were all manufactured using the same manufacturing process. Red and white beetroot were boiled in tap water to allow removal of the skin. The vegetables (raw tomato, red pepper and carrot; cooked beetroot and sundried tomatoes) were incorporated into white bread dough as a mixture of puree and diced vegetable (5 mm). All vegetable doughs contained the same weight of puree and dice. Identical weights of dough were placed into lidded tins of equal dimensions and allowed to prove until the tin was full. The breads were then baked in a deck oven (Tom Chandley Ltd., Manchester, UK) and cut into 12 mm slices on a commercial bread slicer.

### 2.2. Consumer study

#### 2.2.1. Consumers

One-hundred and twenty healthy consumers were recruited to take part in the study. All consumers completed the first part of the study, but seventeen consumers dropped out of the second part for personal reasons.

Consumers represented seven demographic categories based on gender (men and women), age (young and old) and socio-economic class (classes 1–2, 3–5 and 6–8). Socio-economic class was determined according to the 2010 National Statistics Socio-economic Classification Guidelines (NS-SEC) (Rose & Pevalin, 2010), where classes 1–2 refer to professional occupations, classes 3–5 refer to intermediate to lower supervisory occupations and classes 6–8 refer to routine occupations and the unemployed. The demographic characteristics of the consumers can be seen in Table 2. Power calculations were performed for the primary outcome: overall liking. At 80% power and 5% significance, the minimum number of subjects required to allow for the detection of a significance difference in liking of 2 on a 9 point hedonic scale between breads was estimated to be 100. Therefore, 120 subjects were recruited to allow for dropouts.

#### 2.2.2. Consumer recruitment and screening

The majority of the consumers ( $n = 112$ ) were recruited by mail (from a database of volunteers who had taken part in previous consumer studies) and the remaining eight were recruited after responding to posters and flyers in shops and supermarkets around Reading and the

**Table 2**  
Demographic characteristics of total study consumers ( $n = 120$ ) and 4 consumer clusters.

	All	Cluster 1 ( $n = 36$ )	Cluster 2 ( $n = 31$ )	Cluster 3 ( $n = 24$ )	Cluster 4 ( $n = 29$ )
Age, %					
18–34	43	39	55	50	31
35–54	41	42	23	29	48
55+	16	19	22	21	21
Gender, %					
Male	42	42	48	29	45
Female	58	58	52	71	55
Socio-economic group <sup>a</sup> , %					
1–2	34	28	29	42	41
3–5	43	42	45	50	34
6–8	23	30	26	8	25
F & V intake, %					
High (>4 portions/day)	22	50	20	8	28
Medium (3 portions/day)	33	33	32	21	17
Low (<2 portions/day)	45	17	48	71	55
Bread type, %					
White	27	19	36	46	17
Wholegrain	25	36	29	21	10
Brown	15	19	16	13	28
White/brown (50/50)	12	14	10	4	10
Seeded	11	6	3	8	21
Granary	7	0	6	4	14
Specialty	4	6	0	4	0

Values are shown as percentages of total study group.

<sup>a</sup> Socio-economic group was according to the 2010 National Statistics Socio-economic Classification Guidelines (Rose & Pevalin, 2010).

Download English Version:

<https://daneshyari.com/en/article/6396822>

Download Persian Version:

<https://daneshyari.com/article/6396822>

[Daneshyari.com](https://daneshyari.com)