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Consumer acceptance of functional foods: socio-demographic, cognitive and attitudinal determinants

Wim Verbeke *

Department of Agricultural Economics, Ghent University, Coupure links 653, B-9000 Gent, Belgium

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Abstract

Despite the forecast of a bright future for functional foods, which constitute the single fastest growing segment in the food market, critiques arise as to whether this food category will deliver upon its promises. One of the key success factors pertains to consumer acceptance of the concept of functional foods, which is covered in this study. Data collected from a consumer sample ($n = 215$) in Belgium during March 2001 are analysed with the aim to gain a better understanding of consumer acceptance of functional foods. Functional food acceptance is defined as giving a score of minimum 3 on a 5-point scale, simultaneously for acceptance if the food tastes good, and if the food tastes somewhat worse as compared to its conventional counterpart. With this specification, 46.5% of the sample claimed to accept the concept of functional foods. A multivariate probit model is specified and estimated to test the simultaneous impact of socio-demographic, cognitive and attitudinal factors. Belief in the health benefits of functional foods is the main positive determinant of acceptance. The likelihood of functional food acceptance also increases with the presence of an ill family member, though decreases with a high level of claimed knowledge or awareness of the concept. This adverse impact of high awareness decreases with increasing consumer age. Belief, knowledge and presence of an ill family member outweigh socio-demographics as potential determinants, contrary to previous reports profiling functional food users.

Keywords: Functional foods; Consumer acceptance; Attitude; Knowledge; Health

1. Introduction

Functional foods has been reported as the top trend facing the food industry. This has been exemplified by substantial strategic and operational efforts by leading food, pharmaceutical and biotechnology firms during the 1990s (Childs & Poryzees, 1997; Sunley, 2000; Lennie, 2001). Global market size estimates vary largely as shown in Table 1. This variation results from the use of different sources and definitions of the concept, which in itself is an issue of debate (for an overview of definitions see Roberfroid, 2002), despite the broadly accepted consensus definition published by Diplock et al. (1999). [1] The expected annual growth rate of the functional food market ranges from 15% to 20% at the end of the 1990s (Hilliam, 2000; Gardette, 2000; Shah, 2001) to a possible 10% as the most recent estimate (Weststrate et al., 2002). Although growth rate estimates decrease over time, the number remains impressive compared to growth rates of no more than 2–3% per annum for the food industry as a whole.

Within the food industry, the need for further research into consumer behaviour was identified as a top priority by Childs and Poryzees (1997). The competitive environment for functional foods has been reported to suffer

* Fax: +32-9-264-6246.
E-mail address: wim.verbeke@ugent.be (W. Verbeke).

[1] The working definition of functional foods provided by Diplock et al. (1999) in their consensus document reads: 'A food can be regarded as functional if it is satisfactorily demonstrated to affect beneficially one or more target functions in the body, beyond adequate nutritional effects, in a way that is relevant to either improved stage of health and well-being and/or reduction of risk of disease. A functional food must remain food and it must demonstrate its effects in amounts that can normally be expected to be consumed in the diet: it is not a pill or a capsule, but part of the normal food pattern.'

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Table 1
Global market size estimates for functional foods

Market size (million US$ per year)	Year	Definition	References
15,000	1992	Functional, enriched and dietetic foods	Menrad (2000)
6600	1994	Functional foods	Hilliam (1998)
10,000	1995	Functional foods	Arthus (1999)
11,300	1995	Functional foods	Heller (2001)
21,700	1996	Functional, enriched and dietetic foods	Menrad (2000)
10,000	1997	Foods with specific health benefits	Byrne (1997)
22,000	1998	Foods with specific health benefits	Gilmore (1998)
16,200	1999	Functional foods	Heller (2001)
17,000	2000	Functional foods (forecast from 1998)	Hilliam (1998)
17,000	2000	Functional foods (forecast from 1997)	Hickling (1997)
33,000	2000	Functional foods	Hilliam (2000)
7000	2000	Foods that make specific health claims	Weststrate, van Poppel, and Verschuren (2002)
50,000	2004	Functional foods (forecast from 2000)	Euromonitor (2000)
49,000	2010	Functional foods (forecast from 2000)	Heller (2001)

from a lack of data and understanding of consumer market segments (Gilbert, 1997). Consumer acceptance of the concept of functional foods, and a better understanding of its determinants, are widely recognised as key success factors for market orientation, consumer-led product development, and successfully negotiating market opportunities (Gilbert, 1997; Grunert, Bech-Larsen, & Bredahl, 2000; Weststrate et al., 2002). Acceptance failure rates from recent food cases have shown that consumer acceptance is often neglected or at least far from being understood. This holds for instance for GM foods (Frewer, Howard, & Shepherd, 1997; Burton, Rigby, Young, & James, 2001; Frewer, Miles, & Marsh, 2002; Cook, Kerr, & Moore, 2002; Saba & Vassallo, 2002), for novel foods (Frewer, 1998; Tuorila, Lahteenmaki, Pohjalainen, & Lotti, 2001) or emerging food production and processing techniques like rBST in milk production (Burrell, 2002; Turner, 2001), beef growth hormones (Verbeke, 2001; Lusk, Roosen, & Fox, 2003) or food irradiation (Frenzen et al., 2001; Hayes, Fox, & Shogren, 2002). More particularly, in each of the abovementioned cases, there were major differences in public perception between EU and US consumers.

Given the importance of the topic for the food industry, considerable amounts of consumer research must have been undertaken, though only a handful of studies have reached the public domain. Available consumer research has so far mainly focused on consumer beliefs, attitudes and socio-demographic profiling of the functional food consumer, with descriptive and bivariate analyses prevailing. Despite previous efforts, the need to know the consumer inside and out remains urgent since consumer opinions (Childs & Poryzees, 1997; Milner, 2000a) and the marketing environment, with regulatory and scientific advancements (Kwak & Jukes, 2001; Martin, 2001; Stanton et al., 2001), change rapidly.

The need to understand functional food consumers is more prominent today than ever before for several reasons. First, although Americans were believed to be overwhelmingly aware and accepting functional foods and are doing more to incorporate them into their diets (IFIC, 2000), the most recent HealthFocus study (Gilbert, 2000) reported lower frequencies of healthy food consumption, despite equal intention and aspiration to eat healthily more often, and despite continuing confidence in the personal ability to manage one's own health. In the same study, it was shown that perceptions of taste and enjoyment of healthy foods have declined. Also, Gilbert (2000) alerted a slowing down trend in the US when indicating that the number of consumers who report regular consumption of healthy foods has dropped whereas no change was seen in shoppers' desire to improve their diets. Similarly, IFIC (2002) reported little familiarity among US consumers with terms commonly used to describe the concept of functional foods in 2002, despite consistently strong interest since 1998.

Second, a logical question emerges about the situation in Europe: will European consumers behave similarly to their American counterparts, or will functional food acceptance and consumption follow the same trend as previously seen with cattle growth hormones or genetically modified foods? American consumers better accepted both technologies, whereas Europeans were far more critical and largely rejected the technology and its outcomes in terms of food for consumption. In a similar vein, it can be hypothesised that Europeans' acceptance of functional foods is less unconditional, better thought-out, and with more concerns and reserves as compared to the US. This may also result from the recent sequence of food safety scares (e.g. BSE, dioxins, foot-and-mouth disease, *E. coli*, aviatic pneumonia, acrylamid).

Third, Jonas and Beckmann (1998) reported that functional foods are at risk of being a food category that consumers do not seem to embrace as enthusiastically as the food industry had hoped for. Danish consumers in particular were suspicious about functional foods, which they judged as "unnatural and impure". Similarly, Niva (2000) and Mäkelä and Niva (2002) indicated that the need for functional foods is increasingly questioned in Northern European countries, hence yielding the conclusion that consumer acceptance of functional foods cannot be taken for granted. Finally, reports have been published balancing minuses against the plusses that dominated previously (Dagevos, Stijnen, Poelman, & Bunte, 2000; Ernst, 2001). Emerging signs of criticism, conditional consumer acceptance, declining market growth rate estimates and the need to better understand consumer decisions form the major rationale for this deeper investigation of consumer acceptance of functional foods. Furthermore, most of the previous studies on functional food consumption date back five or more years, which is a long term given the rapidly evolving market under consideration.

The specific objective of this study is to investigate the role of socio-demographics, cognitive and attitudinal variables on the acceptance of functional foods. The rationale for focusing on the understanding of consumer acceptance pertains to its key role in behavioural processes or change. Specific hypotheses are set forth in the next section based on the literature review. The research method includes cross-sectional data collection and analyses using bivariate and multivariate statistics. Finally, conclusions and recommendations are given.

2. Consumer acceptance of functional foods

Despite the overwhelming interest of the food industry and the alleged prospect of a bright future for functional foods, only a few papers—at least in the public domain—have reported empirical studies of consumer acceptance based on primary data collection. Most of these studies investigated consumer reactions towards functional foods during the 1990s in the US (Wrick, 1992, 1995; Gilbert, 1997; Childs, 1997; Childs & Poryzees, 1997; IFIC, 1999; Gilbert, 2000; IFIC, 2000). Among the few studies focusing on European consumer reactions towards functional foods are those by Hilliam (1996, 1998), Poulsen (1999), Niva (2000), Bech-Larsen, Grunert, and Poulsen (2001), Mäkelä and Niva (2002) and Pferdekämper (2003). These studies vary widely in terms of focus (consumer awareness of the concept, attitude towards functional foods, acceptance, choice) and methodologies used (qualitative or exploratory versus quantitative or conclusive). From the diversity of the available studies, socio-demographic characteristics, cognitive and attitudinal factors emerged as potential determinants of consumer acceptance of functional foods.

2.1. Socio-demographic determinants

Based on a review of quantitative studies in the US during 1992–1996, Childs (1997) identified the US functional food consumer as being female, well educated, higher income class, in a broad 35–55 age group. A more recent quantitative study by IFIC (1999) reported that women, college graduates and consumers aged 45–74 are most likely to have adopted functional foods in their diets. Gilbert (1997) reported a higher proportion of 55+ aged and college educated among the functional food users in the US. Finally, also the latest quantitative follow up study from IFIC (2000) confirmed that the largest consumer group who uses functional foods to target a specific health concern consists of 55+ aged.

Poulsen (1999) and Bech-Larsen et al. (2001) reported evidence of considerable socio-cultural differences between US and European consumers related to functional food use. Poulsen (1999) confirmed the preferred age group (aged 55+) and women as main functional food users, though pointed towards higher acceptance among the lower educated. In contrast with the latter finding about the impact of education, Hilliam (1996) posited that purchasing of functional foods in Europe is biased towards the higher socio-economic groups, reflecting a higher willingness or ability to pay a price premium, as well as better knowledge and higher awareness.

Most consensus is reached on the gender issue with respect to functional food acceptance: all studies consistently report female consumers as the most likely users or buyers. Females' stronger purchase interest towards functional foods (Childs & Poryzees, 1997; Gilbert, 1997) is especially important given their primary role as the person responsible for food purchasing. In general, women have been shown to be more reflective about food and health issues and they seem to have more moral and ecological misgivings about eating certain foods than men, who are more confident and demonstrate a rather uncritical and traditional view of eating (Beardsworth et al., 2002; Gilbert, 1997; Kubberod, Ueland, Rodbotten, Westad, & Risvik, 2002; Verbeke & Vackier, 2004).

Another relevant socio-demographic factor pertains to the presence of young children in the household. This factor may impact food choice because of its potential association with higher food risk aversion or higher quality consciousness, as exemplified for instance for fresh meat after the BSE crisis (Verbeke, Ward, & Viaene, 2000). Furthermore, parenting triggers focus on nutrition (Childs, 1997), which yields a search for nurturing benefits through the provision of wholesome foods that lay a strong foundation of health for children (Gilbert, 2000). Thus, shoppers with children are believed to be more likely to look for fortification in their foods (Gilbert, 1997).

Finally, experience with relatives' loss of good health and associated economic and social consequences have been reported to act as an incentive to adopt disease preventative food habits (Childs, 1997). Given the fact that prevention is a major motivation of functional food use (Wrick, 1995; Milner, 2000b), it can logically be hypothesised that experience with illnesses increases probabilities of functional food acceptance.

Despite some divergence in former empirical evidence about the impact of socio-demographic characteristics on functional food acceptance, formal hypotheses can be set forth. The review indicates that age, gender, education, presence of young children, and presence of ill family members emerge as socio-demographic determinants of functional food acceptance. The hypothesised effects of socio-demographic determinants are that acceptance of functional foods increases with higher age (H1), being female (H2), having young children (H3), ill family member (H4), and lower education (H5).

2.2. Cognitive and attitudinal determinants

Besides socio-demographics, knowledge and attitude or beliefs have been demonstrated to explain a large part of the variations in consumer decision-making towards functional foods. In their 1999 report of a qualitative study, IFIC (1999) indicated that knowledge and beliefs are the major motivations for either purchasing and consuming, or for not yet having adopted functional foods in diets. Furthermore, IFIC (1999) pointed to a lack of knowledge as the major reason for not consuming functional foods. Similarly, knowledge of foods and food ingredients was reported to contribute positively to the success of functional foods in the UK market (Hilliam, 1996). On the contrary, Pferdekämper (2003) reported health consciousness and preventative health behaviour as positive influencers on functional food acceptance, whereas product knowledge was insignificant. [2] Given some inconsistencies in previous empirical findings, the impact of knowledge of the concept of functional foods (not specific products) on functional food acceptance is not hypothesised, though considered as an empirical issue to be investigated from the obtained dataset. Similarly, interaction effects between socio-demographic and cognitive and affective determinants are investigated without being formally hypothesised.

Apart from the potential impact of knowledge, beliefs clearly play a crucial role as determinants of product acceptance. Multiple conceptualisations of beliefs in the context of functional foods have been used previously. These range from belief in one's own impact on personal health (Hilliam, 1996), health benefit belief (Childs, 1997), perception of health claims (Bech-Larsen & Grunert, 2003), belief in the food-disease prevention concept (Wrick, 1995), belief in the disease-preventative nature of natural foods (Childs & Poryzees, 1997), and opinions of the relationship between food and health (Niva, 2000). Unanimously, positive correlations between those beliefs and acceptance or purchasing interest for functional foods have been reported.

In our specific case, we opted for measuring two constructs: one related to "health benefit belief" of functional foods and one related to the "perceived role of food for health". Whereas the first construct clearly deals with the perception of functional food benefits in particular, the latter includes items measuring the importance of health, locus of control and health oriented behaviour in more general terms without making specific reference to functional foods. Both constructs are hypothesised to associate positively with functional food acceptance (H6 and H7).

A number of previous empirical studies have also identified the premium price for functional foods as a major hurdle to acceptance and buying intention. Childs and Poryzees (1997) concluded that pricing and price perception (together with taste, see next section) may be better predictors (as compared to beliefs) of future functional foods purchasing habits. This led to the recommendation that future research may have to focus on pricing sensitivity as a determinant of acceptance and purchase. Hence, the hypothesis is that the perception of functional foods as being too expensive lowers the likelihood of functional food acceptance (H8).

3. Research method

3.1. Consumer survey

Cross-sectional consumer data were collected through a survey with 255 Belgian consumers in March 2001 (Verbeke, Moriaux, & Viaene, 2001). All respondents were responsible for food purchasing within their household, which is reflected in the unequal gender distribution. From this sample, 40 cases were excluded from the analysis for reason of inconsistent responses (see specification of acceptance) or missing observations in one or more of the variables of interest, thus yielding a final valid sample of 215 cases. Respondents were selected through non-probability judgement sampling and were personally interviewed at home. Socio-demographic characteristics of the valid sample are summarised in Table 2. Although this sample is not strictly statistically representative, it includes respondents with a wide variety of socio-demographic backgrounds. More specifically, higher education is over represented with 56.7% in the sample versus 32.6% in the population. However, the distribution of age and presence of children closely match the distribution in the population.

3.2. Questionnaire and scaling

Respondents were personally contacted and asked to complete a self-administered questionnaire. The ques-

[2] In these studies, knowledge pertained mainly to awareness of the concept, technology or concrete products. Similarly, the measure of knowledge used in this study is a measure of claimed awareness, and not an objective measure of learning-based factual knowledge.

Table 2
Socio-demographic characteristics of the sample (% of respondents, $n = 215$)

	Sample	Population[a]
Age		
<25	23.7	18.4
25–40	27.5	32.8
40–50	24.1	22.6
>50	24.7	26.2
Average (S.D.)	39.1 (14.5)	
Children <12 years		
Yes	21.4	19.7
No	78.6	80.3
Education		
<18 years	43.3	67.4
>18 years	56.7	32.6
Gender		
Female	62.8	
Male	37.2	
Ill family member		
Yes	21.4	
No	78.6	

[a] *Source*: NIS (2002).

tionnaire included multiple filler items in order to limit common method error variance. The concept of functional foods was defined halfway through the questionnaire, using a "vulgarised" version of the definition of the concept based on Diplock et al. (1999). [3] Measures related to "perceived role of food for health", and two items of the knowledge (or awareness, see Footnote 2) construct were completed before providing this definition (thus unaided). Acceptance, health benefit belief, price perception, one item relating to knowledge and socio-demographics were administered after providing the definition of the concept of functional foods. The different items in the constructs used are reported in Appendix A.

The three items related to knowledge (2 unaided, 1 aided) were measured on 7-point scales and had a composite reliability coefficient alpha of 0.77. The summed knowledge was used as a continuous variable in bivariate analysis, and recoded into three categories for the multivariate probit model: low (lowest quartile, *KNO1*), medium (*KNO2*) and high (highest quartile, *KNO3*) knowledge. In order to avoid the dummy variable trap, only *KNO2* and *KNO3* are included in the multivariate econometric model (thus using *KNO1* as the base or reference category; see next section). Similarly, a 7-point scale was used to assess the perceived role of food for health (three items, *FDHE*). The resulting Cronbach alpha coefficient for the three items was 0.61, yielding a variable ranging from 3 to 21.

Five-point scales were used to measure the four items related to health benefit beliefs (4 items; *HBB*) and price perception (single item; *PRP*). Cronbach alpha's scale reliability measure for the four-item scale was 0.82, which denotes good and acceptable internal reliability consistency. Hence, health benefit belief could also be included in the multivariate econometric model as a continuous variable, obtained from summing up the ratings over the four items.

Two Likert-scaled items formed the basis for determining functional foods acceptance: (1) "Functional foods are all right for me as long as they taste good", and (2) "Functional foods are all right for me even if they taste worse than their conventional counterpart foods". In a first stage of analyses, consumer reactions on both statements have been considered as separate variables for bivariate analysis. In the second stage when dealing with multivariate analysis, one binary variable "acceptance of functional foods" was specified following the procedure shown in Table 3. This procedure with indirect measurement of acceptance has the advantage of avoiding optimistic response bias, accounting for the trade-off on taste (see next paragraph), and detecting and deleting inconsistencies. Hence, it provides a more reliable binary measure as compared to a direct yes/no-probing for acceptance as such.

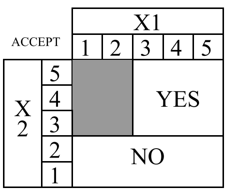
Cases with a score below 3 for acceptance if the taste is all right and a score of 3 or more for acceptance if the taste is worse were considered as inconsistent ($n = 29$), and hence removed from the sample. Frequency distributions of the different acceptance scores within the valid sample are presented in Table 3. Since this choice is rather arbitrary, it is important to note that taste is considered as a breaking-point, since rejection of functional foods based on taste is equalled to a decisive "no".

The decision to take the attribute taste into account when defining acceptance is based on numerous studies that indicate taste as the single largest determinant of food choice, directing consumers to eating, even in situations of uncertainty or risk (Richardson, MacFie, & Shepherd, 1994; Verbeke, 2001). Despite an increasing importance of health-related, convenience-related and process-related dimensions on consumer acceptance of food, taste is reported to continue to be the prime consideration in food choice (Grunert et al., 2000; Zandstra, de Graaf, & Van Staveren, 2001). Bad taste associates with rejection, whereas good taste increases the chances of acceptance. Also in the specific case of functional foods, taste has been reported as a strong influential belief for the buying intention (Poulsen, 1999) or a very critical factor when selecting functional foods (Childs & Poryzees, 1997; Tuorila & Cardello, 2002). Also Gilbert (2000) pointed towards the fact that the primary obstacle to making healthy food choices is taste

[3] The vulgarised definition presented to respondents reads: 'Functional foods are normal foods that (claim to) demonstrate health-promoting effects, when consumed in normal doses by healthy people'.

Table 3
Acceptance of functional foods, frequency distributions of Likert scaled variables and dichotomous acceptance variable (%, $n = 215$)

	Totally not agree	Not agree	Neutral	Agree	Fully agree
Functional foods are acceptable to me if they taste good (*X1*)	8.9	11.1	30.2	38.3	11.5
Functional foods are acceptable to me, even if they taste worse than conventional foods (*X2*)	18.4	35.1	37.2	8.0	1.3
Acceptance of the concept of functional foods (dichotomous) (*ACCEPT*)					
Yes = 46.5					
No = 53.5					



and that consumers are hardly willing to compromise taste for eventual health benefits.

3.3. Probit model specification

In order to assess the simultaneous effects of multiple factors on functional food acceptance, multivariate modelling is performed. Since our objective is to model acceptance as a discrete decision (yes/no), the adoption of a limited dependent variable model is appropriate to the current problem. We opted for using probit modelling following Green (1997). In this case, the dichotomous dependent variable takes an empirical specification formulated as a latent response variable, say $ACCEPT^*$, where:

$$ACCEPT_i^* = \beta_0 + \sum_{k=1}^{K} \beta_k x_{ki} + \varepsilon_i \quad (1)$$

In Eq. (1), i denotes the respondent, x_{ki} represent $k = 1$ through K independent variables explaining functional foods acceptance for respondent i with β_k as parameter that indicates the effect of x_k on $ACCEPT^*$. Finally, ε_i is the stochastic error term for respondent i. The latent variable $ACCEPT^*$ is continuous, unobserved and ranges from $-\infty$ to $+\infty$. Variable $ACCEPT^*$ generates the binary variable $ACCEPT_i$ as specified in (2), where:

$$ACCEPT_i = \begin{cases} 1 & if ACCEPT_i^* > 0, \\ 0 & \text{otherwise.} \end{cases} \quad (2)$$

In our case of functional food acceptance, Eq. (2) is also defined as

$$ACCEPT = \begin{cases} 1 & \text{if the concept of functional foods is accepted by respondent } i, \\ 0 & \text{if the concept of functional foods is not accepted by respondent } i. \end{cases} \quad (3)$$

Implicit in the probit model is the assumption that the cumulative distribution function for the error term follows the cumulative normal distribution, denoted as $\Phi(\bullet)$. This implies that the probability of the investigated events occurring (acceptance of functional foods in our case) can be defined as: $\text{prob}(ACCEPT_i = 1) = \Phi(ACCEPT_i^*)$. Given the mathematical form of the cumulative normal distribution function $\Phi(\bullet)$, and after specifying an appropriate set of exogenous explanatory variables x_{ki}, the parameters can be estimated through maximising the value of the log likelihood function. In line with the previously mentioned hypotheses and description of the explanatory variables used in the questionnaire, the complete empirical specification of the probit model for functional food acceptance is

$$\begin{aligned} &\text{prob}(ACCEPT_i = \text{yes}) = \Phi(ACCEPT_i^*) \quad \text{and} \\ &\text{prob}(ACCEPT_i = \text{no}) = 1 - \Phi(ACCEPT_i^*), \quad \text{with} \\ &ACCEPT_i^* = \beta_0 + \beta_1 AGE_i + \beta_2 GEN_i + \beta_3 EDU_i \\ &\quad + \beta_4 KID_i + \beta_5 ILLf_i + \beta_6 FDHE_i \\ &\quad + \beta_7 HBB_i + \beta_8 PRP_i + \beta_9 KNO2_i \\ &\quad + \beta_{10} KNO3_i + \beta_{11}(AGE_i)(KNO2_i) \\ &\quad + \beta_{12}(AGE_i)(KNO3_i) + \varepsilon_i \end{aligned} \quad (4)$$

A measure suggesting the goodness of fit of probit models is the percentage of observations that are correctly predicted by the model (Green, 1997). Another goodness of fit measure for dichotomous dependent variable models has been presented by Estrella (1998). The interpretation of this measure conforms with the classical R^2 in the linear regression in that a value of 0 corresponds to no fit and a value of 1 to perfect fit. Both measures of fit are calculated and reported in the empirical results section. Alternative specifications of $ACCEPT_i^*$ with additional variables or interaction effects did not yield improvements in the goodness of fit of the estimated probit models (see next section).

4. Empirical findings

4.1. Bivariate analyses

The hypothesised determinants of functional food acceptance are first explored through bivariate analyses, with both statements relating to acceptance being considered as separate variables. Logically, acceptance scores for functional foods "if they taste good" exceed those for acceptance "even if they taste worse" (3.25 versus 2.55, $p < 0.001$). Education, presence of children and an ill family member were not significantly associated with either of the acceptance statements (all $p > 0.10$). Similarly, gender and age were not significantly associated with acceptance of functional foods "if they taste good". However, gender and age significantly associated with acceptance of functional foods "even if they taste worse than their conventional alternative foods". Acceptance of functional foods in the presence of noticeably worse taste was significantly higher among female respondents (2.66 versus 2.38 for male, $p = 0.044$) and correlated positively with age ($r = 0.134$, $p < 0.05$), thus confirming a higher willingness to compromise on taste among female and older consumers. The three knowledge (awareness) items were positively correlated with education, though only for men (all r around 0.3; $p < 0.01$), whereas correlations were insignificant for women.

With respect to cognitive and attitudinal determinants, knowledge (awareness) was found not to correlate significantly with either of the functional food acceptance statements. However, health benefit belief correlated positively with the acceptance of functional foods "if they taste good" ($r = 0.272$; $p < 0.01$) and even stronger with acceptance "even if they taste worse than their conventional alternative foods" ($r = 0.446$; $p < 0.01$). "Perceived role of food for health" correlated negatively with acceptance of "good tasting" functional foods ($r = -0.178$; $p < 0.01$), though positively with acceptance of "worse tasting" functional foods ($r = 0.226$; $p < 0.01$). This finding is indicative of a conviction that trustworthy functional foods (those that merit acceptance), almost by definition in the perception of consumers, taste worse. With respect to price perception, acceptance of good tasting functional foods was found to correlate positively with the belief that functional foods are too expensive given their health benefit ($r = 0.375$; $p < 0.01$). This finding contradicts expectations, though may be interpreted in the sense that price does not impose a major hurdle (or if so, this hurdle is outweighed by perceived benefits) for those who are willing to accept functional foods.

4.2. Multivariate probit model estimates

Since individuals represent a bundle of socio-demographics with cognitive skills and affective feelings, multivariate analyses reflecting more complexity among individual consumers are most appropriate to finally test the stated hypotheses. Using the data described in Table 1 and the specification set forth in Eq. (4), the discrete choice model of functional food acceptance was estimated with the purpose to assess the simultaneous impact of socio-demographic, cognitive and attitudinal determinants. Before estimating the probit model, explanatory variables were tested for detecting multicollinearity within the sample. Degrees of covariation between any pair of selected explanatory variables were acceptable, with the highest levels being seen for health benefit belief and perceived role of food for health ($r = 0.365$) and for age and education ($r = -0.425$), respectively. Table 4 presents the results of the probit analysis for functional food acceptance. Alternative specifications with age or "perceived role of food for health" as categorical (dummy) variables did not yield improved log likelihood values of the model, thus both were left in the linear continuous form. R^2 and correct predictions % measures of goodness of fit suggest a good fit for estimation based on cross-sectional data obtained through surveys with personal interviews (Green, 1997).

Parameter estimates from this multivariate analysis do not consistently confirm the previously detected bivariate associations. In this multivariate setting, only estimates denoting presence of an ill family member, health benefit belief and high knowledge are significant (Table 4). The signs of the estimates in the multivariate setting indicate that the probability of accepting functional foods increases with the presence of an ill family member and with stronger health benefit belief. Both findings are as expected, thus confirming H4 and H6. The sign of the estimate of high knowledge is negative, which means that high knowledge decreases the probability of accepting functional foods. At first sight, this finding may contrast expectations, though may be imperative of serious faults in current consumer knowledge about functional foods. In cases where better knowledge yields lower acceptance, the contents of knowledge and ways of spreading this knowledge should be questioned and scrutinised.

Interestingly, a significant and positive estimate of the interaction between age and high knowledge is discovered. This means that the impact of knowledge differs across age groups, more specifically, the marginal impact of high knowledge on functional food acceptance increases with increasing age, thus becoming less negative with the following metric: $[\Delta ACCEPT^* \mid KNO3 = 1] = -2.126 + 0.040AGE$. Including a similar interaction term with knowledge and gender, and knowledge and

Table 4
Probit estimates, dependent "acceptance of the concept of functional foods" ($n = 215$)

Parameter k	Estimate β_k	Standard error	t statistic	p value
Constant	−1.711	0.815	−2.10	0.036
Age	−0.001	0.012	−0.08	0.933
Gender (*GEN*)	0.063	0.201	0.31	0.754
Education (*EDU*)	−0.065	0.090	−0.72	0.469
Children aged <12 (*KID*)	−0.314	0.236	−1.33	0.184
Ill family member (*ILLf*)	0.635	0.237	2.68	0.007
Perceived role of food for health (*FDHE*)	−0.014	0.029	−0.47	0.639
Health benefit belief (*HBB*)	0.187	0.039	4.74	0.000
Price perception (*PRP*)	−0.127	0.197	−0.64	0.518
Knowledge medium (*KNO2*)	−0.437	0.659	−0.66	0.507
Knowledge high (*KNO3*)	−2.126	0.823	−2.58	0.010
(*AGE*)(*KNO2*)	−0.001	0.015	−0.09	0.931
(*AGE*)(*KNO3*)	0.040	0.020	2.00	0.045

Number of positive observations = 100 (46.5%).
Restricted log likelihood value = −155.58.
Maximum unrestricted log likelihood value = −123.78.
Log likelihood $\chi^2_{(\mathrm{df}=12)} = 63.6$ ($p < 0.001$).
R^2 (Estrella, 1998) = 27.3.
% of correct predictions = 68.8 (versus 53.5% for the naive predictor of all cases = 0).

education did not improve the log likelihood value of the model.

Contrary to the expectations based on findings in other countries, socio-demographic characteristics like age, gender, education and presence of children are not confirmed as significant determinants of functional food acceptance, although some were confirmed upon first inspection in our bivariate analyses. This finding may not be so surprising when considering that all previous studies investigated consumer profiles through bivariate analyses only, whereas in this multivariate setting individuals are considered simultaneously as a bundle of socio-demographic characteristics with cognitive and affective skills. Furthermore, other studies dealing with determinants of food choice have also indicated that socio-demographics lose explanatory power as valid characteristics for consumer segmentations relating to food choice (Grunert, Brunsø, Bredahl, & Bech, 2001; Risvik, 2001). Instead, cognitive, affective and situational factors emerge as determinants of functional foods acceptance.

4.3. Simulations

The most important benefit of probit models is the ability to simulate probabilities of events occurring over a range of explanatory variables. Cumulative normal distributions can be calculated and shown graphically, e.g. for the range of health benefit belief and over selected values of the other significant determinants like knowledge (Fig. 1) or presence of an ill family member (Fig. 2). First, the graphs show the tremendous impact of belief in the health benefits of functional foods. Acceptance ranges from nearly zero to almost 100%

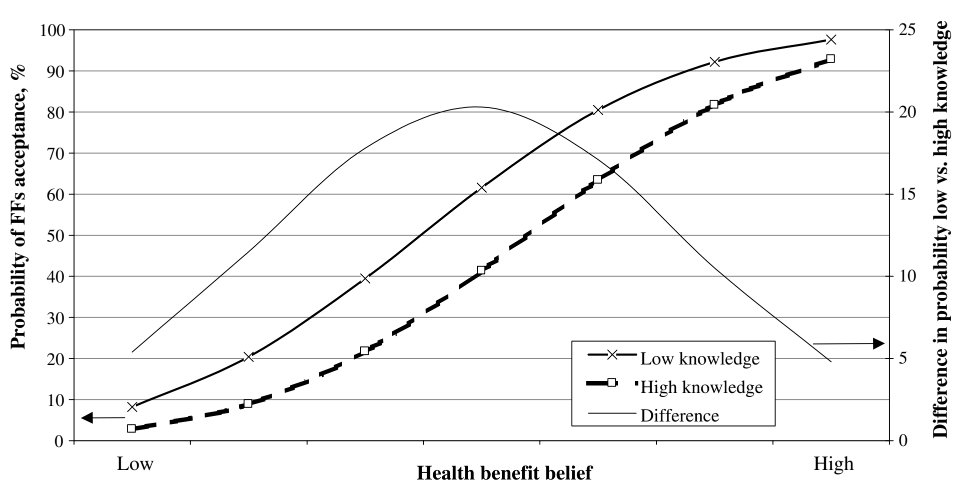


Fig. 1. Probability of functional foods acceptance across health benefit belief for low versus high knowledgeable consumers.

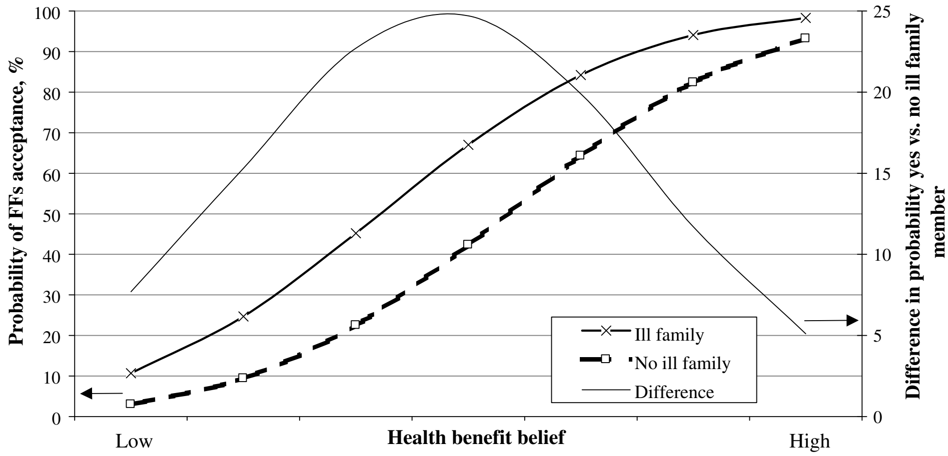


Fig. 2. Probability of functional foods acceptance across health benefit belief for consumers with versus without an ill family member.

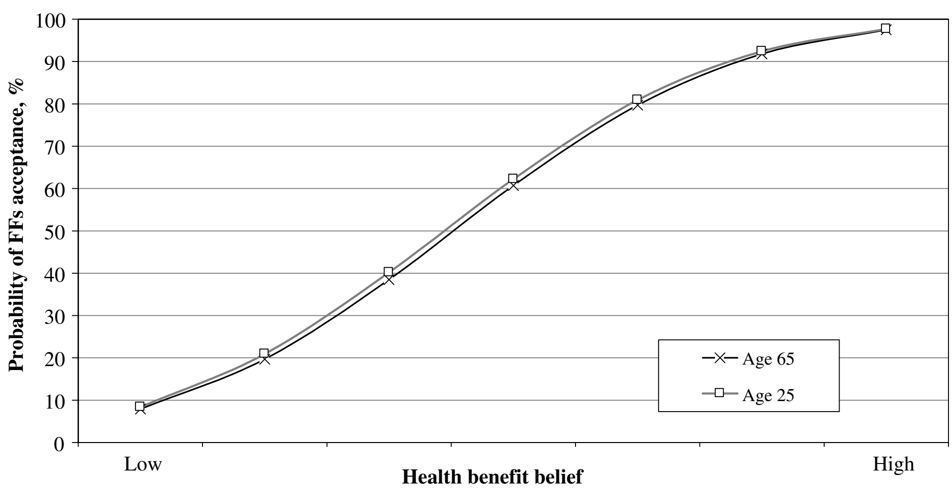


Fig. 3. Probability of functional foods acceptance across health benefit for low knowledgeable consumers with age 25 versus 65 years.

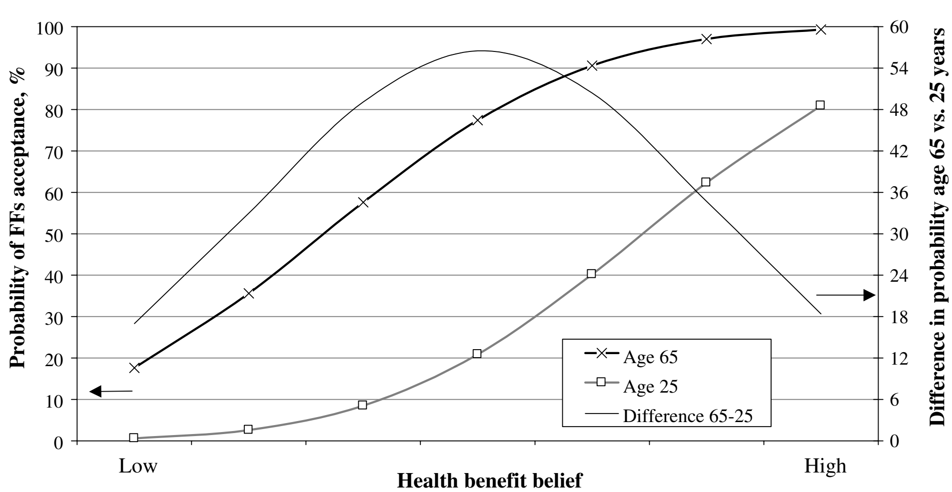


Fig. 4. Probability of functional foods acceptance across health benefit for high knowledgeable consumers with age 25 versus 65 years.

from low to high levels of health benefit belief. Figs. 1 and 2 show the exact meaning of knowledge and presence of an ill family member as determinants of functional food acceptance. The difference between two curves shows the impact of the treatment variable on the vertical right axis. Logically, this difference is largest around the midpoint or neutral position of the health benefit belief scale, as can be seen from the hump-shaped curves. For instance, the probability of acceptance differs 20%-points between low and high aware (knowledgeable) consumers around the midpoint of health benefit belief, whereas this difference is around 5%-point at the extremes. Hence, at neutral health benefit belief, low knowledgeable consumers have a 20%-point higher probability of accepting functional foods as compared to high knowledgeable consumers. Similarly, presence of an ill family member increases the likelihood to accept functional foods with 25%-points.

Furthermore, simulating probabilities based on the estimated model parameters allows displaying the exact meaning of the significant age–knowledge interaction effect (Figs. 3 and 4). Fig. 3 displays the total insignificance of age in the specific case of low knowledgeable consumers. For the specific case of high knowledgeable consumers, a completely different picture is obtained, as shown in Fig. 4. Within the group of consumers claiming to be well informed and knowledgeable about functional foods, age differences are apparent with elderly consumers showing a significantly higher likelihood of functional food acceptance as compared to youngsters. The difference in likelihood of acceptance ranges from 18%-points at both extremes of the health benefit belief spectrum, up to a 55%-points higher likelihood of acceptance among the elderly around the midpoint of health benefit belief.

5. Conclusions

A review of the literature points towards socio-demographic, cognitive and attitudinal factors as potential determinants of functional food acceptance. Most previous studies available in the public domain were implemented during 1995–1999 in the US or Europe, and mainly performed bivariate analyses to investigate the role and impact of these determinants. In our study in Belgium, survey data were collected in 2001 from a valid sample of 215 individuals, and subjected to both bivariate and multivariate analyses. Given that this sample is not fully representative (e.g. biased towards higher education and including only responsible persons for food purchasing, hence more women than men), generalisations beyond the sample at hand are speculative. Hence, the objective of this paper was not to quantify consumer acceptance of functional foods in Belgium, instead, the primary objective was to explore determinants of acceptance.

Bivariate analyses point towards a higher probability of acceptance of functional foods among female and older consumers, at least in the case where some loss of taste is to be accepted for increased perceived health benefits. Belief in the health benefits of functional foods is found to correlate positively with functional food acceptance. Multivariate analysis through probit modelling confirms the paramount role of health benefit belief for accepting the concept of functional foods. Initial bivariate associations disappear when investigating acceptance of functional foods in a multivariate setting. This is the case e.g. for gender, age, price perception and perceived role of food for health. In line with IFIC (1999), this study shows that knowledge and belief outweigh the impact of socio-demographic determinants on functional food acceptance. Furthermore, a significant effect is noticed for presence of an ill family member. With respect to knowledge, an interesting negative impact on the likelihood to accept functional foods is found. Today's self-reported consumer knowledge has an adverse effect, which is particularly present among the younger while fading away with increasing age.

In conclusion, Child's (2002) typification of the end of the 1990s US functional food consumer as "She's elite, informed and educated" is not confirmed for the Belgian (European?) segment of functional food users in the early 21st Century. Based on our study, those most likely to accept functional foods can be typified as a "benefit believers, who faced illness among relatives and whose eventual criticism towards functional food information fades away with ageing". This gap may be indicative of differences between the US and EU consumers in terms of food quality and safety perception, or trust in industry and government sources, with Europeans being more critical towards novel foods, novel food technology and food-related information. Given this profile, communication about functional foods, either from a public policy or commercial perspective, emerges as particularly challenging because of the lack of readily measurable and directly available segmentation criteria such as socio-demographics. Difficulties with targeting cognitively and attitudinally differentiated segments may explain the decreasing rates of growth in this sector and increasing doubts about whether functional foods are actually delivering upon their promises as the single largest growth market in the European food chain.

The findings from this study reinforce the idea of a rational/cognitive oriented decision-making process for functional foods, including active reasoning. This is in line with the Theory of Planned Behaviour, the hierarchy-of-effects paradigm, and corroborates with Evangelista, Albaum, and Poon (1999) who showed that positive attitudes affects subsequent behaviour to the extent that this behaviour is attributed to internal causes and not due to circumstantial pressures. An interesting avenue for future research deals with the role of classical triggers of active reasoning, such as involvement, differentiation and time pressure (Engel, Blackwell, & Miniard, 1986) in the specific case of functional foods. Involvement with functional foods can be hypothesised to be high because of personal relevance to the individual, potential reflection on self-image, incurred cost and risk. The level of product differentiation may be optimal (not too high or too low) for evoking evaluation of alternatives. Finally, time pressure can be hypothesised to be low because of the preventative nature of functional foods, with benefits that show up only after a reasonable period of usage. Thus, consuming today may not be perceived as causing any difference as compared to delayed consumption after extensive evaluation. Further research is needed to confirm these theoretically based hypotheses, on which some light has been shed by the present study.

Appendix A. Formulation of multi-item constructs

Acceptance of functional foods (2 items; both threshold 3 on 5-point Likert scale)

"Functional foods are acceptable for me if they taste good."
"Functional foods are acceptable for me, even if they taste worse than their conventional alternative foods."

Knowledge (3 items on 7-point scales; Cronbach's alpha = 0.77; *KNO*)

"I know foods with specific beneficial health impact." (unaided)
"I know enriched foods." (unaided)
"How do you judge your personal knowledge of functional foods." (aided)

Perceived role of food for health (3 items on 7-point scales; Cronbach's alpha = 0.61; *FDHE*)

"Food plays an important role for my personal health."
"I feel to have control over my personal health."
"I feel to eat healthier now as compared to 5 years ago."

Health benefit belief (4 items on 5-point scales; Cronbach's alpha = 0.82; *HBB*)

"Functional foods are likely to have a beneficial impact on my personal health."
"I experience functional foods as being part of a natural way of living."
"Functional foods allow me taking my personal health in my own hands."
"Functional foods are a convenient way of meeting recommended daily intakes, which I would never meet with my conventional diet."

Price perception (1 item on a 5-point scale; *PRP*)

"According to my personal opinion, functional foods are too expensive given their claimed health benefit."

References

Arthus, F. (1999). Alicaments: la santé dans l'assiette. *Pharmaceutiques, 66*, 61–65.
Beardsworth, A., Bryman, A., Keil, T., Goode, J., Haslam, C., & Lancashire, E. (2002). Women, men and food: the significance of gender for nutritional attitudes and choices. *British Food Journal, 107*, 470–491.
Bech-Larsen, T., & Grunert, K. (2003). The perceived healthiness of functional foods: a conjoint study of Danish, Finnish, and American consumers' perception of functional foods. *Appetite, 40*, 9–14.
Bech-Larsen, T., Grunert, K. G., & Poulsen, J. B. (2001). The acceptance of functional foods in Denmark, Finland and the United States. MAPP Working Paper 73. The Aarhus School of Business, Aarhus.
Burrell, A. (2002). Consumers' reactions to rBST milk with and without labelling. *TSL Tijdschrift voor Sociaal-Wetenschappelijk onderzoek van de Landbouw, 17*, 7–20.
Burton, M., Rigby, D., Young, T., & James, S. (2001). Consumer attitudes to genetically modified organisms in food in the UK. *European Review of Agricultural Economics, 28*, 479–498.
Byrne, M. (1997). Fortified future for functional foods. *Food Engineering International, 10*, 42.
Childs, N. M. (1997). Functional foods and the food industry: consumer, economic and product development issues. *Journal of Nutraceuticals, Functional and Medical Foods, 1*(2), 25–43.
Childs, N. M. (2002). Functionality of natural foods. In Paper presentation at Bord Bia, Ireland. Available: http://www.bordbia.ie/events/kinsale2002/childs.pdf.
Childs, N. M., & Poryzees, G. H. (1997). Foods that help prevent disease: consumer attitudes and public policy implications. *Journal of Consumer Marketing, 14*(6), 433–447.
Cook, A. J., Kerr, G. N., & Moore, K. (2002). Attitudes and intentions towards purchasing GM food. *Journal of Economic Psychology, 23*, 557–572.
Dagevos, J. C., Stijnen, D. A. J. M., Poelman, A. A. M., & Bunte, F. H. J. (2000). *De wereld van functional foods: Op het raakvlak van twee ketens?*. Wageningen (Wageningen UR): ATO/LEI.
Diplock, A. T., Aggett, P. J., Ashwell, M., Bornet, F., Fern, E. B., & Roberfroid, M. B. (1999). Scientific concepts of functional foods in Europe: concensus document. *British Journal of Nutrition, 81*(suppl. 1), S1–S27.
Engel, J. F., Blackwell, R. D., & Miniard, P. W. (1986). *Consumer behavior*. New York: The Dryden Press.
Ernst, E. (2001). Functional foods, neutraceuticals, designer foods: innocent fad or counterproductive marketing ploy? *European Journal of Clinical Pharmacology, 57*, 353–355.

Estrella, A. (1998). A new measure of fit for equations with dichotomous dependent variables. *Journal of Business and Economic Statistics, 16*, 198–205.

Euromonitor (2000). Functional foods: a world survey. Euromonitor, Chicago.

Evangelista, F., Albaum, G., & Poon, P. (1999). An empirical test of alternative theories of survey response behaviour. *Journal of the Market Research Society, 41*, 227–244.

Frenzen, P. D., DeBess, E. E., Hechemy, K. E., Kassenborg, H., Kennedy, M., McCombs, K., & McNees, A. (2001). Consumer acceptance of irradiated meat and poultry in the United States. *Journal of Food Protection, 64*, 2020–2026.

Frewer, L. (1998). Consumer perceptions of novel food acceptance. *Outlook on Agriculture, 27*(3), 153–156.

Frewer, L. J., Howard, C., & Shepherd, R. (1997). Public concerns about general and specific applications of genetic engineering: risk, benefit and ethics. *Science, Technology and Human Values, 22*, 98–124.

Frewer, L. J., Miles, S., & Marsh, R. (2002). The GM foods controversy: a test of the social amplification of risk model. *Risk Analysis, 22*, 701–711.

Gardette, N. (2000). Is there a future in Europe for functional food? MBA thesis. City University Business School, London.

Gilbert, L. (1997). The consumer market for functional foods. *Journal of Nutraceuticals, Functional and Medical Foods, 1*(3), 5–21.

Gilbert, L. (2000). The functional food trend: what's next and what Americans think about eggs. *Journal of the American College of Nutrition, 19*(5), 507S–512S.

Gilmore, J. (1998). Nutraceutical booming. *Food Ingredients and Analysis International, 12*, 300.

Green, W. (1997). *Econometric analyses*. Upper Saddle River: Prentice-Hall.

Grunert, K. G., Bech-Larsen, T., & Bredahl, L. (2000). Three issues in consumer quality perception and acceptance of dairy products. *International Dairy Journal, 10*, 575–584.

Grunert, K. G., Brunsø, K., Bredahl, L., & Bech, A. (2001). Food-related lifestyle: a segmentation approach to European food consumers. In L. Frewer, E. Risvik, & H. Schifferstein (Eds.), *Food, people and society: a European perspective of consumers' food choices* (pp. 211–230). Berlin: Springer.

Hayes, D. J., Fox, J. A., & Shogren, J. F. (2002). Experts and activists: how information affects the demand for food irradiation. *Food Policy, 27*, 185–193.

Heller, I. R. (2001). Functional foods: regulatory and marketing developments. *Food and Drug Law Journal, 56*, 197–225.

Hickling, M. (1997). Market developments in functional foods. In *Developing, marketing and regulation of functional foods and nutraceuticals* (pp. 127–129). London: SMi Ltd.

Hilliam, M. (1996). Functional foods: the Western consumer viewpoint. *Nutrition Reviews, 54*(11), S189–S194.

Hilliam, M. (1998). The market for functional foods. *International Dairy Journal, 8*, 349–353.

Hilliam, M. (2000). Functional food: how big is the market? *World of Food Ingredients, 12*, 50–53.

IFIC (1999). *Functional foods: Attitudinal research (1996–1999)*. Washington: IFIC, International Food Information Council Foundation.

IFIC (2000). *Functional foods attitudinal research August 2000: Quantitative and qualitative summary*. Washington: IFIC, International Food Information Council Foundation.

IFIC (2002). The consumer view on functional foods: yesterday and today. *Food Insight, 2002* (May/June), 5, 8.

Jonas, M. S., & Beckmann, S. C. (1998). Functional foods: consumer perceptions in Denmark and England. MAPP Working paper. The Aarhus School of Business, Aarhus.

Kubberod, E., Ueland, O., Rodbotten, M., Westad, F., & Risvik, E. (2002). Gender specific preferences and attitudes towards meat. *Food Quality and Preference, 13*, 285–294.

Kwak, N.-S., & Jukes, D. (2001). Issues in the substantiation process of health claims. *Critical Reviews in Food Science and Nutrition, 41*(6), 465–479.

Lennie, T. A. (2001). Influences of market forces on nutraceutical research: role of the academic researcher. *Nutrition, 17*(5), 423–424.

Lusk, J. L., Roosen, J., & Fox, J. A. (2003). Demand for beef from cattle administered growth hormones or fed genetically modified corn: a comparison of consumers in France, Germany, the United Kingdom and the United States. *American Journal of Agricultural Economics, 85*, 16–29.

Mäkelä, J., & Niva, M., (2002). Changing views of healthy eating: cultural acceptability of functional foods in Finland. Paper presented at Nordisk Sociologkongress, På Island Reykjavic, Iceland, August 2002.

Martin, A. (2001). Functional foods: from marketing to public health. *OCL-Oleagineux Corps Gras Lipides, 8*(4), 310–311.

Menrad, K. (2000). Markt und Marketing von funktionellen Lebensmitteln. *Agrarwirtschaft, 49*(8), 295–302.

Milner, J. A. (2000a). Summary. *American Journal of Clinical Nutrition, 71*(Suppl.), 1743S.

Milner, J. A. (2000b). Functional foods: the US perspective. *American Journal of Clinical Nutrition, 71*(suppl.), 1664S–1669S.

NIS (2002). Private households statistics. NIS, National Institute for Statistics, Brussels.

Niva, M. (2000). Consumers, functional foods and everyday knowledge. Paper presented at Conference of nutritionists meet food scientists and technologists, Porto, Portugal, 2000.

Pferdekämper, T. (2003). Determinants of the acceptance of functional food using an example of new probiotic rusk—an empirical analysis. Paper presented at Consumer perception of healthiness of foods and consumer acceptance of new functional foods, 7–8 April Middelfart, Denmark.

Poulsen, J. B. (1999). Danish consumers' attitudes towards functional foods. MAPP Working paper 62. The Aarhus School of Business, Aarhus.

Richardson, N., MacFie, H., & Shepherd, R. (1994). Consumer attitudes to meat eating. *Meat Science, 36*, 57–65.

Risvik, E. (2001). The food and I: sensory perception as revealed by multivariate methods. In L. Frewer, E. Risvik, & H. Schifferstein (Eds.), *Food, people and society: A European perspective of consumers' food choices* (pp. 23–37). Berlin: Springer.

Roberfroid, M. B. (2002). Global view on functional foods: European perspectives. *British Journal of Nutrition, 88*(Suppl. 2), S133–S138.

Saba, A., & Vassallo, M. (2002). Consumer attitudes toward the use of gene technology in tomato production. *Food Quality and Preference, 13*, 13–21.

Shah, N. P. (2001). Functional foods fro probiotics and prebiotics. *Food Technology, 55*(11), 43–46.

Stanton, C., Gardiner, G., Meehan, H., Collins, K., Fitzgerald, G., Lynch, P. B., & Ross, R. P. (2001). Market potential for probiotics. *American Journal of Clinical Nutrition, 73*(suppl.), 476S–483S.

Sunley, N. C. (2000). Functional foods in an emerging market. *Food Australia, 52*(9), 400–402.

Tuorila, H., Lahteenmaki, L., Pohjalainen, L., & Lotti, L. (2001). Food neophobia among the Finns and related responses to familiar and unfamiliar foods. *Food Quality and Preference, 12*(1), 29–37.

Tuorila, H., & Cardello, A. V. (2002). Consumer response to an off-flavor in juice in the presence of specific health claims. *Food Quality and Preference, 13*, 561–569.

Turner, R. S. (2001). Of milk and mandarins: rBST, mandated science and the Canadian regulatory style. *Journal of Canadian Studies, 36*, 107–130.

Verbeke, W., & Vackier, I. (2004). Profile and effects of consumer involvement in fresh meat. *Meat Science, 67*(1), 159–168.

Verbeke, W. (2001). Beliefs, attitude and behaviour towards fresh meat revisited after the Belgian dioxin crisis. *Food Quality and Preference, 12*, 489–498.

Verbeke, W., Moriaux, S., & Viaene, J. (2001). Consumer knowledge and attitude towards functional foods in Belgium: evidence from empirical research. *Annals of Nutrition and Metabolism, 45*(Suppl 1), 114.

Verbeke, W., Ward, R. W., & Viaene, J. (2000). Probit analysis of fresh meat consumption in Belgium: exploring BSE and television communication impact. *Agribusiness, 16*(2), 215–234.

Weststrate, J. A., van Poppel, G., & Verschuren, P. M. (2002). Functional foods, trends and future. *British Journal of Nutrition, 88*(Suppl. 2), S233–S235.

Wrick, K. L. (1992). Consumer viewpoints on 'designer foods'. *Food Technology, 1992*(March), 100–104.

Wrick, K. L. (1995). Consumer issues and expectations for functional foods. *Critical Reviews in Food Science and Nutrition, 35*(1&2), 167–173.

Zandstra, E. H., de Graaf, C., & Van Staveren, W. A. (2001). Influence of health and taste attitudes on consumption of low- and high-fat foods. *Food Quality and Preference, 12*(1), 75–82.