FOOD CHOICE, NUTRITIONAL INFORMATION AND FUNCTIONAL INGREDIENTS: AN EXPERIMENTAL AUCTION EMPLOYING BREAD

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Abstract

In this paper we present the results of an experimental auction conducted to examine the influence of nutritional information on food choice and in particular estimate consumer willingness to pay for bread that contains functional ingredients which is used to make sandwiches. We find that consumers are willing to pay more for a whole grain and whole grain granary bread sandwich than other bread types. We also find that consumers do react positively to the provision of nutritional and health benefit information but that this effect occurs regardless of whether we supply specific or non-specific health benefit information. We discuss information provision and health policy implications that emerge from our analysis.

Key Words: Functional foods, bread, willingness-to-pay.
JEL Codes: D44, I1

1. Introduction

There are an increasing number of novel food products being developed and offered to the market, which are frequently differentiated by the modified attributes they offer the consumer. Currently, many of these are being marketed in terms of the benefits they offer for consumer health as well as the potential to reduce the risk of diseases. Research into food choice has identified 'health' as a variable that has been used in the decision making process (Steptoe et al. 1995; Lappalainen et al. 1998). Recently some of the new food product developments have been labelled as 'functional foods' (e.g. Doyon and Labrecque 2008; Siró et al. 2008). There are many different definitions of what constituted a functional food, a European commission working definition was created stating that "a food can be regarded as 'functional' if it satisfactorily demonstrated to affect one or more target functions within the body, beyond adequate nutritional effects, in a way that is relevant to either an improved state

of wellbeing and/or reduction of risk of disease" (Diplock et al. 1999). This market is growing in economic importance, with estimates of global market size in the range of ten of billons of dollars and predictions that it will continue to grow significantly over the coming decade (Hilliam 2000).

Functional foods have the potential to improve population health in line with the objectives identified by national public health strategies. Specifically, from a public health perspective, the increased consumption of functional ingredients in bakery products implies that the quantity of fibre in the diet, especially whole grains, increases. Whole grain cereals are an important component of a healthy balanced diet containing a range of macronutrients (fat, carbohydrates and fibre) and micronutrients (vitamins, minerals and phytonutrients) (Dewettinck et al. 2008). Consuming whole grain foods has been shown to prevent several different, fatal and prominent non-communicable diseases, such as Type 2 Diabetes Mellitus, Cardiovascular Disease and certain cancers[1] (Slavin et al. 2001; Anderson 2003; Smith et al. 2003). It has been estimated that a total of 113,836 deaths per year in the UK could potentially be reduced by the consumption of whole grains and the alteration of lifestyle choices (Mozaffarian et al. 2008). Other economy wide estimates of the health benefits associated with a specific functional food have been examined by Malla et al. (2007). Malla et al. used modelling to show the economic costs associated with switching to a functional healthier trans-fat free oil (trans fats are associated with elevated cholesterol and an increased incidence of coronary heart disease) were significantly less than the benefits from improved health outcomes and reduced health care costs to society.

The perceived benefits associated with functional food have informed the debate amongst health professionals about the role that functional food should play in public health policy. Some believe that functional foods should be used to prevent and reduce diseases, with products being aimed at the general population, whilst others advocate the use of functional food for treatment (Frewer et al. 2003; Dwyer 2007). This position concurs with patient groups, such as, the British Cardiac Society, British Hyperlipidaemia Association, the British Hypertension Society and the British Diabetic Association who all promote prevention rather

[1] Colorectal, gastric (upper and lower), pancreatic, breast, prostate, gallbladder, endometrium, ovaries, bladder and kidney cancer.

than cure (British Cardiac Society et al. 1998).

Although consumers and health professionals have displayed positive preferences for functional food in general, there is also evidence that consumers differ in the extent to which they buy specific food products with functional ingredients, especially bakery products[2]. Even though there is little difficulty including functional ingredients in bakery products, whether the resulting functional product meets consumer demands is less clear. Compared to dairy products current consumption of bakery functional products, specifically bread, is relatively low.

Despite these advances in bread as a 'functional food' there are various reasons why consumers might be unwilling to adopt these products. Verbeke (2006) notes that relying on a consumer to adopt a product that contains a functional ingredient but which has been compromised in terms of taste is highly unlikely. Siro et al. (2008) observe that the acceptance of functional foods is conditional on the product. Additionally, data indicates that consumers are less likely to consume whole grain bread compared to other types of grain (Hoare et al. 2004). Also, consumers face numerous barriers when trying to consume recommended intakes of whole grain foods identifying taste, texture, moisture content, price, preparation time, lack of knowledge about whole grains and inability to identify whole grain products, and the limited availability of whole grain products as limiting factors (Adams and Engstrom 2000; Kantor et al. 2001; Jones et al. 2002).

To combat the issues of taste, texture and moisture content in whole grain products, the food manufacturing industry need to develop new products with these factors in mind. Whole grains contain functional ingredients, including important phytochemicals and dietary fibre, which are thought to cause health benefits (Sidhu et al. 2007). One way to overcome some of

[2] Bread has recently become a vehicle for functional ingredients, for example, with the introduction of omega 3 fatty acids. In addition, whole grains naturally contain functional ingredients, including phytochemicals (phytic acid, glutathione, and phytosterols), as well as dietary fibre (Inulin and beta-glucan), which yield health benefits, which could not be consumed in white bread alternatives (Sidhu et al. 2007).

the identified barriers is by including the beneficial components from the whole grain and adding them to the refined grain alternative creating a functional food.

This research examines the potential for one such product - white bread with an additional functional ingredient. Specifically, bread provides an interesting case study of consumer response to the use of a functional ingredient because it is a staple part of most peoples' diets, low involvement and frequently purchased. In addition, there already exist several forms of bread (e.g. whole grain bread) that can be bought and consumed that already provide health benefits. However, the majority of bread consumed in the UK is white bread, which has had many of the natural benefits associated with consuming grain based products removed. In this research we examine consumer acceptance and willingness to pay (WTP) for a white bread product that is enhanced with the addition of extra fibre in the form of Inulin, a functional ingredient adding the health benefits of whole grain. Inulin is a soluble fibre found naturally within whole grain granary bread.

To conduct this research we have employed an experimental food auction (Lusk and Shogren 2007). The reason for employing this research method is that experimental auctions have been designed to combat the criticisms and biases that cause problems with hedonic methods of research, such as blind product tasting and product preference (Lange et al. 2002). Both hedonic methods and survey instruments fail to replicate real life situations, resulting in the consumer responding positively to questions when asked if they would purchase and consume a product with a particular attribute. In reality this may not directly translate into a purchase when the product is available. Even though the experimental auction method is based within the laboratory setting, real products and money are exchanged. This gives the individual an incentive to reveal the real value of the product being studied (Lusk et al. 2004). This in turn reduces problems of hypothetical bias where no monetary payment is made (List 2003)[3]. Having consumers pay money during the auction process ensures the bids placed better reflect the market value, as there are consequences to over and underbidding. The experimental auction employed in this paper, required participants to bid over a selection

[3] Hypothetical bias occurs when participants are not incentivised to provide accurate information about their WTP for a product. Auctions offering real products to the participant, who are then expected to pay for the product, are likely to reduce excessive hypothetical bias.

of sandwiches made from different types of bread. The experiment was designed to focus on differences in (i) respondents' WTP for different types of bread; (ii) the level of information relating to health impacts bids; and (iii) the specific health claim effects the bids received.

The structure of the paper is as follows. In Section 2 we briefly review the literature on health and food with a specific focus on bread as well as functional ingredients. In Section 3 we describe and explain our experimental auction. Then in Section 4 we examine the data generated by our auction and present the results of our analysis. Finally, in Section 5 we conclude.

2. Literature Review

There is a burgeoning literature examining consumer attitudes towards food products, such as functional food, that have enhanced benefits or use ingredients that are the result of scientific modifications or new technologies (e.g. Siró et al. 2008; Pothoulaki and Chryssochoidis 2009). There is also a related literature that is rapidly increasing in size that examines how consumers respond to food packaging and the information conveyed about the products they are willing to buy (e.g. Grunert 2002; Cowburn and Stockley 2005). Within these literatures we are most interested in research that have employed experimental approaches such as food auctions or stated preference surveys, which focus on functional foods and individuals WTP for such food products, in particular bread.

A common theme that runs through this literature is the role of consumer preferences and attitudes regarding functional food. It has been found that attitudes and preferences are influenced by the associated provision of information. For example, Labrecque et al (2006) examined how consumer preferences for functional food are influenced by the credibility of the information being provided. As might be expected respected sources of information provide credibility and as a result increase the likelihood of adoption. Naylor et al. (2009) in a study of functional food and health claims find that when information provision is conflicting less health conscious consumers are less likely to choose a functional food over a non-functional food. However, if a consumer is health conscious they are less likely not to select a functional food. According to Naylor et al this is because of confirmatory bias,

whereby these consumers believe the functional food health claim.

In light of these observations it is, therefore, of little surprise to find that many studies have revealed positive WTP on the part of consumers for food products that are functional and/or contain functional ingredients. For example, West et al. (2002) investigated Canadian household attitudes, beliefs, knowledge and WTP for functional food employing a Choice Experiment (CE). They found that Canadian consumers highly rated and approved of the functional properties of the food products used in the CE. However, they do note that respondents are only WTP for functional food conditional on the safety and nutritional dimension of the food. In another CE Markosyan et al. (2009) estimated consumers WTP for apples with a coating that contains specific flavonoids and antioxidants. They also find that respondents are willing to pay a small price premium for apples with enhanced functional attributes. Hailu et al. (2009) examine consumer preferences for functional foods and nutraceuticals that contain probiotics. Employing a CE they find that "mode of delivery" that is, the type of product used to deliver the functional benefit matters. Similarly Siegrist et al. (2009), who examine consumer willingness to buy functional food produced using nanotechnology find that products produced using nanoparticulate-engineered additives yielded lower willingness to buy results than for products with functional benefits generated naturally. This study fits in with results summarised by Siro et al. (2008) relating to a general dislike in the EU of food products that have been engineered to have health benefits.

Turning to the experimental auction literature we can see that experimental (food) auctions have been used in a wide-range of topics including new production technologies (GM), food safety (irradiation of meat and treatment of milk), value of wine, food quality and information provision (e.g. Lange et al. 2002; Rozan et al. 2004; Poole et al. 2007; Rousu et al. 2007; Marette et al. 2010). A particular advantage of employing an experimental auction is that the provision of information to participants can be isolated from other effects. Information can take various forms such as health benefits, health warnings or various credence attributes.

As a result of the advantages of experimental auctions this technique has proven to be a popular method to examine how information provision impacts the potential WTP of

consumers for functional food. For example, Hobbs et al. (2006) undertook a WTP study employing an experimental auction to examine consumer attitudes towards bison in Canada. The study considered how consumers value bison compared to beef, as well as additional health-related attributes from consuming bison (e.g. lower fat and without the use of growth hormones). This study employed sandwiches as the food to deliver the two types of meat. In terms of auction method Hobbs et al employed a Vickrey second-price auction. They asked survey participants to bid for each sandwich with information differentiation for the various types of sandwich offered. Employing a suitable econometric specification they found that there was no significant difference in WTP for bison over beef even with the additional information about quality assurances. It was identified that ensuring consumers had a positive eating experience was more important than the information provided.

Another experimental food auction that employed sandwiches was conducted by Drichoutis et al. (2008). They undertook an experimental auction to see how consumers value nutritional labels. This study considered sandwiches: 6-inch sub sandwich, a wrapped pita sandwich and a Mediterranean type sandwich. In round one the participants could look at the sandwich and taste the sandwiches. In the next round they undertook the same activity except this time nutritional information was provided. They follow Harrison et al. (2004) and estimate WTP by employing a Tobit specification with upper and lower limits. Importantly, they find that the provision of information matters and is indicated in their results via higher WTP estimates.[4]

Another example of an auction showing how information can influence WTP is presented by Marette et al. (2010). They consider a fortified yoghurt drink and their results show a statistically significant positive impact of information that details the cholesterol reducing properties of the yoghurt. Importantly, they find this effect for participants` with and without cholesterol problems. Interestingly, they also explain that auction participants place less emphasis on the negative impacts and more on the positive impacts of a functional food. This observation relates to the findings of Naylor et al. (2009) and confirmatory bias.

[4] The use of Tobit specifications is relatively common in the literature because of the censored nature of the data. For example, Rozan et al (2004) employ a left censored random effects Tobit to take account of zero bids in their data in a statistically appropriate manner.

In summary, research within this literature has found that in general individuals are WTP for functional food or food containing functional ingredients as long as other important properties of the product are not compromised. In addition, experimental auctions have shown that the effect of information provision relating to the health benefits associated with a food product also yield an increase in WTP.

3. Experimental Auction Design and Implementation

Prior to conducting our experimental auction a number of focus groups were conducted. These informed the development of the food auction process. A total of three focus groups, which recruited 14 people, were conducted to establish the way people choose and purchase shop bought sandwiches. As a result of the focus groups it was identified that a cheese ploughman's sandwich was the most suitable for the food auction.

In terms of the actual auction all sandwiches were prepared using a standard recipe weighed by electronic scales on the morning of the auction to ensure freshness. Each sandwich consisted of two slices of medium sliced bread, 6g of vegetable fat spread, one prepared pre-sliced mild Edam cheese slice, 10g of small chunk sandwich pickle and 20g prepared iceberg lettuce.

For each auction five variants of the cheese ploughman's sandwiches were made, each only varying the bread type: White, Half White/Half Whole grain, Whole grain, Whole grain Granary and a White bread substitute for Functional (Inulin) bread (communicated to participants as the 'functional' bread product).

A Vickrey second price auction with a full bidding process was used. Full bidding was selected to maximise participant engagement and interest in the auction process. The Vickery auction is easy to explain to participants and deals with on-margin bidders. The majority of working adults are likely to have an appreciation of the market value of pre-packaged sandwiches and therefore should be considered on-margin bidders.

It was decided that we would not employ a reference price or reveal bids as rounds progressed during the auction. Both approaches are employed in the literature and have been shown to effect WTP estimates. For example, in terms of a reference price Bernard and He (2010) show how reference prices can affect bids. Findings by Drichoutis et al. (2008) showed higher bids were received when reference price information was provided versus no information. As a result they conclude that it remains unclear if knowledge of a reference price yields more reliable estimates[5].

A total of 141 participants (56 males and 85 females) were recruited from University staff and students. The sample size for the auction was chosen based on similar food auction experiments using perishable goods (Lange et al. 2002; Lusk et al. 2004; Poole et al. 2007; Rousu et al. 2007). Participants were excluded if they had an allergy to any of the sandwich ingredients.

At least 10 potential participants were invited to each auction. Unknown to the participants the auctions alternated between providing specific and non-specific nutritional health claims during round two of the auction. Overall, there was a slight over attendance at specific health information auctions (six more participants). The same researcher conducted a total of 12 auctions over a one-month period using the following protocol:

Step 1: On arrival all participants completed and signed a consent form, and a form committing them to buy the product if they won the auction. To provide anonymity each participant was provided with a unique ID. Each participant received £5 for taking part in the auction.

The amount of money endowed to participants could be considered a limitation of the research as it acted as the upper value that could be placed as a bid by individuals taking part. However, £5 was chosen because of the cost of a shop bought sandwich generally lies between £2 to £4 depending on its filling.

[5]Drichoutis et al (2008) note, *"Whether bid values based on knowledge of reference prices are more reliable than those valuations that are not is still an open question. All we are concluding from our simple study is that provision of reference or field price information influences bid values in experimental auctions."* (p. 448)

Step 2: Participants completed a Dutch Eating Behaviour Questionnaire (DEBQ) and a questionnaire on their current hunger and mood levels using Visual Analogue Scales (VAS).

The DEBQ asks individuals a set of 33 questions to identify their eating behaviours: 'restrained', 'emotional' and 'external' (van Strien et al. 1986). Restrained eating theory combines the behavioural consequences of emotional and external eating formed as a result of dieting. Dieters (restrained eaters) can actually over consume calories when experiencing dis-inhibiting factors. The 'emotional eating' concept is based on the psychosomatic theory; an individuals` normal reaction to emotional states would be to lose their appetite, however, some people respond by eating more. Externality theory addresses the issue of 'external eating', which deals with an individual's response to food stimuli regardless of their level of satiety. These three concepts can change the way individual's react to food and were recorded as control variables for use during data analysis.

Participants were also asked about their mood and hunger prior to the commencement of the auction using the VAS. Participants were required to place a vertical mark on a 10cm line between two mood extremes, the higher the value the more positive their mood. This data was also used as control variables during the data analysis.

Step 3: Participants were then fully briefed on the procedure of the auction method using a power point presentation and script, to ensure consistency. Within this presentation, information about the auction technique was discussed. The Vickery second price auction was the auction mechanism employed. As part of the briefing process the best strategy to use with this auction was discussed with participants so that we could as far as possible ensure that bids are incentive compatible.

Step 4: A training auction was conducted using crisps and followed the same number and of rounds as the actual sandwich auction. Note, participants were not asked to rate the crisps based on the information provided. This only occurred during the main auction. As with the actual auction once all the bids from the training round has been collected they were ordered into ascending price order. The person with the highest bid was required to pay the second

highest price. At this point participants were allowed to talk and ask the facilitator questions about the auction procedure. The training auction helped the participants to understand the auction process, which they were going to take part in.

Step 5: The main auction was now undertaken. During the auction, each participant was sat separately. They could not confer or talk during the actual bidding process. Over three rounds all participants considered and bid for five freshly made cheese ploughman's sandwiches made with different types of bread (i.e. White, Half White/Whole grain, Whole grain, Whole grain Granary and a White bread substitute for Functional (Inulin) bread, communicated to participants as the 'functional' bread product). Thus, each person produced 15 bids (3 rounds x 5 types of sandwiches). The participant's submitted sealed bids, at the end of each round, for each product. Each participant was required to submit additional information prior to bidding about the appeal of the sandwich based on the information provision in rounds one and two and provide information about the attributes of the bread during round three on a seven-point likert scale.

A key feature in the auction was the type of information provided to participants about the sandwiches. Specifically, during round two we provided the nutritional information for each sandwich that was worked out using the values provided by each manufacturer and adjusted for weight. The nutritional information was presented to the participants as per 100g per sandwich (two slices of bread with filling) and used the traffic light system colour coding for four key components (fat, saturated fat, sugar and salt) (Food Standards Agency 2010). This information was provided to both of the groups. In addition, we provided specific and non-specific health claims. The non-specific health claim for any bread type containing whole grain was as follows:

'*Naturally Rich in Whole Grains'*

and for the functional product:

'Source of Fibre'.

These can be contrasted with the specific health claims, which for whole grain bread types which were:

'People with a healthy heart tend to eat more whole grain foods as part of a healthy lifestyle'

and for the functional bread containing Inulin:

'Inulin from chicory promotes healthy gut bacteria. This product provide a third of the suggested 5g/day of Inulin'.

An example of the difference in nutritional information employed in the experimental auction is presented in Figure 1.

Figure 1: Example of Non-Specific and Specific Product Information

Product B — Functional Bread (Inulin) Sandwich

Nutritional Information	Per 100g	Per Sandwich
Energy	242kcals	354kcals
Protein	8.4g	12.2g
Carbohydrate	26.6g	38.8g
of which sugars	4.0g	5.8g
Fat	11.6g	17.0g
Saturates	5.5g	8.0g
Fibre	3.0g	4.4g
Salt	1.3g	1.9g

Source of fibre.

Product B — Functional Bread (Inulin) Sandwich

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Saturates	5.5g	8.0g
Fibre	3.0g	4.4g
Salt	1.3g	1.9g

✓ Source of fibre

Inulin from chicory promotes healthy gut bacteria. This product provide a third of the suggested 5g/day of Inulin.

In Figure 1 we can see the difference in information for White Bread containing Inulin. The additional information in terms of health benefits from product consumption as well as how this relates to an individuals' daily requirement is also clear to see.

Given these differences in information the rounds were implemented as follows[6]:

> **Round One** - Participants were shown pictures of the sandwiches and asked to rate them based on appearance. Once this information was collected they submitted a sealed bid for each product.
>
> **Round Two** - Participants received nutritional information plus specific or non-specific health claims for each sandwich. They then re-rated each sandwich. Once this information was collected they submitted a sealed bid for each product.
>
> **Round Three** - Participants then tasted the five sandwiches on offer. They then rated the sandwiches. Once again this information was collected and then a sealed bid was collected for each product.

Step 6: Once all rounds had been completed a round and product was selected at random as the binding round and the person bidding the highest had to pay the second highest price.

Step 7: The final step required participants to complete a questionnaire collecting information about their socio-demographic characteristics.

Finally, it needs to be noted that Inulin bread is only available in small experimental batches and due to logistical difficulties it was not actually used in the food auction. White bread was used as a substitute for the functional product as they share the same taste and texture characteristics. The nutritional information presented with the 'functional' bread was based on white bread but with adjusted fibre content.

[6] The focus group information formed the basis of the auction rounds with the aim to be similar to real life purchase habits of the participants.

4. Survey Data and Results

4.1. Descriptive Statistics

As a result of the recruitment of participants we do not claim that the sample is representative of the UK population due to reliance on students. However, 38% of the sample was male, which is higher than many food related surveys reported in the literature. Overall, most participants were single (52%), students (47%), aged between 18-27 (47%) and were earning £11,000 or less (34%).

Thus, given the makeup of the sample it is difficult and problematic to generalise the findings of this research to the entire population. Further research needs to be conducted to identify if the observations recorded are repeatable in other sample populations, particularly as this cohort preferred whole grains and particularly whole grain granary, which may be a trend specific to the sample. However, it should be noted that research conducted by Depositario et al. (2009) compared student and non-student groups WTP in an auction. They showed that there was no difference in bids received between the groups and that over multiple rounds bidding behaviour converged supporting the use of students within auctions.

4.2. Data Analysis and Results

The main focus of the analysis we present in this paper is how respondents react to the provision of specific and non-specific health claims about the type of bread they eat. To identify this effect we conduct a number of hypothesis tests and estimate a number of regression models with our auction data. For all regression models the dependent variable is either the bid in a specific round or the difference in bids made by an individual between two rounds.

The regression analysis we conduct with our data is similar to that of Rousu et al. (2007) and Marette et al. (2010) in that we examine differences in bidding behaviour between the rounds of the auction so that we can isolate the effect of information provision. Specifically, our

regression analysis presents three sets of results. First, we estimate a model to examine the bids made in the first round of the auction. Second, we run a regression to examine the difference in bids between the first and second rounds so as to see the impact of nutritional information. Finally, we run a regression to explain the difference between the second and third rounds to see how tasting the sandwiches impacts the bids.

In keeping with these earlier studies we employ a censored regression model (i.e. a Tobit specification). However, because we do not employ a reference price as part of the experimental auction procedure we only censor our dependent variable at zero. By employing a censored regression specification we correctly take account of zero bids and differences in our data. Finally, in terms of how we employ the auction data we pool all the bread types so as to increase the statistical power of the analysis. To take account of the different bread types we employ bread specific dummy variables (i.e., fixed effect).

A complete list of all the explanatory variables employed in the analysis is presented in Table 1.

Table 1: Explanatory Variables

Variable	Label	Units	Average
White bread	W	Yes = 1, 0 = No	0.2
Whole grain	WG	Yes = 1, 0 = No	0.2
Half and half	HH	Yes = 1, 0 = No	0.2
Whole grain granary	WGG	Yes = 1, 0 = No	0.2
Functional bread	FF	Yes = 1, 0 = No	0.2
Gender	Gender	Male = 0, Female = 1	0.62
Income	Income	1 – less than £12,000 2 – £12,000 to £21,999 3 – £22,000 to £31,999 4 – £32,000 to £41,999 5 – £42,000 to £51,999 6 – greater than £52,000	2.63
Age	AGE	Years	35
VAS 1 - Mood	VAS 1	Factor analysis score	Min = -3.363 Max = 2.152
VAS 2 – Hunger	VAS 2	Factor analysis score	Min = -3.695 Max = 2.167

VAS 3 – Thirst	VAS 3	Factor analysis score	Min = -2.594 Max = 2.596
VAS 4 – Indulgence	VAS 4	Factor analysis score	Min = - 3.106 Max = 5.806
DEBQ Restrained Eaters	DEBQR	1 never 2 seldom 3 sometimes 4 often 5 very often	2.51 SD = 0.885
DEBQ External Eaters	DEBQEXT	1 never 2 seldom 3 sometimes 4 often 5 very often	3.31 SD = 0.75
DEBQ Emotional Eaters	DEBQEMO	1 never 2 seldom 3 sometimes 4 often 5 very often	2.57 SD = 0.79
Primary Shopper	PRIMSHOP	Not shopper = 0, Shopper = 1	0.72
Knowledge of whole grains	KNOWWG	Not know = 0, Know = 1	0.94
Visual Appeal (Round 1) for all sandwiches	LOOKSCORE	1 – Not at all Appetising 4 – No Opinion 7 – Extremely Appetising	W = 3.80 WG = 4.49 HH = 3.90 WGG = 4.81 FF = 3.79
Nutritional Appeal (Round 2) for all sandwiches	NUTSCORE	1 – Not at all Appealing 4 – No Opinion 7 – Extremely Appealing	W = 3.08 WG = 4.81 HH = 4.69 WGG = 5.01 FF = 3.94
Nutritional Information	NUTINFO	Yes = 1, 0 = No	0.52

The explanatory variables presented in Table 1 are composed of control variables identifying differences in participants in the auction, and explanatory variables capturing differences in the auction treatments (information provision).

We also constructed a set of variables, VAS1, VAS2, VAS3 and VAS4, shown in Table 1, from the data collected during the auction. To construct these variables we took the data collected from the VAS for all the sensory attributes considered. Examples of these attributes

include Drowsy-Alert, Uncertain-Confident and Bored-Interested. Due to the volume of data collected we undertook factor analysis to reduce the number of variables to be included in the regression analysis. A Kaiser-Meyer-Olkin (KMO) test indicated that the VAS scores for mood and hunger and the sensory attributes for each sandwich were free from multicollinearity and were suitable for factor analysis (i.e. KMO >0.5). The 15 variables from the mood and hunger VAS were reduced to a total of four factors each with an eigen value greater than one. Cumulatively the four VAS factors explained 66.4% of the variance in the data collected.

In addition, we also asked all participants to rate each sandwich using 13 sensory attributes in round three of the auction. Each of the sandwiches attributes were included in a separate factor analysis, with an eigen value threshold of greater than one employed. We reduced the set of sandwich attributes to five factors for each bread type. However, we have not included these variables in our analysis, as they provided no statistically significant results.

Before we present our hypothesis test and regression results it is briefly worth examining the raw bid data and the associated ratings for each type of sandwich for rounds one and two. As previously noted, during the auction participants were asked to provide a bid and corresponding appeal rating (round one and two). This information is summarised in Table 2.

Table 2: Summary of Average Bids Received and the Average Rating (By Round)

	White Bread Sandwich		Whole grain Bread Sandwich		Half and Half Bread Sandwich		Whole grain Granary Bread Sandwich		Functional Bread Sandwich	
	Bid	Score	Bid	Score	Bid	Score	Bid	Score	Bid	Score
Round 1[a]	£0.87	3.80	£1.11	4.49	£0.96	3.90	£1.23	4.81	£0.85	3.79
Round 2[b]	£0.84	3.08	£1.17	4.81	£1.13	4.69	£1.24	5.01	£0.92	3.94
Round 3	£0.83		£1.15		£1.00		£1.28		£0.89	

Notes:
a - Mean Likert scale (1-7) indicating the appeal of the sandwich based on the sandwiches appearance
b - Mean Likert scale (1-7) indicating the appeal of the sandwich based on nutritional information

From Table 2 we can observe that participants' WTP was higher for whole grain and whole grain granary bread sandwiches. There also appears to be a reasonably strong correlation between price and the likert scale ratings awarded to each type of sandwich. We can observe that the mean bids in round one were higher for breads containing more fibre (apart from the new bread). In round two this trend continues, although after the nutritional information was received, bids increased for all breads apart from white bread. In round three once participants had been able to taste the bread, only the whole grain granary bread bid increased. The score related to the appeal of the bread, which appears to increase between round one and two for all bread types apart from white. This is a result of participants being presented with the nutritional information, regardless of whether this was specific or non-specific.

To initially test if there were associations between the differences in the bids received between the rounds[7] (i.e. the delta price) and the bread type, non-parametric Mann-Whitney U tests were employed to test the following hypothesis:

> H_0 – There is **not an** association between nutritional information and delta price (change in price) between the rounds
> H_1 – There is **an** association between nutritional information and delta price (change in price) between the rounds

The main results are reported in Table 3.

Table 3: Mann-Whitney U Results for the Two Nutritional Information States and Delta Price

Delta Price	Bread Type	Univariate Analysis		Mean Delta Price Round 2 to 3	
				Non-Specific	Specific
Round two and three	Half white and Half whole grain	1	**0.096**	-.0906	-.1828
	Functional (Inulin) bread	1	**0.074**	0.530	-.1308

The Mann-Whitney U results between the different nutritional information groups only

[7] Rounds one and two, rounds two and three and rounds one and three

showed an association between rounds two and three. The statistically significant results are found for the half white and half whole grain bread and the functional (Inulin) bread sandwiches. For the half white and half whole grain bread sandwich, the delta price showed that participants who received the specific nutritional information decreased their bids more between round two and three (after participants received the nutritional information and were then required to taste the sandwich), than participants who received non-specific nutritional information. Between rounds two and three participants who received non-specific nutritional information increased their bids for the functional bread, participants who received the specific nutritional information decreased their bids between round two and three.

A weakness of the non-parametric test results is that they only compare one variable to another. However, in this case there are multiple variables that could impact an individual's bid. To examine all of the data collected, we know present multiple regression results. In our regressions the dependent variable is either the bid made or the difference in the bids made between rounds. The regression results presented in Table 4 are for round one (R1) and then for differences between rounds two and one (R2-R1) and rounds three and two (R3-R2).

Table 4: Regression Results

	R1		R2-R1		R3-R2	
Variable	Coefficient	P Value	Coefficient	P Value	Coefficient	P Value
W	0.593	**0.000**	0.220	**0.056**	0.187	0.269
WG	0.758	**0.000**	0.328	**0.005**	0.139	0.420
HH	0.687	**0.000**	0.486	**0.000**	0.131	0.443
WGG	0.857	**0.000**	0.260	**0.000**	0.338	**0.045**
FF	0.572	**0.000**	0.350	**0.022**	0.118	0.482
GENDER	0.098	0.178	-0.087	0.123	0.048	0.549
INCOME	-0.003	0.884	0.021	0.117	-0.048	**0.016**
AGE	-0.001	**0.051**	0.000	0.927	0.000	0.636
AGE2	0.000	0.950	0.000	0.238	-0.001	**0.004**
PRIMSHOP	0.129	**0.078**	-0.180	**0.001**	-0.215	**0.006**
KNOWWG	0.119	0.373	-0.432	**0.000**	-0.057	0.682
VAS1	0.025	0.410	-0.075	**0.002**	0.023	0.509
VAS2	-0.033	0.219	-0.007	0.736	-0.036	0.231
VAS3	-0.003	0.914	0.101	**0.000**	0.000	0.999
VAS4	0.011	0.679	-0.019	0.357	0.014	0.647
DEBQR	-0.094	**0.005**	0.017	0.508	0.005	0.879
DEBQEXT	-0.038	0.394	0.070	**0.038**	-0.082	**0.094**
DEBQEMO	0.131	**0.003**	0.053	0.110	0.076	0.110
LOOKSCORE	0.143	**0.000**	-0.070	**0.000**		
NUTSCORE			0.074	**0.026**	-0.006	0.888
NUTINFO			0.053	0.267	0.051	0.460
NUTSCORE*WG			0.036	0.470	0.009	0.895
NUTSCORE*HH			0.087	**0.046**	-0.129	**0.039**
NUTSCORE*WGG			0.032	0.493	-0.033	0.565
NUTSCORE*FF			0.029	0.542	0.001	0.984
Observations	690		690		690	

Beginning with the results for round one (R1), we can see that the dummy variables for all bread types are statistically significant and positive. Interestingly, the functional bread has the smallest coefficient indicating the lowest bid, which is keeping with the raw data reported in Table 2. In terms of the socio-economic variables older individuals bid slightly less than younger participants. We also see that if a participant is the primary food shopper, that this yields a higher bid. If we consider the various constructs none of the VAS constructs are statistically significant, but both the DEBQR, which is negative and DEBQEMO, which is

positive are statistically significant. Finally, and as we would expect, we observe that the score rating given by respondents to how a particular sandwich appears (LOOKSCORE) is also positively related to the bid.

Next we consider the difference in bids between rounds two and one (R2-R1). One of the first things to note is that the dummy variables for the bread type are all positive and all statistically significant. This indicates that the provision of information has had a positive impact on the bids. Next considering the various socio-economic variables we find that being the primary shopper has a negative impact, as does prior knowledge of whole grains. Both of these results indicate that the provision of the information in round two did not have the same impact on individuals who had prior knowledge of whole grains.

An important difference in the results for this regression is that some of the VAS coefficients are now statistically significant. Specifically, VAS 1 is negative and significant identifying that mood had an association with bids. VAS 3 is positive and significant showing that their reported fluid needs has an impact on their bid. In relation our other construct we now find that DEBQEMO is positive and statistically significant.

Next we can compare how survey participants difference in bids relates to the ratings they provided for how the bread looked (LOOKSCORE) compared to the nutritional information provided (NUTSCORE). We can see that the way the bread was scored in round one in terms of the way it looked is negatively related to the bid difference. We also observe that the score for the bread type taking account of the information provided is positive and significant. To understand this result in more detail we generated an interaction dummy to capture the score given to each bread type in terms of the information. These interaction results are all positive but only one is statistically significant for the half white/half whole grain bread.

The final result we comment on for the difference in the bids is for the treatment effect. That is, how has the difference in nutritional information provision affected the bids made? We can see in Table 4 that NUTINFO is positive, but it is not statistically significant. This result indicates that differences in nutritional information provision (specific or non-specific) have not had an effect on the difference in the bids made.

Finally, we turn to difference between round three and two (R3-R2). The results confirm that the main statistical differences in the bids occurred between rounds one and two. Also, these results confirm that tasting the sandwiches did not have a positively strong impact on the bids apart from the whole grain granary sandwich.

5. Discussion and Conclusions

In this paper we have conducted an experimental food auction to examine consumer responses to the provision of nutritional information for a variety of bread products including a novel functional white bread. Overall, this study has found that the provision of a specific or non-specific health claim along with nutritional information influenced participants WTP.

Specifically, our results show that in round one, respondents' bids did relate to the appearance attributes of the sandwiches. Then in round two the provision of nutritional information with a specific or non-specific health claim, a form of credence attribute, did have a strong impact on the bids. A credence attribute is an attribute, which even after consumption a consumer is unable to verify without the help of some external information. What is interesting is that the increase in bidding was not sensitive to the type of health claim provided (the credence attribute). The finding that providing a health claim increases WTP is supported by Marette et al. (2010).

When asked, participants stated that they preferred the simple non-specific health claim for the new functional bread rather than the specific health claim. It has previously been identified that consumers prefer succinct non-complex wordings for health claims with consumers not distinguishing between different types of claims on food (Williams 2005). We also found that most participants had not heard of the functional ingredient with some confusing it with Insulin, which then put them off the product. Clearly, further work will be needed to improve the taste and consumers understanding of the potential benefits of Inulin in the diet if products such as enhanced white bread are to be credible. This may not be an easy task.

Once the sandwiches were tasted in round three, there was only a significant increase in bids for the whole grain granary sandwich. A potential mechanism for the failure of most bids to increase could be due to consumer expectations not being met whilst tasting the product after receiving the nutritional information (Mela 2007). Thus, the most important attributes giving rise to a change in bids was nutritional information, albeit generic in affect. This result is important as it indicates that although the bids in round two have increased, the quality and scientific precision of the information does not make a significant difference. This suggests that consumers react positively to nutritional information but they do not appear to place a premium on more specific information.

Interestingly, consumers who had prior knowledge about the health benefits associated with a diet rich in whole grains responded differently during round two of the auction. The increase in WTP of these "knowledgeable" consumers was significantly less at round two. This suggests that their initial round one bid incorporated their pre-existing knowledge of whole grains. The provision of additional nutritional information may only serve to confirm the preferences of these "knowledgeable" consumers. Within the auction the prior knowledge of consumers was self determined and future work may seek to identify the sources of this knowledge and if it corresponds to publically available information.

Turning to the differences in responses between bread types, differences were observed in the bids received between the whole grain granary bread in comparison to the functional (Inulin) sandwich. This suggests participants prefer whole grain bread as a food to provide health benefits and subsequently a source of a functional ingredient. Thus, despite the ability of bakers to make a healthier white bread, consumers did not appear willing to pay more for this product compared to bread that already contains whole grain. Prior research has shown that consumers are well aware of the health benefits associated with whole grain foods and as such may not view the consumption of an alternative functional product as a necessary means of avoiding disease (Arvola et al. 2007; Vassallo et al. 2009). However, participant mean bids were slightly higher for the functional white bread than the traditional white bread, but less than the whole grain bread varieties. Within the auction it is clear that there was a stronger preference for the whole grain bread varieties than the new bread. But, there was some evidence of support for the functional white bread compared to the traditional white

bread. This may indicate that there is better recognition for whole grain products and their associated benefits compared to more novel forms of functional ingredients. It is also important to understand that in recent years the range of products in the UK bread market has exploded, with each manufacturer offering several varieties including whole grain and diet products. New product development has focused on the benefits of whole grains including oats, which includes beta-glucan another possible ingredient and how it can help maintain normal cholesterol levels (Hovis 2010).

Overall, these results indicate that more research is needed to identify how consumers perceive the functional bread to commercially available products. This may help industry to identify if some other attributes in addition to the health benefits associated with a functional ingredient are needed to better market the product. There has already been a lot of research into the acceptance of functional foods by consumers that can be called on to effectively market a new bread product. This research has shown that if consumers believe in the benefits of a functional food they are more likely to accept it. Also consumers who have an ill family member can positively increase the acceptance of the food (Verbeke 2006). However, research has also shown that consumer worry about the benefits of the functional product (McConnon et al. 2004).

Turning to the implementation of our experimental auction there are a number of issues that warrant further consideration. Within the existing literature, food auctions have generally attempted to control for mood and hunger, and their impact upon the bids received. As this auction was conducted during the typical lunch period it was felt that mood and hunger were important factors to control. The mood and hunger scores were statistically significant in our auction, especially in round two, suggesting that as the auction progressed it was important to control for participants' current hunger and mood levels. We also acknowledged that there are a number of ways in which our auction could be modified in the future. It was felt that the sandwiches themselves could be improved removing a possible source of bias in the data. During the auction only cheese sandwiches were available for purchase. Whilst this removed a confounding factor it did not allow all participants to express their preference for their preferred sandwich. The experimental results might have been different if each participant was bidding for their preferred sandwich filling. This might have provided more insight into

preferences towards the overall sandwich and would have lent itself towards an endowment method for establishing WTP for a particular bread type. Also, for consistency participants were shown photographs of the sandwiches but this perhaps removed certain visual, tactile and olfactory clues that might have guided participants WTP.

Finally, in research by Roosen et al. (2007) into the effect of health information on liking and choice, used an experiment which endowed women with canned fish (tuna or sardines). In this experiment participants initially tasted the fish before being given nutritional information about the fish, at which point they got to try the fish again. Perceptions of the fish were more positive to the healthier choice (sardines) even though they had stated that their initial taste preference was for the tuna. Roosen et al. suggest that this was because of preferences being altered from taste to a more rational decision of health information. In our auction, all participants received nutritional information ahead of tasting the product. Whilst this procedure was validated by the focus group it does not allow for the capturing of hedonic and impulsive bidding behaviour due to taste alone. Further research might like to vary the order of the auction rounds.

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