

# **Do consumers in the UK trade off taste and environmental attributes**

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## **Abstract**

A large choice experiments was conducted in the UK to assess consumers' preferences and willingness to pay for five strawberries attributes (greenhouse gas emissions (GHG) from production, type of production (organic/not organic), level of sweetness, level of juiciness and price) as well as to analyse whether consumers perceive these attributes as complements, substitutes (overlapping) or independent. The results showed that consumers in the UK are willing to pay a price premium for sustainable strawberries (organic strawberries or strawberries produced with low GHG emissions). They were also found to positively value front-of-package information on the sweetness and juiciness of strawberries. Overall, British consumers prefer the strawberries to be sweet and slightly juicy. Consumers' price premium for organic strawberries was found to be largely lower than the current retail price premium, significantly lower than their price premium for strawberries produced with low GHG emissions, and not significantly different from their price premium for sweet and slightly juicy strawberries. The results also showed that front-of-package information on the sweetness and juiciness of strawberries is an effective way to increase consumers demand for sustainable strawberries. It was also found that the demand for organic strawberries can be increased if they are produced with low GHG emissions and labeled as so.

# **Do consumers in the UK trade off taste and environmental attributes**

## **1. Introduction**

Using front-of-package labels to provide consumers with information on food attributes such as sustainability, health, origin and taste has been found to be positively valued by consumers. A massive research effort has been devoted to investigate consumers' preferences and willingness to pay for food products with these attributes as key to production and marketing success of food products. Despite the growing interest for these attributes, a major question that remains minimally addressed is whether consumers treat these food attributes as related and, if so, whether they consider them as substitutes or complements.

Assessing the trade-offs that consumers may make when they are presented with conflicting attributes is important because firms engaged in product differentiation are not only interested in identifying the attributes that are attractive to consumers, but also in carefully evaluating whether there is any potential conflict between the chosen attributes. This study attempts to fill this gap by consumers preferences and willingness to pay for different levels of four strawberries attributes (i.e. greenhouse gas emissions (low/moderate/high), type of production (organic/conventional), sweetness (intensely sweet/sweet/slightly sweet) and juiciness (juicy/slightly juicy/firm)), and (2) find out whether consumers perceive these attributes as complements, substitutes (overlapping) or independent.

## 2. Methods

The data were collected through a national, web-based survey conducted in the UK. The initial design of the choice experiment and the questionnaire were developed and revised based on input from a small sample of 100 respondents in each country. The final version of the survey was administered by a market research company using its panel of strawberries consumers. A total of 1,232 shoppers of food products in the UK completed the survey. The sample was required to be representative of the population in terms of gender, age, employment status and geographical area of the country. The quality of the data was checked after finishing the collection and all the ineligible observations (e.g., respondent who spent less than 10 seconds to complete each choice set) were discarded and replaced by eligible responses from new respondents.

In each country, respondents were presented with a series of choice sets each including three hypothetical strawberries alternatives described in terms of five attributes: (1) level of GHG emissions (i.e., low (120g of CO<sub>2</sub>e per 1kg of strawberries), moderate (420g of CO<sub>2</sub>e per 1kg of strawberries), high (680g of CO<sub>2</sub>e per 1kg of strawberries)), (2) type of production (i.e., organic/not organic), (3) sweetness (i.e. intensely sweet, sweet, slightly sweet), (4) juiciness (i.e. juicy, slightly juicy, firm), and (5) price (i.e., £1.50, £2.70, £3.80, £5.00). The choice of the non-monetary attributes was based on a literature review of similar studies and the results obtained from a pilot studies (interviewing 100 respondents). The choice of the price levels was based on the real market prices of strawberries in the UK.

Given all the attributes' levels, a full factorial design of 216 (3\*2\*3\*3\*4) profiles was generated. Since presenting participants with 216 profiles would be time consuming and cognitively challenging, we used the Ngene Software to generate a Bayesian D-

optimal design with a minimum number of choice sets that allow a robust estimation of all main- and two-way interaction effects. The Bayesian D-optimal design was obtained after 25,000 iterations with 500 Halton draws per iteration, achieving a Db-error of 0.18. The obtained design consisted of 36 choice sets of four alternatives each (i.e., three strawberries alternatives plus the opt-out alternative). To make the choice task cognitively easier for respondents, the design was blocked in four blocks (i.e., 9 choice sets per respondent). In the choice task, respondents were successively shown 9 different choice sets and were repeatedly asked to choose the alternative they prefer most. In addition to collecting information on consumers' choices, the online survey was also used to collect information on respondents' socio-demographics, purchasing habits as well as their attitudes towards issues related with the attributes considered in the study.

As for the analysis of the collected data, we estimated a random parameter logit (RPL) in WTP space. Thus, the results displayed in Table 1 represent respondents' estimated WTP for the attributes levels as well as all the two-way interactions of the levels of the different attributes. Preference heterogeneity is revealed through the estimated standard deviations, which indicate how the valuation of the entire sample spreads around the estimated means. The results of the estimated standard deviations are displayed in Table 1. The RPL model extends the standard conditional logit model by allowing one or more of the parameters in the model to be randomly distributed and the unobserved factors to be correlated over time (McFadden and Train 2000). All the parameters (i.e. all the main- and the two-way interactions effects) were assumed to be normally distributed.

Since the attributes considered in this study have different units of measurement, comparing (e.g., ranking the attributes in terms of preferences) respondents' preferences for these attribute is inappropriate. The appropriate way to compare respondents' preferences for the different non-monetary attributes is to calculate the marginal rate of substitution (MRS). When the price is included as the denominator in the ratio calculation, the MRS is interpreted as marginal WTP. The estimated WTP displayed in Table 1 represents the price premium that average respondent is willing to pay for the corresponding level of attribute (e.g. organic) relative to his/her willingness to pay for the reference level (baseline) of the same attribute (e.g. not organic).

### **3. Results**

All the estimations were conducted using the software R with 500 Halton draws to simulate the random parameters. The estimated RPL model show significant improvement in fit when tested against the conditional logit models (see Table 1).

The results show that consumers in the UK prefer strawberries produced with low GHG emissions over strawberries produced with moderate or high GHG emissions. They were also found to prefer organic strawberries over non-organic strawberries. Furthermore, the results show that consumers in the UK prefer sweet strawberries over intensely sweet or slightly sweet strawberries and juicy strawberries over slightly juicy and firm strawberries. These results concur with findings from previous studies (Onozaka and McFadden (2011); Kallas and Gil, 2012; Akaichi et al., 2017; Hung et al, 2017) that showed that consumers are willing to pay a price premium for environmentally-friendly food products.

**Table 1:** Estimated means and standard deviations of respondents' willingness to pay

Estimated parameters	Mean	Standard deviation
<b>Random Parameters</b>		
Low GHG	0.42 ***	0.279 ***
Moderate GHG	-0.11	0.456 ***
Organic	0.29 ***	-0.835 ***
Sweet	0.22 ***	0.239 ***
Slightly sweet	-0.15 ***	0.637 ***
Juicy	0.19 ***	0.396 ***
Slightly juicy	0.28 ***	-0.231 ***
<b>Non-random parameters</b>		
Low GHG * Organic	0.18 ***	-0.086
Low GHG * Sweet	0.07	-0.039
Low GHG * Slightly sweet	0.08 **	-0.015
Low GHG * Juicy	-0.16 **	0.018
Low GHG * Slightly juicy	-0.12	-0.006
Moderate GHG * Organic	-0.13	-0.043
Moderate GHG * Sweet	-0.07	0.002
Moderate GHG * Slightly sweet	-0.16 ***	0.137 **
Moderate GHG * Juicy	0.31 ***	-0.213 ***
Moderate GHG * Slightly juicy	0.36 ***	-0.049
Organic * Sweet	0.09	-0.064
Organic * Slightly sweet	0.00	-0.067
Organic * Juicy	0.14 ***	0.093 **
Organic * Slightly juicy	-0.08	-0.043
Sweet * Juicy	0.01	-0.069
Sweet * Slightly juicy	-0.02	0.014
Slightly sweet * Juicy	0.06	-0.198 ***
Slightly sweet * Slightly juicy	0.05	-0.244 ***
No choice option	-4.72 ***	
Initial Likelihood		-11527.94
Final Likelihood		-9822.51
Adjusted Rho-squared		0.36

\*\*\* (\*\*) Statistically significant at 1% (5%) level

Note: GHG stand for greenhouse gas

The results from this study and previous studies on similar topics suggest that the superiority of a food product in terms of environmental sustainability can be used to differentiate them and, hence, increase their consumption.. Organic strawberries are available in several of the major retail stores in the UK. However, to the best of the authors' knowledge, fresh strawberries with carbon footprint claims are not yet available for consumers in the UK, despite the extensive literature evidencing the existence of a potential market for them. Consumers' confusion in interpreting and understanding carbon labels (Gadema and Oglethorpe, 2011) and attitude-behavior gap (Hartikainen et al., 2011) were found to be major barriers for the purchase of food products produced with low GHG emissions. Therefore, research work is still needed to minimize the effect of these barriers.

Interestingly, the results show that consumers in the UK are willing to pay a higher price premium (£0.42) for strawberries with low GHG emissions than organic strawberries (£0.29). We found very similar results in a related study that we conducted to assess consumers' preferences and WTP for beef mince attributes. We found that British consumers' price premiums for beef mince produced with lower GHG emissions and organic beef mince are £0.39 and £0.28, respectively. Therefore, more research work is needed to find out why British consumers value more the attribute low GHG emissions than organic. Is it, for example, because consumers in the UK are aware of the fact that organic food are generally produced with higher GHG emissions than non-organic foods? This seems to be a plausible explanation because 62% of respondents in this study did not agree with the statement that "the production of organic strawberries emit less GHG emissions than the production of non-organic strawberries".

There is an extensive literature on the importance of taste in the choice of food products. Most of the studies found that taste is one of the main drivers of food choice decision. Front-of-package information on the taste of food products (e.g. “Thin and crispy”, “Sweet and juicy”) is becoming a common practice used by producers and retailers to help consumers choosing the fruit with their preferred taste. One of the objective of this study was to find out whether consumers in the UK positively value the front-of-package information on taste (i.e. the level of sweetness and juiciness of strawberries). The results displayed in Table 2 show that consumers in the UK indeed positively value this type of information. In fact, they were found to be willing to pay £0.22 and £0.37 more for sweet strawberries than intensely sweet and slightly sweet strawberries, respectively. As you can see their price premium for sweet strawberries is higher than their price premium for organic strawberries. Consumers price premium for sweet strawberries (£0.37) was found to be not significantly different from their price premium for strawberries with low GHG emissions (£0.42).

The juiciness of the strawberries was also found to be an important attribute of strawberries for British consumers. The results show that they are willing to pay £0.28 and £0.19 more for juicy and slightly juicy strawberries, respectively, than for firm strawberries. We also found that their price premium for slightly juicy strawberries is not significantly different from their price premium for organic strawberries. These results imply that consumers may trade off taste and environmental attributes in real market, especially that the real market premium for organic strawberries (around £1.50) is much higher than average consumers price premium (£0.29). Furthermore, it is noteworthy that consumers in the UK were



found to prefer the strawberries to be sweet and slightly juicy. However, it is noteworthy that in retail stores strawberries are habitually labeled as sweet and juicy.

The results displayed in Table 2 show that the estimated standard deviations of the main effects are all statistically significant. This means that respondents' preferences for the attribute levels are heterogeneous. Since we assumed that the distributions of the parameters corresponding to the non-monetary attributes are all normal, the proportion of the sample having positive or negative valuation on each attribute can also be inferred (Train 2003). For example, we found that 64% of respondents in the UK) preferred organic strawberries over non-organic strawberries and vice versa for the rest of respondents (36%).

Most of the studies that assessed consumers' preferences for food attributes using a choice experiment assumed that all the two-way interactions between attributes are insignificant. Thus, consumers are assumed to perceive the attributes as independent. The advantages of this approach are: big reduction in the number of choice sets that respondents has to evaluate, considerably lower sample size, and massive improvement in the estimation of the choice model in terms of complexity and estimation time. Nonetheless, this assumption can lead to significant bias of the estimated preferences and WTP, if consumers perceive the attributes considered in a choice experiment as complements (i.e. positive and statistically significant estimated interactions) or substitutes (i.e. negative and statistically significant estimated interactions). The resulting bias does not affect only the estimated WTP but also the results from subsequent analysis such as cost benefit analysis, where the estimated WTP is generally used as a proxy of the component "benefit". As aforementioned, in this study, we generated the choice experiment design in a way

that all the two-way interactions can be estimated and how consumers perceive the interactions between the attributes can be determined. The results are also displayed in Table 1.

The results show that out of 18 estimated interactions 8 are statistically significant. This proves that it was a right decision in this study not assuming the independence of the non-monetary attributes as it is assumed in most of studies that have used choice experiment. The significant and positive interaction that was found for the co-presence of low GHG emissions and organic claims implies that the use of the two types of labels generated added positive effect (£0.18) to the combined main effects (£0.42 + £0.29) of the two attributes (complementarity effect). We saw earlier that the majority of consumers in the UK think that organic strawberries emit more GHG emissions than non-organic strawberries. Therefore, it seems that the co-presence of both claims (i.e. organic and low GHG emissions) on the same product can trigger an additional price premium that consumers are willing to pay for this bundle of attributes.

Regarding the interactions between the environmental and taste attributes, the results show that consumers generally perceive these attributes as independent with some exception. For instance, the results show that consumers in the UK perceive the attributes organic and juicy as complement. This implies that their total price premium for strawberries labelled as organic and juicy is £0.62 (i.e. £0.29 + £0.19 + £0.14). The significant and negative interaction that was found for the co-presence of the labels “low GHG emissions” and “juicy” suggest that consumers might perceive the values of these two labels to be overlapping when these attributes are presented simultaneously. In other words, consumers are willing to discount their total price

premium by £0.16 if the strawberries are labelled as juicy and produced with low GHG emissions. The results also show that consumers perceive the attributes levels forming the bundles “moderate GHG emissions & juicy” and “moderate GHG emissions & slightly juicy” as complements. Nonetheless, they were found to perceive the attribute levels moderate GHG emissions and slightly sweet as complements. As you can see, the values of the estimated interactions are statistically and economically significant. This shows that failing to estimate the interaction effects can significantly bias the results.

#### **4. Conclusion**

Consumers in the UK are willing to pay a price premium for sustainable strawberries. They were also found to positively value front-of-package information on the sweetness and juiciness of strawberries. Overall, British consumers prefer the strawberries to be sweet and slightly juicy. This suggests that the demand for environmentally-friendly strawberries can be increased using environmental claims. Consumers seem to find carbon footprint claims difficult to understand and interpret. Therefore, more research work is still needed to determine the best claim design that minimize this problem and, hence, increase the effectiveness of the label to boost the demand for low-carbon footprint food products.

The results also showed that front-of-package information on the juiciness and sweetness of strawberries is an effective way to provide consumers with information on strawberries taste and increase the demand for strawberries by consumers who consider the taste as the main driver of their purchasing decision of strawberries. Consumers in the UK consider the attributes low GHG emissions and organic to be

complements. Therefore, their willingness to buy organic strawberries can be increased if they are produced with low GHG emissions and labeled as so.

Consumers in the UK were found to be willing to pay a price premium for organic strawberries that are labeled as juicy. Therefore, the demand for organic juicy strawberries can be improved if the strawberries are clearly labeled as having a juicy taste. Finally, the results showed that assuming that consumers perceive food attributes as independent (as it is assumed in most of studies on similar topics) is misleading and is likely to result in biased results. Despite that designing choice experiments that allow for the estimation of all the two-way interactions between attributes is time consuming and economically challenging, the improvement in the results validity and prediction accuracy is worth the time and effort spent to cope with that additional hurdle.

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