Consumers' preferences and perceptions of genetic diversity and health benefits of potatoes

RESAS WP2.3.2. Protecting genetic diversity

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This research assessed consumers' preferences and perception of genetic diversity and health benefits of potatoes. An online survey on consumers' preferences and perceptions of potatoes: diversity, health benefits and disbenefits was conducted. A representative sample of 660 Scottish consumers answered a choice experiment as well as attitudinal and perception questions. Three different 'treatments' (sets of descriptive information) on the health benefits of potatoes were conveyed to consumers in order to test differences in response (*i.e.* examine if and how information impacts their preferences). The survey was analysed using descriptive statistics and econometric techniques. The main results were:

- Most respondents (67%) were satisfied with the diversity of potato varieties available in their usual retail outlet and 57% thought that this diversity was high.
- Most of the respondents believed potatoes provided general health benefits yet a significant proportion of them remained neutral or disagreed when discussing specific contributions to human health:
    - 87% of the respondents agreed that potatoes can be part of a healthy diet
    - 50% agreed that they were rich in vitamin C while 50% remained neutral or disagreed
    - 60% of the participants did not think that potatoes contributed to weight gain while 40% remained neutral or disagreed
    - 58% of the respondents did not think carbohydrates were detrimental to human health while 42% of them remained neutral or disagreed
- Respondents appeared to have concerns about fairness in the retail chain and thought that farmers should be better remunerated (69% of the respondents) but somewhat fewer were ready to pay a higher price for farmers to earn more (45% of the respondents)
- 21% of the participants thought purple fleshed potatoes were healthier while over half (54%) of them remained neutral. 39% of the participants agreed they were likely to buy purple potatoes in the future should they be given the choice while 34% disagreed and 27% remained neutral.
- The most important aspects respondents expected from their daily food were: affordability (86% of the respondents), pleasurable sensations (73% of the respondents), healthiness (66% of the respondents) and convenience (57% of the respondents).
- Second most important aspects related to environmental friendliness (46% of respondents), fair trade (45%) and local origin (40%)
- Price, colour, origin and size of potato tubers are key factors in consumers' choice of potatoes at the purchasing stage.
- Consumers prioritize between characteristics (attributes) of potatoes and make trade-offs between potato profiles at the purchasing stage. In a regular shopping situation, they prefer:
    - A white fleshed potato over a less common purple fleshed one
    - Scotland grown potatoes over potatoes grown in the rest of the UK or Israel
    - Medium or big potatoes to small ones
    - Lower prices per Kg to higher prices per Kg
- Information about the health benefits of potatoes significantly impacted consumers' preferences for potatoes and increased their willingness to pay for purple fleshed potatoes by 0.72 £/Kg and 1.39 £/Kg for a simple and complex information message respectively.
- Respondents with a high need for cognition tended to value purple fleshed potatoes more than respondents with a low need for cognition (defined as the tendency for an individual to engage in and enjoy thinking).

This survey follows up from previous research conducted under RESAS WP2.3.2 by the research team and aimed at enhancing the conservation of potato genetic resources in Scotland (Barlagne 2019a, 2019b; Barlagne et al. 2019; Kyle, Duckett, and Barlagne 2018a, 2018b; Duckett, Barlagne, and Kyle 2017).

1.0 Introduction

Genetic diversity within commercial varieties of potatoes is relatively narrow at the global level (Jansky et al. 2013). The same is true of the genetic diversity in the Scottish potato sector with the commercial varieties having been developed from a restricted number of clones (Barlagne 2019b). Yet the potential of current collections such as the Commonwealth Potato Collection is yet to be unlocked (Barlagne 2019b; Kyle, Duckett, and Barlagne 2018b). One way to increase agrobiodiversity in supply chains is through market interventions and changing consumers' behaviour (Bioversity International, 2017). At the same time, the potato has traditionally suffered from a bad reputation as a starchy product and its health benefits are generally overlooked by consumers (Kyle, Duckett, and Barlagne 2018a). Nonetheless research has demonstrated the numerous benefits of potatoes for health consumed as part of a healthy diet and some varieties have a particularly distinctive nutritional profiles directly connected to a specific genotype (for example, red-skinned and purple potatoes have two to three times more antioxidant potential than white potatoes) (Kaspar et al. 2010).

This research note summarises the findings of empirical research into consumers' perceptions of potatoes and expectations towards food as well as the responsiveness to potatoes with an increased nutritional profile.

In particular, this briefing note aims to answer the following research questions:

1) What are consumers' perceptions of potato diversity, health benefits and disbenefits and of the fairness of potato trade?
2) What do consumers expect from their everyday food?
3) What are consumers' preferences for different potato characteristics? How does information impact the hierarchy of those preferences?

2.0 Methods

A literature review was performed in 2019 to confirm hypotheses with regards to consumers' preferences for potatoes as well as the factors affecting those preferences (Jemison, Sexton, and Camire 2008; Samotyja 2019; Naico and Lusk 2010; Kaspar et al. 2010; Fernqvist 2015; Brown 2005; Devaux, Kromann, and Ortiz 2014). Four experts in potato production and marketing working at AHDB, The James Hutton Institute, and RESAS were consulted to validate findings from this literature review and its relevance to the Scottish context. In addition, two focus groups with consumers (10 participants) were conducted in September and October 2019 to further refine those hypotheses, identify the relevant characteristics (attributes) of potatoes that influence purchase decision and test the choice experiment questionnaire (Barlagne et al. 2015; Barlagne et al. 2017).

An online survey was then conducted in April and May 2020. A representative sample (gender and age) of 660 Scottish consumers were recruited by a market research company. Respondents were initially screened on whether they were fully or partially responsible for household shopping and on whether they had purchased fresh potatoes in the last 3 months. The participants gave informed consent to participate. The characteristics of the respondents are described in Table 1. The average household was composed of 2.02 adults, 0.10 children under 5 years old and 0.32 children between 5 and 18 years old. The sample was generally representative of the Scottish population by gender and age. It was nearly evenly distributed between male and female and counted between 15 to 21 % in

each age bracket. Almost all respondents (94%) cook regularly. About 28% of the households had children. Most of the respondents had educational achievement with close to 52% having attended School or College and 48% University of higher. Most of the sample (82%) had an income ranging between £10,000 and £49,999.

Table 1 Respondent characteristics as frequency (n = 660)

VARIABLE	CATEGORIES	FREQUENCY (%)
GENDER[A]	Male	47.58
	Female	52.27
	Other	0.15
AGE[A]	18 - 29	20.76
	30 - 39	15.91
	40 - 49	15.61
	50 - 59	17.88
	60 - 69	13.64
	70 +	16.21
ARE YOU USUALLY COOKING IN YOUR HOUSEHOLD?	Yes	66.82
	No	5.91
	I share the cooking	27.27
PRESENCE OF CHILDREN IN THE HOUSEHOLD	Yes	28.18
	No	71.82
LEVEL OF EDUCATION	No schooling	0.61
	School	28.48
	College	23.03
	University or higher	47.88
GROSS ANNUAL INCOME	Under £ 10,000	9.39
	£10 000 - £19,999	15.30
	£20,000 - £29,999	21.06
	£30,000 - £39,000	16.67
	£40,000 - £49,999	13.48
	£50 000 - £59,999	9.24
	£60 000 - £69,999	6.36
	£70,000 - £79,999	3.94
	£80,000 - £89,000	1.67
	More than £90,000	2.88

The survey was designed to last a maximum of 20 minutes and comprised 4 stages. Figure 1 summarizes the research protocol. First, respondents answered a set of questions to assess their Need for Cognition defined as the 'tendency for an individual to engage in and enjoy thinking' (Cacioppo and Petty 1982). A revised version of Cacioppo and Petty's original questionnaire, known as the Mental Effort Tolerance Questionnaire (METQ) was used in this study (Dornic, Ekehammar, and Laaksonen 1991; Stenlund and Jonsson 2017). The measure of respondents' need for cognition will be used to test the hypothesis that information messages on food health benefits will impact consumers' purchase decision differently depending on their tendency to engage and enjoy more cognitive

challenges. This finding will be valuable for future communication campaigns on healthy diets, to better adjust how to present information depending on the targeted consumers' profile.

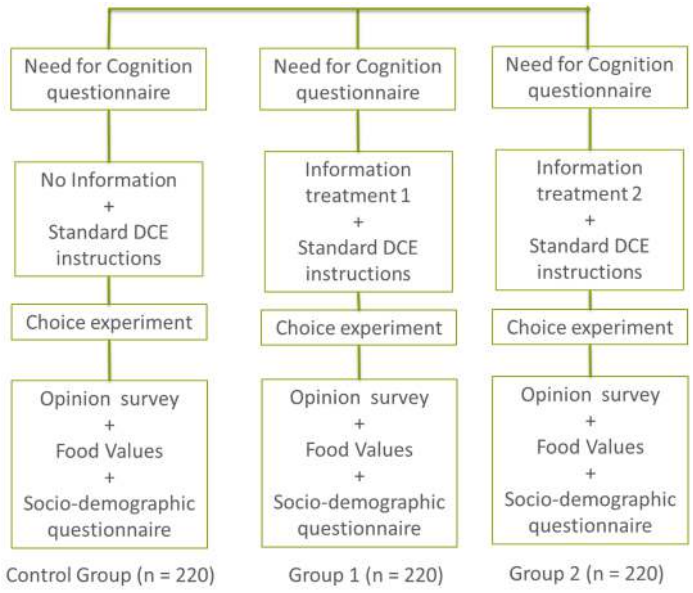


Figure 1 Online survey protocol

Second, respondents were subject to the information treatment. The participants were affected to 3 groups, each with a different information treatment: a control group, a group subject to a simple information treatment and a group subject to a complex information treatment (see Annex 1). Representativity of the sample was observed in each of the 3 treatments therefore the 3 sub-samples share the same characteristics in terms of age and gender. Third, participants were asked to complete the choice experiment.

A choice experiment is a stated preference approached in which respondents are asked to make a series of choices between alternative potato profiles. In the choice experiment used for this analysis, respondents had to make 6 choices between 2 profiles and the option not to buy potatoes. These 3 options are presented on what is called a choice set. Figure 2 illustrates an example of a choice set that was provided to the participants. Each choice set comprised two potato profiles to choose from in addition to an opt-out alternative if the respondents were not satisfied with any of the first two options. The alternative profiles (option A or option B as seen on Figure 2) are described using the relevant characteristics (attributes) of potatoes that were identified during the focus groups as key purchase factors. The potato profiles differed in the colour of the flesh (white or purple), the origin (Scotland, UK-except Scotland, Israel[1]), the size (small, medium, big) and the price in £/Kg (0.80, 1.20, 1.50, 2.10, 2.30, 3.00). The statistical analysis of choices made by respondents will help identify and quantify the weight of each characteristic in consumers' purchase decision.

[1] Israel is the biggest source of potato imports in Scotland

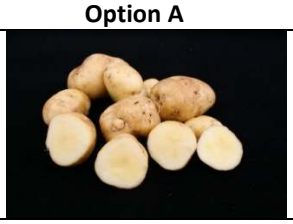
	Option A	Option B	None
Colour of the flesh			If these were the only two options, I would not buy potatoes
Origin	Scotland	Israel	
Size	Big	Medium	
Price (£/kg)	3.00	0.80	
Select your preferred option:	□	□	□

Figure 2 Illustration of a choice set

Three different econometric models were estimated to understand participants' preferences for the different potato characteristics as well as to understand the impact of information on their preferences.

3.0 Results

3.1 What are consumers' perceptions of potato diversity, health benefits and disbenefits and of the fairness of potato trade?

Asked "how much [they] agree with…" a set of 10 statements about potato varietal diversity, health benefits and disbenefits of potatoes as well as fairness of potato trade in Scotland (see Figure 3), most respondents (67%) were satisfied with the diversity of potato varieties available for them to buy on the market and above half of the respondents (57%) thought that this diversity was high. They believed potatoes yield health benefits while contributing to a healthy diet (87%), yet they appeared to be mixed as to the vitamin C content of potatoes since 50% of the respondents agreed that that Vitamin C content of potatoes was high and 50% remained neutral or disagreed. As much as 60% of the participants did not think that potatoes contributed to weight gain but a significant 40% of them either remained neutral or disagreed.

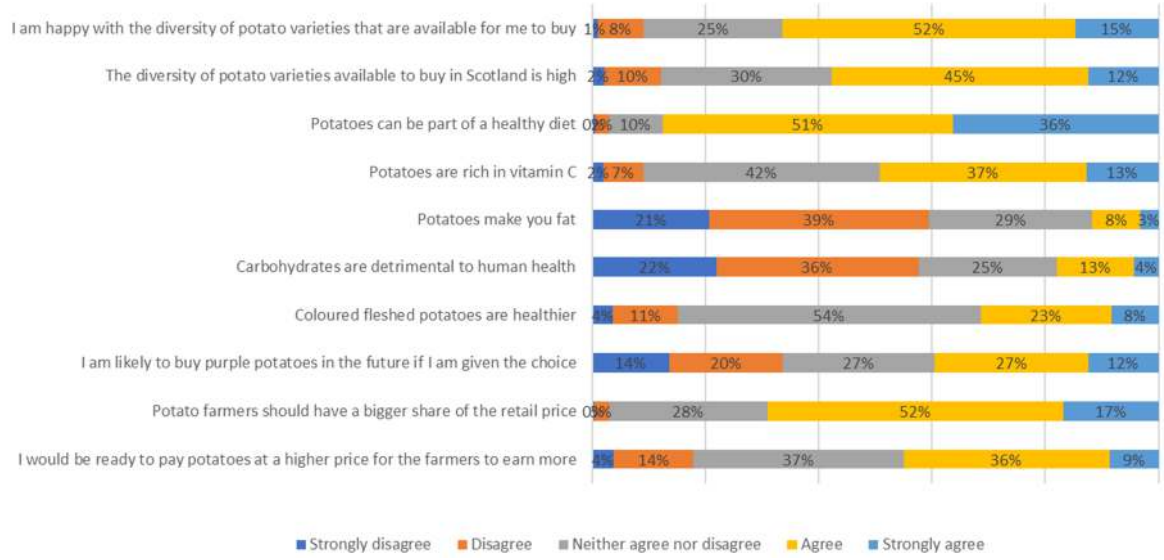


Figure 3 How much do you agree with the following statements? Results expressed in percentages of answers per category

Similarly, 58% of the respondents did not think carbohydrates were detrimental to human health but 42% of them either remained neutral or disagreed. Participants appeared to have fairness concerns and thought that farmers should be better remunerated (69%) but somewhat fewer were ready to pay a higher price for farmers to earn more (45% of the respondents).

With regards to purple fleshed potatoes, about 21% of the participants thought that they were healthier while over half (54%) of them remained neutral. Finally, 39% of the participants agreed they were likely to buy purple potatoes in the future if they are given the choice while 34% disagreed and 27% remained neutral.

3.2 What do consumers expect from their daily food?

Asked about *"how important the food [they] eat on a typical day is…"* with regards to a range of characteristics, respondents attributed a great importance the affordability (86% of the respondents), pleasurable sensations (73% of the respondents), healthiness (66% of the respondents) and convenience (57% of the respondents). Concerns for environmental friendliness and fair trade are almost equally present amongst respondents 46% and 45% of the respondents respectively rating them as important or very important. The local origin, the role of food for weight control and mood monitoring were of a lesser importance to the participants with between 40% to 30% if the respondents finding them important or very important. Finally, 20% of the respondents considered organic production to be important to very important (Figure 4).

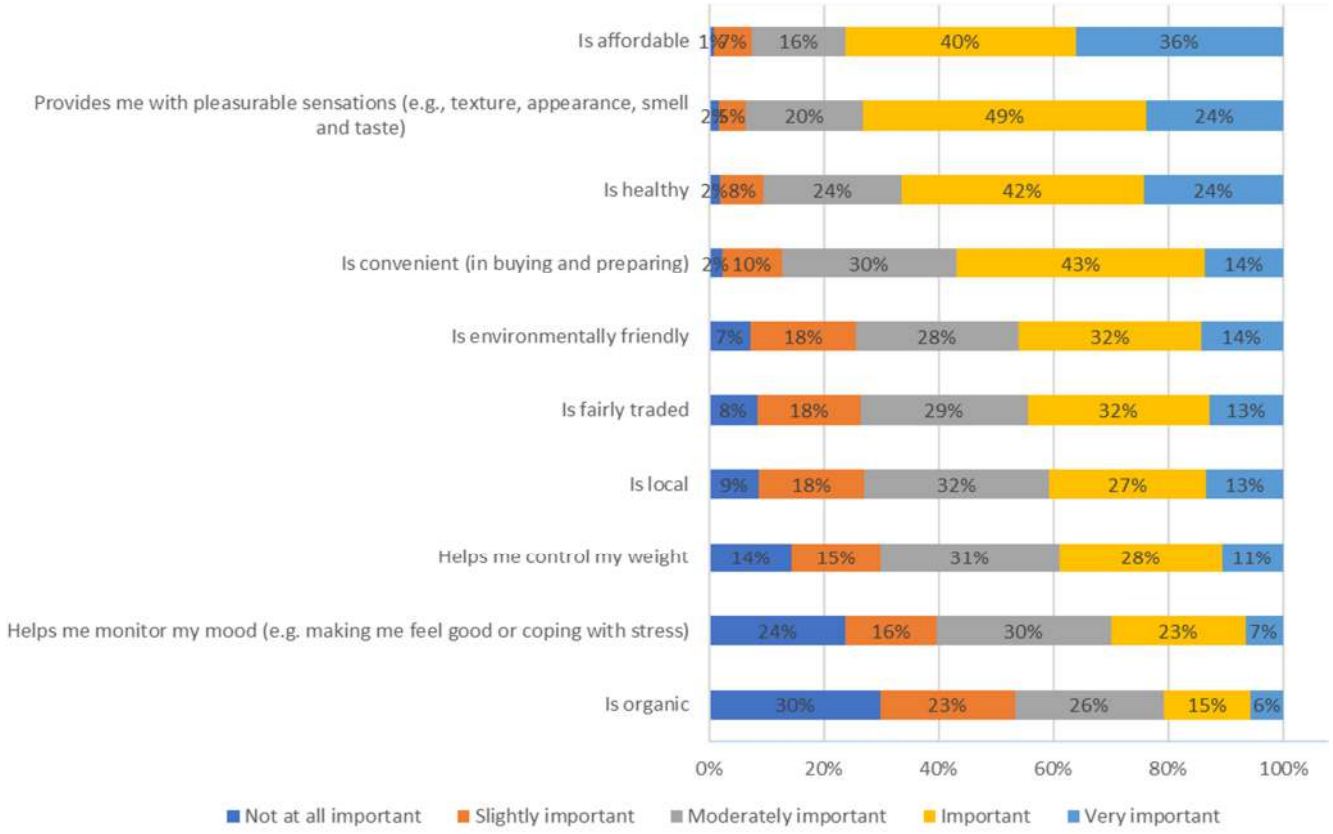


Figure 4 How important is that the food you eat on a typical day is...? Results expressed in percentages of answers per category

3.3 What are consumers preferences for different potato characteristics? How does information impact the hierarchy of those preferences?

3.3.1 Consumers preferences for different potato characteristics

Model 1 (Table 2) represents the baseline situation where consumers are not provided with any information about the potato profiles they have to choose from. All the effects of the model are significant at the 1% confidence interval which means that all **the characteristics included in the model (colour, origin, tuber size and price) played an important role in participants choice for one profile over the other.**

In addition, the model reveals that respondents preferred to choose one of the two options available over the opt-out alternative *i.e.,* they would rather buy one of the two potatoes offered in the choice set than none. **This confirmed respondents' appetite for potatoes.**

Overall, results confirmed that **consumers prioritized between characteristics (attributes) of potatoes and make trade-offs between potato profiles at the purchasing stage.**

Indeed:

- Respondents preferred a white fleshed potato over a purple fleshed one. On average, respondents were willing to pay £2.63 less per kilo for a purple fleshed potato than for a white

fleshed potato *i.e.,* **in a regular shopping situation, consumers are more likely to choose a usual white fleshed potato over a less common purple fleshed one**;

- Respondents preferred a potato grown in Scotland over a potato grown in the rest of the UK or in Israel. They were on average willing to pay £1.02 more per kilo to purchase potatoes grown in Scotland rather than in the rest of the UK, and 1.64 £/Kg more for potatoes grown in Scotland rather than Israel. This **confirms their preference for local production;**
- they also preferred a medium or large sized potato over a small one. Their average WTP was 0.33 £/Kg and 0.47£/Kg for a medium over a small potato and for a large potato over a small one respectively.
- finally, the price parameter has a negative sign as expected highlighting that **the smaller the price, the better from consumers' point of view.**

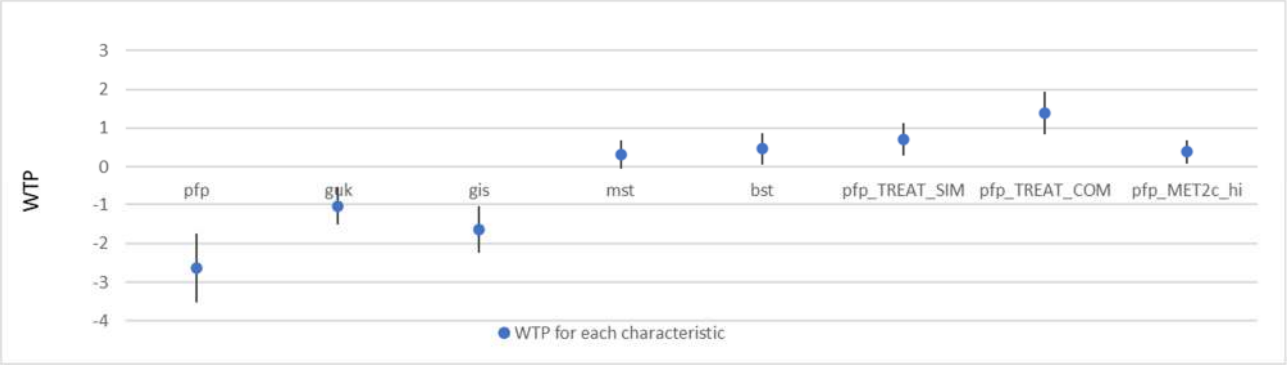


Figure 5 Willingness to pay for potato characteristics and impact of information and need for cognition on willingness to pay

3.3.2 Impact of information on preferences hierarchy

Model 2 (Table 2) represents a situation where information about the health benefits of coloured fleshed potatoes has been randomly provided to some of the participants. Results of this model confirms those of model 1 in relation to the trade-offs made by consumers between potato characteristics. In addition, this model shows the effect of health-related information on consumers' purchase decision.

Analysis of the interaction terms between the information treatments and the potato characteristics highlights that the **introduction of information on the health benefits of purple fleshed potatoes had significant effects** (at the 1% level of significance) **on respondents' preference for purple fleshed potatoes**. Indeed, participants' WTP for purple fleshed potatoes increased by 0.72 £/Kg amongst participants who received the simple information message and by 1.39 £/Kg amongst participants who received the complex information message.

Finally, the interaction between the colour and respondents' need for cognition was also significant (at the 1% level of significance) highlighting that **respondents with a high need for cognition tended to value purple fleshed potatoes more than respondents with a low need for cognition.** Participants with a high need for cognition were on average ready to pay 0.39 £/Kg more for purple fleshed potato that participants with a low need for cognition (see Figure 5).

Table 2 Conditional fixed logit models representing preferences for potato profiles

	Model 1: conditional fixed effects logit without interactions	Model 2 : conditional fixed effects logit with interactions		
	Mean coefficient (Standard error)	Mean coefficient (Standard error)		Mean coefficient (Standard error)
Business as usual	-1.529 *** (0.058)	-2.773*** (0.244)	TREAT_COM*bau	-0.253 (0.305)
pfp	-0.462*** (0.019)	-1.540*** (0.091)	TREAT_COM*pfp	0.815*** (0.104)
guk	-0.208*** (0.022)	-0.602** (0.115)	TREAT_COM*guk	0.018 (0.134)
gis	-0.378*** (0.023)	-0.961*** (0.121)	TREAT_COM*gis	0.043 (0.142)
mst	0.050 ** (0.022)	0.192* (0.115)	TREAT_COM*mst	-0.110 (0.135)
bst	0.070** (0.022)	0.275** (0.114)	TREAT_COM*bst	-0.019 (0.134)
pri	-0.838*** (0.050)	-0.585*** (0.098)	TREAT_COM*pri	-0.174 (0.120)
TREAT_SIM*bau		-0.001 (0.303)	MET2c_hi*bau	-0.848*** (0.249)
TREAT_SIM*pfp		0.419*** (0.106)	MET2c_hi*pfp	0.228** (0.083)
TREAT_SIM*guk		0.173 (0.136)	MET2c_hi*guk	0.042 (0.108)
TREAT_SIM*gis		0.226 (0.144)	MET2c_hi*gis	-0.120 (0.114)
TREAT_SIM*mst		-0.100 (0.137)	MET2c_hi*mst	0.013 (0.110)
TREAT_SIM*bst		-0.111 (0.136)	MET2c_hi*bst	-0.108 (0.108)
TREAT_SIM*pri		-0.065 (0.120)	MET2c_hi* pri	-0.295** (0.097)
Model diagnostics				
Likelihood ratio R	1509.776			1622.363
R^2 (McFadden)	0.174			0.186
R^2 (Cox and Snell)	0.119			0.128
n (observations)	11880			11880
r (respondents)	660			660

***, ** and * indicate 1, 5 ad 10% significance levels respectively

4.0 Conclusion

An online survey was conducted amongst a representative sample of Scottish consumers. We found that amongst colour, origin and size, colour is the characteristic that has the most important weight in consumers' purchase decision. The origin is the second factor, before size. White fleshed potatoes are preferred over purple fleshed potatoes despite the health benefits of purple fleshed potatoes. However, more information on the health benefits of purple fleshed potatoes could help raise the profile of purple fleshed potatoes in consumers' preferences – hence favouring a demand that would support the genetic diversity of potatoes. More detailed information on the health benefits of potatoes has a larger effect than simpler messages. However, affordability remains the key concern in purchase decision. Future research will look into the heterogeneity of consumers' preferences, characterising the main consumer profiles, their preferences and sensitivity to alternative information campaign strategies.

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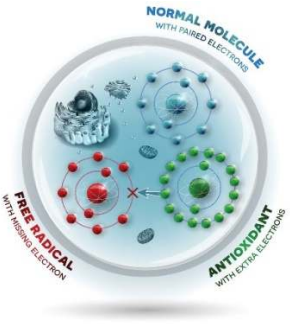
Appendix 1: Information treatments

Group	Treatment
Control group	No information + Cheap talk + DCE instructions
Group 1	Treatment 1: Simple information message + Cheap talk + DCE instructions Potatoes are healthy food and potatoes with coloured flesh are healthier  
Group 2	Treatment 2: Complex information treatment + Cheap talk + DCE instructions Pigmented potatoes contain high concentrations of antioxidants, including phenolic acids, anthocyanins, and carotenoids. These bioactive compounds have been implicated in the inhibition or prevention of cellular oxidative damage and chronic disease susceptibility. Examples of chronic diseases are arthritis, cancer or crohn disease. In a scientific study, healthy adult men consumed white, yellow and purple potatoes once a day for 6 weeks in order to measure the effect of pigmented consumption on their health. The study showed that pigmented potato consumption reduced inflammation and DNA damage. No published study is available for women so far.   *Effect of antioxidants on cellular oxidative damage*