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INVESTIGATING CONSUMER'S PREFERENCES FOR recyclable and bioPLASTIC FOOD PACKAGING IN SPAIN

Petjon Ballco^{a,b*}, Azucena Gracia^{a,b}, Miguel Gómez^c

^a Centro de Investigación y Tecnología Agroalimentaria de Aragón (CITA), Departamento de Economía Agroalimentaria. (Zaragoza, pballco@cita-aragon.es, agracia@cita-aragon.es). ^b Instituto Agroalimentario de Aragón (IA2) (CITA – Universidad de Zaragoza). ^c Cornell University (Ithaca, New York, mig7@cornell.edu).

ABSTRACT

This research aimed to understand consumer preferences for recyclable and bioplastic (biodegradable and compostable) food packaging in Spain and explore their willingness to pay (WTP). Data were gathered through an online survey of 401 nationally representative Spanish consumers. The methodology employed a choice experiment design where consumers stated their preferences for a plastic box of conventional versus organically produced grapes wrapped in 100% recyclable, biodegradable, compostable or conventional non-recyclable fossil-based plastic packaging. The error component random parameter logit model results suggested that consumers perceived a higher utility from choosing biodegradable, compostable and recyclable plastic packaging than conventional non-recyclable fossil-based alternatives. Participant WTP was higher when grapes were packed with biodegradable plastic, followed by compostable and recyclable packaging. Organic grapes were valued more than conventional ones but received the lowest utility and WTP values compared to the other attributes (i.e., recyclable, biodegradable and compostable). These preferences reflect consumer's low level of knowledge regarding food plastic packaging materials and their sustainability. These results offer valuable implications for future research and guide the formulation of targeted marketing strategies, and consumer educational campaigns.

Keywords: Biodegradable, compostable, recyclable, consumer behaviour, willingness to pay.

1. Introduction

Plastic is the most used material for food packaging due to its light weight, flexibility, affordability, and ability to protect food from spoilage and waste (Gerassimidou et al., 2021). However, its production and disposal pose serious environmental challenges. Manufacturing plastic emits harmful pollutants, including large amounts of CO₂, while plastic waste remains a major concern, particularly in marine ecosystems (Baran, 2022). Recycling and reusing plastic are key strategies to mitigate these issues. Yet, plastic recycling rates in the European Union (EU) remain low compared to materials like paper and glass (Gibovic and Bikfalvi, 2021). In Spain, for example, the plastic recycling rate was 51.4% in 2020 which, although appearing substantial, is still low compared to other EU countries (Gibovic and Bikfalvi, 2021). Research has identified several consumer-related barriers to recycling plastic packaging, including limited awareness of its environmental impact (Rhein and Schmid, 2020), reluctance to recycle, insufficient knowledge of recycling practices, and confusion over recycling labels. While recycling is necessary, bioplastics that are commonly derived from renewable sources (e.g., corn starch, sugarcane, and potatoes) offer a parallel solution to mitigate the environmental impact of conventional plastics as they offer environmental benefits, including reduced greenhouse gas emissions and decreased reliance on fossil fuels. Bioplastics are divided into two categories: i) biodegradable plastics, which decompose through microbial action, and ii) compostable plastics that break down under specific conditions into compost (Gerassimidou et al., 2021).

Despite various policy instruments aimed at improving recycling rates (e.g. Directive 94/62/EC, Directive (EU) 2019/904) and regulating the labelling of bioplastics, public awareness of bioplastics remains low. A study in Germany found that 57% of respondents had never heard of bioplastics, and only about 7% could accurately define them (Blesin et al., 2017). Additionally, their relatively high cost hinders market adoption, as consumers often prioritise price over sustainability (De Marchi et al., 2020). However, studies suggest that willingness to pay (WTP) for sustainable packaging increases when consumers receive clear and accessible information (Herrmann et al., 2022). Therefore, it is crucial to explore how labelling influences consumer WTP for 100% recyclable, biodegradable and compostable plastic food packaging.

To address this, we conducted a discrete choice experiment (DCE) via an online survey. As biodegradable labelling is not standardised and available across the EU, we used a hypothetical DCE, which assesses multiple food attributes simultaneously and reflects real-world purchasing behaviour.

2. Methodology

2.1. Data collection

Data collection targeted consumers in Aragón (north-eastern Spain) in February 2023. This sample comprised household food shoppers over 18 years old. Consumers were stratified by gender and age. The final sample consisted of 401 consumers³⁶. Table 1 provides the socio-demographic description with comparisons to Spanish population information.

³⁶ This final sample size for a confidence level of 95.5% (k = 2) when estimating proportions for the more conservative scenario (p = q = 0.5) results in a sampling error of ± 4.3%.

Table 1. Description of the sample ($N = 401$ individuals)

Variable	Indicator	% sample	% Spanish population ^a
Gender	Male	50.1	49.0
	Female	49.9	51.0
Age	18-34 years old	20.7	22.2
	35-44 years old	17.2	17.1
	45-54 years old	19.2	19.6
	≥ 55 years old	42.9	41.1
Education ***	Up to compulsory school (primary, secondary)	10.1	36.3
	High school or equivalent	37.2	23.0
	University	52.1	40.7
Net household income (€/month) ***	≤ € 1500 per month	15.2	28.3
	€ 1501-3000 per month	34.6	43.6
	€ 3001-5000 per month	25.7	21.9
	> € 5000 per month	4.4	6.2
	n.a.	20.1	-

Source: Own elaboration. Notes: When non-reported values are considered, the population has significant differences. *** stands for significant differences between the sample and population from the Chi-2 test at 1% level. ^a Sources for the population are INE (2024) for gender, age, education, and income (year 2023).

The sample is representative of the Spanish population in gender and age. The sample is moderately biased towards more educated respondents (52% hold a university degree compared to 41% of the population) ($p < 0.05$). This is a consistent pattern from samples taken from online panels. Income data reveal that 20% of respondents did not declare their income; for those that did, the largest share of respondents falls within the middle-income range of € 1500 and € 3000 a month (35%), and the lowest earn over € 5000 (4%). Assuming missing observations are equally distributed across income intervals, the difference between the sample and the population is not statistically significant. Likewise, the average monthly income is similar: € 3,086 in the sample versus € 2,902 in the Spanish population (INE, 2024).

2.2. Choice experiment design

The product of reference and the attributes and levels included in the DCE were selected based on market research conducted on different packaged plastic food products (Table 2). Accordingly, the product of reference was grapes, considering their prevalence in conventional, compostable, and recyclable plastic packaging in the local market. Grapes were typically sold in 500-gram trays (48% of registered grape trays had an average quantity of 500 g.). The attributes and levels selected were the production method, packaging material, and price. The packaging material included four levels: conventional fossil-based plastic, 100% recyclable fossil-based plastic, 100% biodegradable bioplastic and compostable bioplastic.

Table 2. Attributes and attribute levels used for the DCE

Attribute	Level
PRICE (€/500 g)	1.75€ - 2.50€ - 3.25€ - 4€
Packaging material	Conventional fossil-based plastic
	100% recyclable fossil-based plastic
	100% biodegradable bioplastic
	Compostable bioplastic
Production method	Organic certification
	Non-organic certification

Source: Own elaboration.

The method of production had two levels: organic and conventional. Finally, the price was chosen to allow the calculation of the WTP. Price levels were determined based on the mean price (2.87€) for 500 g grape trays, with minimum (1.75€) and maximum prices (3.75€). Four levels were chosen: 1.75€, 2.50€, 3.25€ and 4€. The DCE choice tasks were designed according to the Burgess and Street approach (Street and Burgess, 2007) using the NGene software. The design included three attributes with four levels for the packaging material and the price and two levels for the method of production. Two alternatives, labelled as options A and B, were created for each choice task, along with a non-buy option given to participants. A total of twelve choice tasks were obtained, resulting in a D optimality of 83.4. To prevent fatigue, choice tasks were divided into two blocks, with six choice tasks per block and were randomised. Before evaluating the choice tasks participants received basic information on the definitions of recyclable, biodegradable and compostable plastic materials. To prevent hypothetical bias, they also read a “cheap-talk”.

2.3. Model specification and estimation

The data collected were modelled using Lancaster’s consumer utility maximisation theory. According to this theory, consumers derive utility from product attributes rather than the product itself, where the total utility of a product is the sum of the separate utilities of its attributes (Lancaster, 1966). While this utility is known to the consumer, it remains partially observable by the researcher, who only observes specific characteristics, with the remaining utility treated as random, following the random utility theory (McFadden, 1974). Consequently, utility is considered a stochastic variable. Our utility function for respondent *n* choosing alternative *j* from a set of *J* alternatives in each of *t* choice sets is defined as:

$$U_{njt} = \alpha + \beta_{PRICE}PRICE_{njt} + \beta_{ORG}ORGANIC_{njt} + \beta_{REC}RECYCLABLE_{njt} + \beta_{BIO}BIODEGRADABLE_{njt} + \beta_{COM}COMPOSTABLE + \varepsilon_{njt} \quad (1)$$

The α represents the alternative-specific constant coded as a dummy variable, taking the value 1 when selecting the A or B alternatives and 0 the non-buy option. This constant is expected to be positive and significant. The variable “PRICE” represents the four different price levels presented in Table 2, which is expected to impact the utility negatively. The rest of the variables are dummy variables that take the value of 1 for the corresponding types of packaging, “100% recyclable fossil-based plastic”, “100% biodegradable bioplastic”, and “Compostable bioplastic”) and 0 otherwise. Finally, the variable “ORGANIC” is a dummy variable coded as 1 when the product is organic and 0 otherwise (conventional). The ε_{njt} is an unobserved random term distributed following an extreme value type I (Gumbel) distribution, i.i.d. over alternatives and being independent of β and the attributes. We estimate the Random Parameters Logit model with correlated errors (ECRPL-CORR) to account for heterogeneous consumer preferences and correlation across utilities and parameters. We then calculate the WTP, which is the price change associated with a unit increase in each attribute.

3. Results

Table 3 presents the coefficients obtained from the ECRPL-correlated model.

Table 3. Estimation results of the ECRPL-correlated model

	Random parameters		Standard deviations	
	Coeff.	T-ratio	Coeff.	T-ratio
α	7.83***	21.93	-	-
Price	-2.45***	-25.99	-	-
Organic	0.37***	2.98	1.04***	7.42
Recyclable	1.52***	8.00	2.16***	7.97
Biodegradable	1.83***	7.21	1.97***	3.75
Compostable	1.57***	6.75	1.73***	3.35
Sigma	4.08***	12.48	-	-
N	2406			
LL	-1596.93			
χ^2	2092.66			
McFadden-R ²	0.40			
Willingness-to-pay estimates (€/500g)				
Organic	0.15***	3.02	-	-
Recyclable	0.62***	8.71	-	-
Biodegradable	0.75***	7.99	-	-
Compostable	0.64***	7.22	-	-

Source: Own elaboration. Notes: *** indicate statistical significance at 1% levels.

As expected, the alternative specific constant α is positive and statistically significant, indicating that consumers derive higher utility from choosing any alternative (A or B) than the non-buy option. The negative and significant price coefficient aligns with the economic theory. Additionally, the coefficients for all variables are positive and significant, indicating that consumers perceive higher utility from choosing recyclable fossil-based plastic packaging, biodegradable bioplastics, or compostable bioplastics compared to conventional non-recyclable fossil-based plastic packaging. The parameters' standard deviations are also positive and statistically significant indicating heterogeneity in consumer preferences.

To gain a deeper understanding of consumer valuation patterns we calculated the WTP values for the different attributes. The findings reveal that participants exhibit a higher WTP for grapes in a biodegradable plastic package (€0.75), followed by grapes sold in a compostable plastic package (€0.64), and those that are packed in a 100% recyclable plastic package (€0.62), respectively. Organic grapes although valued more than conventional ones, received the lowest valuation (€0.15) compared to the other attributes included in the DCE.

4. Conclusions

The findings indicate consumer preferences for sustainable packaging over conventional non-recyclable alternatives. Biodegradable plastic packaging generates a 26% price premium above the average market price of 500g of grapes, followed by compostable packaging (22%) and 100% recyclable plastic (21%). Although organic grapes are valued more than conventional ones, the additional premium is relatively modest at 5%, suggesting that sustainable packaging has a greater influence on purchasing decisions. From a strategic perspective, marketing efforts should prioritise biodegradable packaging, given its superior WTP. Producers are encouraged to highlight environmental benefits through branding and labelling, which could deliver significant returns. Retailers may also benefit from developing educational content or in-store displays to clarify the distinctions between recyclable, compostable, and biodegradable materials, thereby reinforcing the perceived value and the justification of higher prices. While the organic label continues to add value, the evidence indicates that sustainable packaging provides a strong point of differentiation. Marketing communications should adapt to reflect this evolving consumer priority. Finally, identifying the underlying drivers behind the heterogeneity in preferences (e.g., age, income, educational level) to tailor marketing messages and pricing strategies more effectively will be our future focus in this study.

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