



# Approaches for reducing wastes in the agricultural sector. An analysis of Millennials' willingness to buy food with upcycled ingredients

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## ABSTRACT

Upcycled ingredients are one of the most significant current trends in the food industry aimed to tackle the challenge of solid food loss reduction. This study investigates the potential market among Millennial consumers for products enriched with upcycled ingredients in Italy. We surveyed a sample of 317 Italian Millennial consumers, using a web-based survey. 62% of respondents declared to be informed about the existence of food made from upcycled ingredients and 53% declared to be willing to buy this novel food. Also, 69% of respondents think that food enriched with upcycled ingredients can bring environmental benefits, while only 40% believe that it can bring health benefits.

Using a logit model to analyse consumer preferences, we found that food neophobia and food technology neophobia negatively impact on the likelihood of being willing to buy food produced with upcycled ingredients. Also, consumers who give high importance to food certification are less likely to be willing to buy upcycled foods. Contrariwise, reading labels and believing that upcycled foods are healthier or more environmentally friendly positively impacts on the willingness of Millennial consumers to buy these foods.

Results for the sample analysed eventually suggest that giving right information to consumers about the environmental and health characteristics of the products, through clear labelling, could increase their market uptake thus helping to reduce food loss and contributing to reaching circular economy objectives in the agricultural sector.

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## 1. Introduction

The valorization of solid wastes deriving from food production is becoming an outstanding sustainability issue in agriculture (Peschel and Aschemann-Witzel, 2020). In this context, the production of upcycled foods is particularly relevant as they “use ingredients that otherwise would not have gone to human consumption, are procured and produced using verifiable supply chains, and have a positive impact on the environment” (The Upcycled Foods Definition Task Force, 2020). Upcycled foods are thus very important in the light of favoring the circular economy uptake in the agri-food sector, allowing to reach the objectives of the European Green Deal and Farm to Fork Strategies (European Commission, 2019; 2020).

Also, favouring the uptake of upcycled foods could help to tackle the global issue of reducing food waste and food loss, thus helping to reach the United Nations Sustainable Development Goal 12.3 (Liz Martins et al., 2020) which aims at halving the per capita global food waste and reducing food losses along production and supply chains by 2030.<sup>1</sup>

However, as the aptitude of food companies to produce innovations is greater than the ability of the social system to accept these innovations (Perito et al., 2019), it is important to appraise the eventual consumer preferences for products with upcycled ingredients, so as to understand whether these products would be successful in the market. In fact, as many studies have shown, novel products uptake could be hindered, among other, by a general aversion to new food (i.e., the so-called food neophobia-FN) or to

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<sup>1</sup> <https://www.undp.org/content/undp/en/home/sustainable-development-goals-goal-12-responsible-consumption-and-production.html>, accessed on November 2020.

food processed in a new way (i.e., the food technology neophobia-FTN) (Ritchey et al., 2003; Cox and Evans, 2008).

In particular, considering that the production potentials of upcycled products are not yet fully expressed, and these products will reach a significant presence on the market in the coming years (Zhang et al., 2020), it is of prime importance to investigate the purchasing behavior of those who are not only present consumers, but also future ones, i.e., the Millennials<sup>2</sup>.

Millennials represent an extremely significant share of the market as they make up 25% of the world population, a very attractive segment for food companies (Fibri and Frøst, 2019). Also, they are expected to have an increasing impact on the market as they are very active in the digital space, value trust and, most of all, display high consumer involvement (Bilgihan, 2016). Thus, analysing Millennials' preferences for upcycled foods could allow to envisage present and future tendencies of food consumption (Bollani et al., 2019).

Nevertheless, literature on consumers' acceptance for food enriched with upcycled ingredients is still largely unexplored, also because there are few products that have already been developed and tested (Nitzko and Spiller, 2019), and Millennials are still an understudied segment of the market for sustainable products (Muralidharan and Xue, 2016).

In particular, to the best of our knowledge, only two studies have till now explored generational differences in the preferences for products enriched with upcycled ingredients (Perito et al., 2020; Zhang et al., 2020). However, none of these studies has focused on Millennials attitudes towards upcycled foods by considering the eventual role played by FN and FTN and by products' health and environmental characteristics.

The purpose of this work is to fill this gap in the newly developed stream of literature on the analysis of consumer acceptance of food produced with upcycled ingredients by focusing on Millennial consumers explicitly considering the eventual role played by FN, FTN, products characteristics in terms of environmental and health benefits and other pertinent purchase preferences.

To this aim, a web-based questionnaire was administered to Italian Millennials and replies to the questionnaire were analysed through a binary logistic regression model to appraise the eventual factors affecting the willingness to buy (WTB) products with upcycled ingredients. Three categories of explanatory variables are considered: *i*) some socio-economic characteristics of the respondents, *ii*) variables expressing purchase preferences of the individuals towards: reading the food label, the importance of certification and the expected characteristics of the products in terms of sustainability and health benefits; *iii*) the eventual presence of FN and FTN.

The rest of the paper is organized as follows: Section 2 describes the background and relevant pertinent literature; Section 3 presents the materials and methods used for the survey, including the main hypotheses made in this study; Section 4 presents the main findings; Section 5 the results discussion and Section 6 concludes.

## 2. Background and literature review

Reducing wastes in the agricultural sector is a very relevant issue from the economic, environmental and social points of view (Silvennoinen et al., 2019; Coşkun et al., 2020; Ilakovac et al., 2020).

To date, there is no commonly agreed definition of food loss and waste (Chaboud and Daviron, 2017). The FAO has worked towards the harmonisation of these notions, stating that “food waste” occurs at the retail and consumption levels and “food loss”, on

the other hand, is usually considered as occurring during agricultural production, post-harvest and processing stages in the food supply chain, but does not include the retail level (Gustavsson et al., 2011). For instance, food loss is also represented by edible and potentially edible parts of food products (e.g., peels) that are thrown away and are not reused in the production process (Gustavsson et al., 2011).

In this sense food loss, that has for a long time represented just a cost for the agricultural sector, can become a valuable resource (Klitkou et al., 2019) favoring the uptake of the circular economy principles along the supply chain (Ojha et al., 2020). Valorization of these losses is consequently becoming an outstanding sustainability issue in the food sector (Flamminii et al., 2020).

There are different ways of reusing edible and potentially edible parts of food products. One of these is the extraction of bioactive compounds to add as an ingredient to obtain new functional products (Flamminii et al., 2019). These functional foods<sup>3</sup> are referred to in different ways in the literature, e.g., “value-added surplus products” (Bhatt et al., 2018), “waste-to-value products” (Aschemann-Witzel and Peschel, 2019; Coderoni and Perito, 2020; Perito et al., 2020), but the bulk of published papers now refers to them as products with upcycled ingredients, also following the recently established definition by The Upcycled Foods Definition Task Force (2020).

When adding bioactive compounds, foods with upcycled ingredients can be considered by the consumers as a special type of functional food, that not only add functional ingredients, but also contribute to environmental sustainability by reducing food loss.

The literature that analyses consumer preferences for food with upcycled ingredients is a new strand of research also because upcycled foods have only recently been developed, and not yet fully commercialized. Among the few studies produced, even fewer have studied the preferences of young consumers for these products, despite the relevance of younger generations in shaping actual and future consumption trends. To the best of our knowledge, only two studies have dealt with generational differences when analysing consumer preferences for upcycled foods (Perito et al., 2020; Zhang et al., 2020).

Due to the very limited empirical literature on Millennials' preferences for upcycled foods, to make hypotheses in this study, we relied both on studies investigating consumers' acceptance for upcycled foods, regardless of their age, and on the literature focusing on Millennials' preferences for novel or sustainable foods in general, rather than specifically on food with upcycled ingredients.

Studies examining consumer preferences for food with upcycled ingredients consider different drivers of preferences. Some studies claim that, when analysing consumer acceptance for newly developed products, two major psychological aspects deserve attention. The first is the so-called FN which is defined as consumers who have a clear bias to new food avoidance (Ritchey et al., 2003) and affects both the quality and variety of foods consumed (Falciglia et al., 2000). The second factor is FTN which can influence consumers' attitudes towards food processed in new ways (Cox and Evans, 2008).

Studies investigating the relationship between upcycled foods have shown mixed evidence regarding the role of FN and FTN.

Coderoni and Perito (2020) have found that FN and FTN negatively impact on WTB of upcycled food; Perito et al. (2020) have found that FTN negatively impacts on WTB in the whole sample and subsamples (generations) analysed; while Grasso and Asioli (2020) found no significant link between FN and upcycled foods.

The relevance of FN seems to be confirmed also by the literature on Millennials' preferences for novel foods indicating how, in gen-

<sup>3</sup> Functional foods include “food products which have been modified to include a health benefit beyond the traditional nutrients it would normally contains” (Wilkinson et al., 2005: 6).

<sup>2</sup> People born from 1980 to 2000 (Curău, 2012; Howe and Strauss, 2000).

eral, although younger people seem to appreciate new food more than older generations (Ares et al., 2009; Vanhonacker et al., 2010), they show some level of FN that negatively affects their WTB new foods (D'Antuono and Bignami, 2012; Meiselman et al., 2010; Tuorila et al., 2001).

Another very important driver of food purchase intention is the knowledge base of individuals. In this respect, labels are the first source of information when buying foods (MacInnis and Jaworski, 1991), thus more informed food choices can result from the use of food labels and claims (Lusk, 2012). For Millennials, this is particularly true for sustainable consumption, as studies have shown that the label is one the most effective way of communicating environmental information to them (Smith and Brower, 2012).

Analysing consumer acceptance of products with upcycled ingredients, Bhatt et al. (2018) found that the final choice was influenced by the label used, while Coderoni and Perito (2020) found that reading the food label when buying is positively associated to WTB of upcycled foods.

Another important driver of choice is providing information on food certification (e.g., organic food or product origin) that can increase the final demand (Wier et al., 2008; Canavari and Coderoni, 2020). Literature has not paid much attention to the role of certification in shaping consumers' WTB upcycled food and evidence is mixed. Coderoni and Perito (2020) have shown that consumers who pay attention to certification when buying food are less prone to buying food with upcycled ingredients. On the contrary Perito et al. (2020), found that organic consumers would be more willing to buy food with upcycled ingredients. Of course, results are not directly comparable, as one study looks at the general certification of products and the other at a specific certification (the organic one), thus they highlight the need for further investigation.

One last relevant aspect that drives consumer choices is directly linked to the attributes of food.

A considerable number of research studies have explained how consumer purchase acceptance of functional foods can be correlated with the importance assigned to health (Goetzke et al., 2014; Defrancesco et al., 2017) and environmental concerns (Verain et al., 2012; Laureti and Benedetti, 2018). When dealing specifically with upcycled foods, Coderoni and Perito (2020) have shown that respondents were most likely to be willing to buy upcycled foods if they believed that these could bring environmental or health benefits. Also, Bhatt et al. (2018) found that consumers may perceive upcycled foods as helping the environment more than conventional ones.

This information about product characteristics could be particularly relevant for younger consumers as they are more committed to sustainable food consumption than older people (Bucic et al., 2012; Vermeir and Verbeke, 2006) and are more receptive to ethical and environmental issues (Ukenna et al., 2012; Mohr and Schlich, 2016; Schoolman et al., 2016), especially those related to waste, packaging and agricultural practices (Allen and Spialek, 2018).<sup>4</sup> In addition, it has been found that product healthiness is a key motivation that also influences the preferences of young consumers (Temesi et al., 2019; Verneau et al., 2019) and it has been observed that their purchase of environmentally sustainable products can be fostered by health concerns (Verain et al., 2012).

As regards the attitude of young consumers to upcycled foods, as already mentioned, only two studies are found in the literature (Perito et al., 2020; Zhang et al., 2020) and both find some differences in generational behaviour.

<sup>4</sup> In addition, they are more likely to recommend products that are environmentally friendly (Jorge et al., 2020) and use recycled material (Bollani et al., 2019; Lissitsa and Kol, 2016).

Perito et al. (2020) analysed purchase preferences of different generations for two kinds of products with upcycled ingredients: one with improved nutritional attributes and one that is more environmentally friendly. Their results point that, for Millennials, FTN alone seemed to drive the acceptance of upcycled food with improved nutritional attributes, while decisions regarding environmentally friendly upcycled foods were driven by FTN, education, and the preference for organic products.

Zhang et al. (2020) instead analysed generational differences on how consumers perceive the quality of upcycled foods finding that Millennials are among the generations that have higher perceptions of quality of upcycled foods and higher purchase intentions.

From these studies there seems to emerge an interesting commitment of Millennials in buying upcycled foods. Thus, the present study wants to contribute to this new and scarcely developed strand of literature by analysing in greater detail the main factors affecting Millennials' WTB upcycled food by specifically considering the hypotheses derived from the literature here analysed and detailed in Section 3.

### 3. Materials and methods

To conduct this analysis a non-probability sampling method was used; the elements of the sample gathered are selected since convenience in terms of availability, reach and accessibility. Data were gathered by means of a nationwide internet-based survey administered among Italian consumers from December 2018 to May 2019. In particular, the questionnaire was spread via different social media networks as these media are becoming a popular way of reaching participants in social science research, both for reasons of convenience and inclusion (Kayam and Hirsch, 2012). In the present study, social media were used because they allowed to reach a higher share of the specific target (younger consumers) from all over Italy. Usually, sampling in Internet research studies is not random and this makes it easier to observe specific purchase intentions according to the selected groups (Kayam and Hirsch, 2012). In fact, participants are reached through set channels, making them part of a specific group. For example, positive purchase intentions for environmentally friendly products are more likely to emerge in groups or pages of organic consumers, environmental organizations, etc. To reduce this possible selection bias, we posted the questionnaire on Facebook pages and groups with a general target audience, not linked to specific food purchase behaviour (e.g. pages of Italian radio programmes).<sup>5</sup>

Another aspect that could have an impact on the sample selection is the likely recurrence of a social desirability bias, which is a common problem with questionnaires with self-reporting metrics (Paulhus, 1984; Sörqvist et al., 2016). In order to deal with this issue, in our study anonymous web surveys were used, as many survey experiments and meta-analysis have shown that with this mitigation measure people tend to provide fewer positive responses (Gnambs and Kaspar, 2015; Sörqvist et al., 2016). However, this cannot exclude in principle that respondents gave answers that were driven by impression management or self-deceptive positivity.

The questionnaire included an introductory section to inform participants about the objectives of the research project which dealt with the sustainability of the olive oil production system. It was specified that, among the project's objectives, there was the use of upcycled ingredients from olive oil production processes, particularly olive leaves, which are rich in bioactive compounds

<sup>5</sup> Like other studies have shown, although the information was posted also on Twitter and LinkedIn pages, the Facebook network was found to be the most effective in disseminating the survey (Kayam and Hirsch, 2012).

that can be reused after the extraction process (Flamminii et al., 2019), and the analysis of consumer acceptability for food products enriched with these ingredients (e.g., bakery products like salted taralli, crackers and breadsticks or mayonnaise enriched with leaf extracts).

Although the objective of the research project was the sustainability of olive oil production, the questionnaire mentioned food made with upcycled ingredients with no specific reference to olive oil wastes. This choice was made for two reasons: first, at the time the questionnaire was administered, the bakery products were not yet available, so an actual tasting of products was not possible. Second, as this kind of product is not common in the Italian market, we believed it was important to evaluate the general acceptance by consumers without referring to a specific food.

The survey collected information on respondents' socio-demographic characteristics and purchase preferences. The respondents were assured of anonymity and confidentiality.

Both the FTN scale (FTNS) and the FN scale (FNS) were adopted because products made with upcycled ingredients have both a novel technological component in the production process and a component of novelty associated to the food product *per se*.

FN was measured using six items selected from the FNS (Pliner and Hobden, 1992). Following Verbeke (2015), the selection of these items was essentially taken from the six-item FN model proposed by Ritchey et al. (2003). People completed the FNS by indicating their degree of agreement/disagreement with six statements about foods or eating situations.

The FTNS was measured using four items selected from the 'New food technologies are unnecessary' dimension of the scale developed by Cox and Evans (2008). The selection of items included was based on their factor loadings in the original study (Verbeke, 2015). The items included in the study for both scales are the Italian translations of those listed in Table 1. Each item in the FNS and FTNS was scored on a 5-point Likert scale. The items of each scale were merged into one FNS score and one FTNS score. Each score is simply the sum of the individual item scores, reversing, for the FN, the scoring for statements that have negative correlations with the aspect measured (i.e., neophilic items scores).

Cronbach's alpha test were performed on the FNS and FTNS scores to assesses their reliability as a summative rating scale.

Next, the implemented empirical strategy used a binary logistic regression model to elicit factors affecting consumer preferences. The model contemplates as dependent variable the respondents' replies to the question "Would you buy a food product made with upcycled ingredients?".

The socio-economic characteristics of the respondents (i.e., gender, education level, income class), were included among the explanatory variables in order to separate their influence on the final replies; following Verbeke (2015) no specific hypotheses were presented regarding their possible effects on the outcome variable. The other variables included in the model are those expressing the FN and FTN and purchase preferences of the individual which are expected to influence the respective choice, as detailed in the following hypothesis built on the literature presented in Section 2:

- H1: FN and FTN levels of Millennial consumers negatively affect the WTB to buy food with upcycled ingredients.
- H2: Millennial consumers' attitude towards products' label affects the purchase intention to buy food with upcycled ingredients.
- H3: Millennial consumers' attitude towards food certification affects the purchase intention to buy food with upcycled ingredients.
- H4: Environmental information about upcycled food products positively affects the purchase intention of the Millennial consumers.
- H5: Health information about upcycled food products positively affects the purchase intention of the Millennial consumers.

**Table 1**  
Descriptive statistics of FNS and FTNS (scores and items) and of the other variables included in the models.

Variable name and description	Mean	St. Dv.
<b>Food Neophobia Scale (FNS)</b>	13.17	4.54
Scores and Items		
<i>I am constantly sampling new and different foods</i>	3.72	1.07
<i>I don't trust new foods</i>	2.00	0.97
<i>If I don't know what is in a food, I won't try it</i>	2.85	1.25
<i>At dinner parties, I will try a new food</i>	4.10	0.92
<i>I am afraid to eat things I have never had before</i>	2.10	1.15
<i>I eat almost anything</i>	3.95	1.20
<b>Food Technology Neophobia Scale (FTNS)</b>	8.54	3.49
Scores and Items		
<i>There are plenty of tasty foods around, so we don't need to use new food technologies to produce more</i>	1.84	1.00
<i>The benefits of new food technologies are often grossly overstated</i>	2.50	1.20
<i>New food technologies decrease the natural quality of food</i>	2.27	1.12
<i>There is no sense in trying out high-tech food products because the ones I eat are already good enough.</i>	1.95	1.06
<b>WTB</b>		
Willingness to buy food with upcycled ingredients	0.53	0.50
<b>Gender</b>		
1 = female; 0 = male	0.64	0.48
<b>Graduate<sup>a</sup></b>		
The level of education of the respondent (0 = primary or secondary education; 1 = higher)	0.56	0.50
<b>Lower income class<sup>b</sup></b>		
Respondent that declared to have a low income	0.16	0.37
<b>Label</b>		
If reads the food label before buying	0.61	0.49
<b>Certification</b>		
If gives importance to certification when buying food	0.67	0.47
<b>Environmental benefits</b>		
If thinks that food enriched with upcycled ingredients can have environmental benefits	0.69	0.47
<b>Health benefits</b>		
If thinks that food enriched with upcycled ingredients can have health benefits	0.40	0.49

<sup>a</sup> The answer to the question on education was transformed by dichotomizing only for graduate and non-graduate respondents.

<sup>b</sup> The variable income was converted assigning value one to the first response (low) and value zero to the other two responses of income class of respondents (high and medium) so that the behaviour of the respondents belonging to lower income classes could emerge.

All queries were specified as a 5-point Likert scale. Subsequently, in order that the answers of respondents giving a high value to each query could emerge, the variables (except those for FNS and FTNS) were dichotomized, by giving value one to the response categories "agree" and "totally agree" (original response equal to 4 and 5) and value zero to all other responses (original response from 1 to 3). According to Verbeke (2015), the dichotomization is justified on practical and empirical grounds and it also facilitates unambiguous interpretation of the results.

**4. Results**

A total of 317 respondents under 40 years old (and older than 19) completed the questionnaire.

The bulk of respondents (62%) declared they had heard about food made from upcycled ingredients of other production processes and that they knew what it meant; 23% had heard about those products but did not know what it meant; while 15% did not know about the existence of food made with upcycled ingredients.

Table 1 shows means and standard deviations of the FNS and FTNS items and scales, together with the other explanatory variables used in the model.



As regards variables aimed at measuring the different kinds of neophobia, the values for FTNS are much lower than FNS, as expected looking at the composition of the sample, that shows a high proportion of graduate respondents, generally more technology friendly (Slovic, 1987).

Neophilic items (“I am constantly sampling new and different foods”; “At dinner parties, I will try a new food”; and “I eat almost anything”) show higher scores. Rather than a neophobia, general attention to the composition of the products seems to emerge with an average value of 2.85 for item “If I do not know what a food is made of, I do not try it”. Also, a high propensity to sample new foods, when at dinner parties with friends, is found, revealing an interesting peer influence on Millennials’ behavior (Barnes, 2015).

Overall, Cronbach’s alpha tests reveal good internal reliability for both scales: 0.78 for the FNS and 0.80 for FTNS.

As regards socio-economic characteristics of respondents, in the sample the average age is 27 years old, 56% are graduates and 64% are females; only 16% declare to belong to lower income classes.

The majority of respondents (53%) would be willing to buy upcycled foods, declaring to agree or strongly agree to the question “Would you buy a food product made with upcycled ingredients?”.

Attention to the composition of food seems to emerge also when dealing with food labels: most respondents, in fact, read food labels (61%) and give importance to certification when buying food (67%).

As regards the properties associated to food enriched with upcycled ingredients, most respondents think that it can have environmental benefits (69%), while only 40% think that it can have health benefits.

Table 2 shows the results of the conditional logit model estimates. As regards socio-economic characteristics, being female seems to negatively impact on the WTB (with a coefficient estimate of –0.274). However, the coefficient estimated is not statistically different from zero (p-value = 0.420). Being a graduate positively impacts on the likelihood to be willing to buy food produced with upcycled ingredients, with the respective coefficient being significant at 5% confidence level (coefficient estimate: 0.677; p-value = 0.041).

Also, belonging to the lower income class seems to positively impact on the preference for food with upcycled ingredients, with a higher level of significance (coefficient estimate: 1.416; p-value = 0.003).

As regards the influence of FN and FTN (H1), also for Millennials do these traits appear to negatively impact on the likelihood to be willing to buy food produced with upcycled ingredients, with a slightly higher negative impact for FTNS (coefficient estimate: –0.163, p-value = 0.002) than for FNS (coefficient estimate: –0.140; p-value = 0.001).

On the contrary, reading the food label when buying food (H2), can increase the probability of buying upcycled foods (coefficient estimate: 0.875; p-value = 0.013).

**Table 2**  
Logistic Regression Estimations results.

	Coefficient Estimates	p-values	Standard Errors
Female	–0.274	0.420	(0.340)
Graduate	0.677	0.041	(0.331)
Lower income class	1.416	0.003	(0.473)
FTNS	–0.163	0.002	(0.053)
FN	–0.140	0.001	(0.040)
Label	0.875	0.013	(0.352)
Certification	–0.735	0.050	(0.374)
Environmental benefits	1.868	0.000	(0.403)
Health benefits	1.776	0.000	(0.370)
Observations			317
Pseudo R <sup>2</sup>			0.424
Prob > $\chi^2$			0.000

Giving importance to food certification when buying food (H3), negatively impacts on the WTB upcycled foods (coefficient estimate: –0.735; p-value = 0.050).

Looking at results regarding the product’s characteristics, results support the hypotheses made that Millennials should be more likely to buy products enriched with upcycled ingredients if they think that they could have a lower environmental impact (H4) and give health benefits (H5), both with a high significance level (H4 coefficient estimate: 1.868; p-value < 0.001; H5 coefficient estimate: 1.776; p-value < 0.001).

## 5. Discussion

Non-probability sampling methods like the one adopted in this study are very common in early-stage studies in social sciences, as these methods are cost-effective for personal interview surveys and, as highlighted in some literature, the resulting samples often look rather similar to probability sample data (Fowler, 2002). In this study, the use of web instruments to administer the questionnaire did indeed facilitate reaching a high number of respondents, but it raised the issue of representativeness of the sample as the adopted sampling method usually gathers self-selected respondents, thus generating biased samples.

Comparing the demographic characteristics of respondents to the present study with those of the Italian Millennial population as in the National Statistics Surveys<sup>6</sup>, the sample reveals to be slightly biased towards younger people (the average age is 27 years old while the average age of Italian Millennials is 30), with a majority of female respondents (64% against 50% for the population of Italian Millennials) and people with a higher level of education are overrepresented (56% against 23% of Italian Millennials is graduated or has a higher degree of education).

In general, having higher shares of younger and more educated people is very common in samples gathered via the web (Canavari et al., 2005) and the reported gender bias is often considered reasonable in the literature on food purchase intentions (Ding et al., 2015; Verbeke, 2015; Zhang et al., 2020) as women are often responsible for grocery shopping. However, undoubtedly, the sample cannot be considered representative of Italian Millennials.

Despite the limitation of the representativity, the analysis of the sample makes it possible to obtain quite interesting information about the relationship among the variables analysed. Certainly, WTB analyses based on a non-representative sample, cannot be used to extend WTB results to the Millennial population analysed, as figures would be obviously biased, but the relationships among the socio-economic characteristics of respondents, their purchase behaviour and their eventual positive WTB, still remain valid.

Looking at the results of Table 1, values of FNS and FTNS are on average lower than what was found by Coderoni and Perito (2020) for an older sample of Italian consumers; in particular, compared to this study, the Millennial consumers who were interviewed revealed a higher influence of peers when trying new foods and weaker belief that food technologies decrease the natural quality of food. These findings are in line with the literature highlighting that younger people are usually more neophilic (Tuorila et al., 2001; D’Antuono and Bignami, 2012; Meiselman et al., 2010).

As regards the model’s results, the Pseudo R<sup>2</sup> statistic (McFadden Pseudo R<sup>2</sup>) reveals a good model fit as stated by McFadden (1978: 307) “values of 0.2 to 0.4 for rho-squared represent excellent fit”.

As detailed, no specific hypotheses were set with respect to the possible effects of socio-demographics on the outcome variable (Verbeke, 2015). In the sample analysed, being a graduate confirms

<sup>6</sup> <http://dati.istat.it>; accessed on 12/02/2021.

to be a positive driver for WTB of upcycled foods (as in Coderoni and Perito, 2020). This kind of result confirms what is found in the literature (Slovic, 1987), according to which lack of familiarity with a technology may be a cause for lay people to rebut novel foods.

Results about respondents belonging to what has here been defined as the “lower income class” could seem more surprising, as they are associated with a positive purchase intention for the food analysed in this study. This result should be read in the context of the questionnaire formulation in which we did not mention the prices of those products and it could be argued that these kinds of products could be even cheaper than conventional ones, as they are made using some kind of waste. In fact, when specifically analysing the willingness to pay (WTP) for food with upcycled ingredients, both Bhatt et al. (2020) for a sample of 200 US consumers, and Grasso and Asioli (2020) for 106 UK consumers, found a WTP a lower price compared to conventional alternatives. This kind of consumer attitude is, indeed, quite common in sustainable consumption studies where, for example, carbon footprint labelled products have been found to be most effective when combined with lower prices (Vanclay et al., 2011).

The negative influence of both FNS and FTNS on consumers' replies (H1) is found also for Millennials, even if it is lower than for older consumers (Coderoni and Perito, 2020). This finding is in line with other studies that analysed both preferences for upcycled foods (Perito et al., 2020) and the general preferences of millennials for novel foods (D'Antuono and Bignami, 2012; Meiselman et al., 2010; Tuorila et al., 2001).

These types of results are very relevant as they seem to confirm that, at least in the sample analysed, neophobia is a factor that could hamper the uptake of upcycled foods, and, hence, it is important to correctly communicate the safety of these products also to young consumers, who are usually less neophobic.

Reading the food label (H2) was found to positively impact on WTB of upcycled foods, as in previous studies (Coderoni and Perito, 2020). This result could give interesting insights for the definition of the marketing strategies of upcycled foods because it draws attention to the importance of food labels in correctly communicating the products' characteristics to consumers. In fact, as Bhatt et al. (2018) have shown, the WTB upcycled foods might be influenced by the label used. Also, studies on environmentally friendly purchase behavior of Millennials have demonstrated that one of the most effective ways to communicate environmental information is through the labeling on the package (Smith and Brower, 2012) and that previous awareness of the correct meaning of sustainable labels raises positive purchasing attitudes (Pomarici and Vecchio, 2014). Thus, developing a clear upcycled food label and informing consumers about its meaning, could positively impact on the market uptake of these products.

Results about the importance of food certification when buying food (H3) suggest a negative influence on the WTB upcycled foods.

This result, although in line with previous findings (Coderoni and Perito, 2020) is not so easy to interpret without looking at the questionnaire formulation. Here, in fact, have been listed some examples of certification, like organic products and geographical indications, that are very common in the Italian market. The result obtained might thus reveal that those consumers who are very attentive about specific certification of product origins, feel the concept of upcycled food as less trustable than the certified ones. In fact, for example, Bhatt et al. (2018) have demonstrated that upcycled foods are perceived less sustainable than organic ones. This interpretation of the results makes the findings coherent also with the study by Perito et al. (2020) that have found that Millennials consumers that give importance to products origins are less prone to buy upcycled foods both if they think that they could bring environmental or health benefits.

Two major interesting results are those regarding the consumers' perceptions of the product's characteristics, as it emerges that respondents are more likely to state a positive WTB when upcycled foods are supposed to bring environmental (H4) or health benefits (H5). Results are coherent with previous findings for upcycled foods (Coderoni and Perito, 2020), but also with the literature on Millennials' purchase preferences. This latter has in fact shown that Millennial consumers are willing to pay significantly more for sustainability attributes than other generations (Tait et al., 2020) and that healthiness is a crucial driver of young consumers' preferences (Temesi et al., 2019; Verneau et al., 2019).

Overall, the results here presented, if confirmed by larger representative samples, would suggest that a good strategy to deliver upcycled foods with functional ingredients in the market could be to clearly indicate, through labels, their environmental and health properties.

This evidence is reinforced by the results of giving importance to food certification when buying, which negatively impacts on the WTB upcycled foods. This behavior could in fact indicate that consumers who are cautious about food characteristics are less willing to buy products of “unknown” origin (in terms of location and production method). Thus, stressing the characteristics of these products in their labels could help their delivery in the market.

Indeed, the provision of a common certification for products with upcycled ingredients is one of the objectives of the newly established Upcycled Foods Association<sup>7</sup> which is aimed at building a food system in which all food reaches its highest and best use. This association was created in 2019 by upcycled food companies themselves, who recognized the power of collaboration in developing a successful food category and environmental movement and has already drawn up a draft Certification Standard which is opened for comments on the association's website.<sup>8</sup> This step could represent a first approach to deliver information to the consumers about the products' characteristics.

## 6. Conclusions

Reducing food loss and food waste is a global issue for both food security and environmental sustainability goals.

Producing food with upcycled ingredients as functional food with bioactive compounds can have interesting marketing perspectives as it could be a means to obtain the double dividend of reducing food loss and obtaining value added products, with greater health benefits.

However, to avoid that these novel foods fail in the marketplace, it is essential to better understand the drivers for consumers' WTB such items. This is especially true for young consumers who are the actual and potential target of such foods.

This study has thus investigated Millennials' perceptions of upcycled foods analysing their WTB according to some purchase habits or product characteristics.

Findings for the analysed sample suggest that product characteristics of greater health benefits and environment sustainability positively impact on the WTB of Millennial consumers, so providing clear information on food labels could increase the market uptake of these novel products.

Although this study is innovative in its objective, it is not without limitations. First, the sample here analysed cannot be considered representative of the reference population, therefore the results should be validated by replicating the analysis on represen-

<sup>7</sup> <https://www.upcycledfood.org/>, accessed on November 2020.

<sup>8</sup> <https://www.upcycledfood.org/certification-standard>, accessed on November 2020.

tative samples. Also, the survey could interest other countries to carry out comparative studies in order to better understand eventual different emerging behaviours.

Another major limitation of the study is represented by the fact that no real purchase situations have been proposed to the consumers and, without product tasting, it cannot be excluded that the purchase intentions presented here are overestimated. At the time of the survey, upcycled food products were not yet developed by the research unit, but future studies should investigate the WTB or WTP for these novel products on a more practical ground, proposing also products tasting.

### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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