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# **EU Consumers' Perceptions of Fresh-cut Fruit and Vegetables Attributes: a Choice Experiment Model**

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# EU Consumers' Perceptions of Fresh-cut Fruit and Vegetables Attributes: a Choice Experiment Model

## 1 Introduction

In line with the definition given by the International Fresh-Cut Produce Association (IFPA), fresh-cut fruit and vegetables (F&V) are products minimally processed, more precisely, only washed, cut, mixed and packed. Since their origin in Europe in the early 1980's, they have become more and more common in consumers' market basket.

Benefits of fruit and vegetables (F&V) on the food diet are nowadays well known and documented in the literature. According to the World Health Organization (WHO), the average daily recommended intake of F&V is more than 400 grams per capita (WHO, 2008). The last *Consumption Monitor* of European Fresh Produce Association (2012) shows that overall, 2011 experienced a slight 2.6% raise in the consumption pattern to 382 g/capita/day for fresh fruits and vegetables on average for the EU-27 (Freshfel, 2013). In order to increase the daily intake of F&V, the "fresh-cut" sector plays an important role, and may help meet the objective of consuming the recommended daily intake of vitamins, minerals and fiber, due to fresh-cut F&V convenience and freshness. In fact, given the great concern about contemporary dietary habits, governments in several countries have launched informational and educational initiatives aimed at increasing public awareness towards the benefits of F&V, though the effectiveness of this campaign is still debated by several authors (Seiders e Petty, 2004; Gordon et al., 2006; Mazzocchi et al., 2009).

The fresh-cut sector is constantly evolving and innovating in order to enhance quality and safety of products, which attributes are generally valued by consumers. Quality and safety are multifaceted attributes because they arise from a wide set of methods/technologies, therefore the knowledge about consumers' preferences for food technologies is still matter of debate. Microbiology, chemistry, and food engineering researchers are working on providing new solutions in order to enhance quality and safety attributes. Are technological solutions and innovations, however, always accepted by consumers? This is one of the questions this research addresses.

This research is part of QUAFETY<sup>1</sup> EU (Quality and Safety of Ready to Eat Fresh Products), a project co-funded by the European Commission and 6 SME (small and medium size enterprises) that comprises a multidisciplinary group of researchers working on improving fresh-cut products from technical perspectives, combined with economists evaluating consumers' response to the new technologies. The goal of the present research is to provide an analysis of consumers' preferences towards novel attributes of fresh-cut F&V by working closely with engineers, chemists and microbiologists, in order to provide industry the best innovation path for processing fresh-cut F&V based on demand information.

Specifically, our objectives are:

- a) Testing the impact of segmentation variables already defined by the literature on choice of fresh-cut F&V compared to fresh ones;
- b) Assessing consumers' perceptions about the attributes developed through QUAFETY research including shelf life, typology, stabilization processes, and safety indicators.
- c) Estimating the willingness to pay for each attribute analysed;

The analysis is based on a European Union (EU) wide and *ad hoc* survey conducted within during the QUAFETY project, in which about 1500 Italian, Spanish, Greek and British consumers were interviewed. Therefore, our final objective is:

- d) To conduct a cross-country comparison of consumers' preferences in order to target country-specific innovation paths for processing fresh-cut F&V.

## **2 Background**

### **2.1 Fresh-cut F&V consumption in Europe**

The market for fresh-cut F&V in Europe, since its origin in the early 1980's, has been characterized by a double digits growth, although in the five years 2005-2010 this growth has gradually slowed down from 10% to 3%. It should be noted that, despite the continuous growth of the fresh-cut F&V consumption, its market share is still represented by few percentage points. In 2010, fresh-cut fruit market share was about 1% of total volume of fruit sold in the Europe. For fresh-cut vegetables, the situation is slightly different, because the market share has increased by 4% with respect to the total volume of vegetables (Rabobank, 2011).

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To offer a brief overview of the sector in the four countries analyzed in this research, we report that the United Kingdom confirms to be the Europe's leader in the fresh-cut market sales, followed by Italy (FAO, 2010), with a retail market growth in the three years 2008-2010 of 6% in average (Nielsen, 2010). In countries like Germany and Spain, in which fresh-cut F&V is still emerging, the market growth in the last years was higher than other countries in which this market is already established, for instance Italy and the Netherlands (Rabobank, 2010). Trend in consumption seems to reflect the trend of total production of F&V in the different European countries. With reference to the decade 2000-2010, as reported by the last FAO report (2013), Italy and Greece registered a decrease in the vegetable production of -2.0% and -2.4% and a -0.2% and -2.4% in fruit production, respectively. For the United Kingdom, the decrease in vegetables production (-1.8%) is in countertrend with respect to the increase in fruit production (3.2%). For Spain, vegetables and fruit production remained almost unchanged (FAO, 2013). According to 2010 Euromonitor forecasts, consumption of fresh-cut F&V will continue to grow until to 2015 with a constant rate of 2%.

Concerning the features of the fresh-cut F&V market, packaged salads appear to be the leader of fresh-cut products, in fact they hold about 50% of total fresh-cut market volume. The other 50% is shared by the fresh-cut fruit (10%) and the other categories as ready-to-cook, crudités and other with 40% (Rabobank, 2010).

## **2.2 Fresh-cut consumers' attitude and perception**

The research for the fresh-cut F&V quality improvement, from the safety and packaging standpoints, is constantly evolving (Watada et al., 1999; Soliva-Fortuny et al., 2002; Rico et al., 2007; Artés et al., 2009; Amodio et al., 2011). Food science research on technological developments for fresh-cut F&V opens the following question: what is consumers' perception towards quality and safety of fresh-cut F&V products?

While the literature provides a great number of studies about consumers' preferences for the quality of fresh F&V, it remains limited when it comes to minimally processed and packaged F&V. In particular, Pollard et al. (2002) completed a review that provides a rigorous investigation on the factors that affect the choice of F&V and their intake. Sensorial appeal, social interactions, costs, time constraint, personal ideology and advertising are all factors capable of influencing the choice of F&V. Several studies consisting of specific case studies for different types of F&V are also available (Loureiro et al, 2001; Harker et al. 2003; Campbell et al. 2004; Haghiri<sup>①</sup>a et al, 2009).

The literature on ready-to-use products, which includes the fresh-cut sector, provides different results according to specific attributes considered. First, it is appropriate to mention that previous studies have highlighted the existence of an inverse relationship between the family income and the consumption of F&V (Marshall et al, 1994; Cassady et al., 2007), which represents a first possible barrier for the some potential consumers of minimally processed products. Consumers to whom this first barrier does not apply, may encounter further barriers such as consumer's social environment, working time, time outside home, consumption of food in restaurant (Frewer et al. 2001; Buckley et al., 2007).

In particular, the strong relationship between the choice of food and its convenience is evident in the literature. De Boer et al., in 2004, analyzed Irish convenience food consumers through a comparison of the regression results across four convenience food categories. They found that in the category with the highest level of consumption, the frequency of purchase is positively correlated with lifestyle (social events, eating alone, breakdown of mealtimes, novelty) and time pressure, while in a negative way with interest in cooking and importance of freshness. Number of children, full-time employment and disposable income are all variables directly connected with perceived time budget and attitude to convenience products (Scholderer et al., 2005). The strongest drivers for convenience food consumption are age, concern about naturalness, nutrition knowledge, and cooking skills (Brunner T.A. et al., 2010).

The increasing interest for food labeling and consumers' positive attitude towards informational facts is confirmed by literature. Labeling and product information (nutritional, safety and technology) appear to be important attribute for consumers (Delizia et al., 2003). Cardello et al. (2007) studied consumers' perception risks associated with innovative and emerging food preservation technology, finding that "innovative technologies" often are associated with unknown health risk, while the term "cold preservation" yields a positive utility. Interestingly, the attribute "minimally processed" has a negative utility for consumers, which may imply that products that have not been processed sufficiently are perceived as a source of microbiological or other safety risk.

Also the type of packaging seems to influence consumers' choice, in fact label information, the quality of packaging, the brand and the visual impact, are all in descending order, features evaluated by the consumers at the time of purchase (Peters-Teixeira and Neela, 2005).

Jaeger and Rose in 2008, through a stated choice experiment, analyzed "eating occasions" attributes with regard of the choice of fresh fruit. First, they found that fresh-cut fruit is less likely to be chosen than fresh one, independently from the price. Second, their research reveals that the main fruit attributes that influence the choice of consumers are time of storage (date of

packaging) and the country of origin. In addition, the eating occasions in which fruit is preferred to other food are while driving and while eating in public space. By contrast, fresh-cut fruit is preferred to the fresh one in those occasions in which it is eaten slowly and time is taken to linger over the food. Also Owen et al. (2002) reported that the choice of fresh fruit and vegetables is often not influenced by the price of an individual item.

Ragaert et al. (2004) analyzed the perception of minimally processed vegetables and packaged fruit, finding that search attributes (product appearance and packaging) are significantly more important in buying stage, while experience attributes (taste, odor, texture) are more important in the consumption phase. Therefore, consumers are not willing to renounce to the high quality, but they want a fair compromise between convenience and quality.

This study adds to the existing literature in that it tests whether new fresh-cut F&V attributes influence consumers' choices and preferences. At the same time, we are able to verify the influence of socio-demographic characteristics on consumers' preferences.

### **3 Methodology**

#### **3.1 Discrete Choice Model**

Discrete choice models based on the random utility framework are well-established tools in the applied economics literature. In agricultural economics, discrete choice models have been used for several applications, for instance, in the agro-environmental field (Hanley et al., 1998; Campbell et al., 2008; Colombo et al., 2008), in the agri-food marketing (Lusk et al., 2003; Taglioni et al., 2011) and in food safety (Alfens F., 2003; Louriero and Umberger, 2006).

One of the strengths of this methodology is that each good is examined based on its attributes, and each attribute may take different values (or levels). This way, a consumer expresses her preference for each attribute and level (Hanley et al. 2001). Thanks to this feature, stated choice models contributed in the recent years to the improvement of some important aspects of agro-food marketing, like labelling and traceability (Menozzi et al., 2010; Onozaka and McFadden, 2010).

Choice models are based on the theory of consumer developed by Lancaster in 1966 and on the Random Utility Model (RUM). According the theory of consumer, the entire utility in the using of a product could be decomposed in more marginal utilities connected with the various attributes, while according RUM theory, the choice of an individual is connected with

the highest utility. Following the RUM framework, we can write the utility function of an individual  $i$ , who has to choose across a set of alternatives  $J$ , in the time  $t$ , as:

$$U_{ijt} = V_{ijt} + e_{ijt}$$

where:  $U_{ijt}$  is the utility perceived by the individual;

$V_{ijt}$  is the deterministic component and what a researcher can observe;

$e_{ijt}$  is the stochastic error and unknown to the researcher.

Moreover, the utility observed  $V_{ijt}$  is function of the attributes  $X$  connected with the choice:

$$V_{ij} = \beta_j \cdot X_{ij}$$

Where  $X$  is a vector that represents all the attributes of the alternative  $j$  and  $\beta$  is the vector of the coefficients that explain how change the utility  $V$  in consequence to a change of a unit in the attribute  $x$ .

Assuming that each individual will tend to choose the alternative with greater utility  $U$ , in way that  $U_{nj} > U_{ng}$  (per each)  $g \neq j$ , the probability for the same individual  $i$  to choose the alternative  $j$  is given by (Louriero et al., 2007):

$$\begin{aligned} P_{ij} &= \text{Prob} (U_{ij} > U_{ig} \cup g \neq j) \\ &= \text{Prob} (V_{ij} + e_{ij} > V_{ig} + e_{ig} \cup g \neq j) \end{aligned}$$

Where the error terms  $e$  are independently and identically distributed (*i.i.d.*) across the several alternatives  $j$ .

Discrete choice models can be applied on revealed-preference data or stated-preference data. The difference consists in the context of the choice, in the first situation, data are referred to choice that people make in the real-world situation, while in the second situation, the choice is referred to the intention to choose, which is what the people would choose in a hypothetical situation.

This research is based on stated-preference data and the discrete choice model becomes a stated choice model.

### 3.2 Data collection and Choice Experiment

For the data collection, a unique questionnaire was administered in the four countries considered for this marketing study: Greece, Italy, Spain and UK. The questionnaire was translated to the national language of each country. Only questionnaires that were completed entirely, 1461 in total, were used for the analyses. Collected observations were distributed among the considered countries as follows: 202 for Greece, 505 for Italy, 250 for Spain and 504 for United Kingdom. Questionnaires were administered through face-to-face interview in



supermarkets of big and medium cities, equally distributed in all part of country (in the Greece, all questionnaires have been administered in Athens). The survey was conducted during the biennium 2012-2013. The different countries were treated separately, in order to highlight possible differences existing among them.

The questionnaire is organized in three parts. The first part included questions on consumers' habits, in particular questions about consumption and purchase of both fresh and fresh-cut F&V. This part included the choice experiment section. The second part included questions related to consumers behavior, in which respondents were asked to express their level of agreement for different statements. The last part of the questionnaire concerned the socio-demographic characteristics of the interviewees.

For the choice experiment section of the questionnaire, consumers were asked to choose among three different F&V products (three alternatives), each defined by five attributes, including price. The experiment included overall a 5 choice-set, where the consumer was asked for five times to choose one alternative among 5 sets of three alternatives. There is no agreement in the literature on how many choice tasks should be presented in a choice experiment (Louviere et al., 2000). We decided that respondents should not face more than five choice tasks given that they might get fatigued and start picking randomly among choices rather than based on their preference (Sattler et al., 2003). Also, we wanted to make sure the assumption that respondents' tastes do not change during the interview was not violated (Sattler et al., 2003). The alternatives proposed in each choice-set, differed among them for the combination and the level of the attributes analyzed. Each respondent was presented the choice sets in a different order, to control for the possibility of order bias.

The product chosen for the experiment is the lettuce. The use of this product is due to the great popularity that lettuce has among consumers (market share of almost 50% - Rabobank International, 2011). In each choice-set there was always a status quo option, represented by the classical fresh lettuce, with an average shelf life of two days and an average price of 1.70 euro per kg. The attributes considered in the experiment are related to the shelf-life, convenience, typology and technology (stabilization process and safety indicators). The shelf-life attribute has been included in the choice experiment to evaluate the perception of consumers about the short or long shelf-life of the products. Besides the status quo, the interviewees could choose between two alternatives of fresh-cut lettuce, respectively with a medium shelf-life (5-7 days) and a long shelf-life (10-12 days). The convenience is mainly measured by adding a dressing to the product already cut and packaged. Then, an attribute referring to the typology, specifically, whether the salad is mixed (lettuce with other greens) or

monotype (only lettuce), has been included, as well as attributes regarding the technology, which helps evaluate the degree of acceptability of new technologies and their degree of real confidence. The technologies proposed are the use of inert gases, natural preservatives as stabilization process, or the use of light signal as safety indicator. Given that the product origin has been extensively established to have a relevant weight on consumers' choice in previous studies (Jaeger and Rose, 2008; Taglioni et al., 2011), we have not included this attribute in our experiment.

The attributes and their levels considered in the experiment are summarized in Table 1.

**Table 1.** Choice experiment: attributes and alternatives.

Attributes	Alternatives	
	Status quo	Proposals
Price	1.70 €/kg	1.92 € x 250 g (7.68 €/kg) 2.38 € x 250 g (9.52 €/kg) 2.70 € x 250 g (10.81 €/kg) 3.06 € x 250 g (12.24 €/kg)
Convenience	fresh	Cut and packed Cut and packed with dressing
Shelf life	2 days	5-7 days 10-12 days
Typology	-	Mixed salad Monotype salad
Stabilization process	-	With inert gases With natural preservatives
Safety indicator	-	Not indicated Light signal Not indicated

The choice-sets were presented to interviewees without a numerical order, so to not influence the choice.

Figure 1 shows an example of choice-set presented to the interviewee, which consists of two purchase proposals and the status quo.

**Figure 1.** A sample choice set

PURCHASE PROPOSAL			
Choose one of the following alternatives			
Price	1.70 €/kg	€ 2.70 X 250 g (10.81 €/kg)	€ 2.70 X 250 g (9.52 €/kg)
Packaging	fresh	Cut and packed (without dressing)	Cut and packed (without dressing)
Shelf life	2 days	10-12 days	10-12 days
Stabilization process	-	With natural preservatives	With inert gases
Typology	-	Mixed	Monotype
Safety indicator	-		Light signal
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### 3.3 Econometric Analysis

Based on the information provided by the survey, a Latent Class Multinomial Logit Model has been fitted for each European country analysed. A latent class is an unobservable subgroup of consumers within the sample, with same preferences and similar behaviour toward the choice. This approach allows us to highlight the presence of different latent classes, and the probability to be part of in each class depends on socio-demographic characteristics (age, income, family), while the choice depends on product attributes (Table 1).

According to the RUM framework, the utility of individual  $i$ , who belongs to the class  $s$ , derives from the choice of the fresh-cut F&V alternative  $j$ :

$$U_{ij/s} = \beta_s \cdot X_{ij} + e_{ij/s}$$

where  $X_{ij}$  is the vector of all attributes present in the choice model and associated with the alternative  $j$  and the individual  $i$ , while  $\beta_s$  represents the specific vector of taste parameters. The coefficient  $\beta_s$  represents the importance and the influence of each attribute for the different classes. The differences in  $\beta_s$  vectors enable to capture the heterogeneity in the attribute preferences among the different classes estimated.

The attributes considered in the model with their levels, codes and interpretation, are reported in Table 2.

**Table 2.** Attributes used in the empirical model

Name	Attribute	Coded using	Level	meaning
PACK	Packaging	categorical	1	Fresh (no packed)
			2	Cut and packed
			3	Cut and packed with dressing
INERT	Stabilization process	dummy	1/0	With/without inert gases
NAT_PR	Stabilization process	dummy	1/0	With/without natural preservatives
SAF_IN	Safety indicator	dummy	1/0	With/without light signal
SHELFL	Shelflife	categorical	1	2 days
			2	5-7 days
			3	10-12 days
TYPE	Typology	categorical	1	Mixed
			2	Monotype
PRICE	Price	continuous		

In the Latent Class Multinomial Logit Model, assuming that the error terms  $e$  are i.i.d., the probability that the individual  $i$  in the class  $s$  chooses the alternative  $j$ , is given by:

$$P_{ij/s} = \frac{\exp(\beta_s X_{ij})}{\sum_{j=1}^C \exp(\beta_s X_{ij})}$$

In this way, the empirical model becomes:

$$P_{ij/s} = \frac{\exp(\beta_{pack} X_{ij} + \beta_{shelflif} X_{ij} + \beta_{type} X_{ij} + \beta_{inert\_ga} X_{ij} + \beta_{nat\_pres} X_{ij} + \beta_{saf\_ind} X_{ij} + \beta_{price} X_{ij})}{\sum_{j=1}^C \exp(\beta_{pack} X_{ij} + \beta_{shelflif} X_{ij} + \beta_{type} X_{ij} + \beta_{inert\_ga} X_{ij} + \beta_{nat\_pres} X_{ij} + \beta_{saf\_ind} X_{ij} + \beta_{price} X_{ij})}$$

Considering  $Z$  as a vector that specifies all the individual characteristics, which do not vary across the choices, the probability to that the individual  $i$  belongs to the latent class  $s$ , is the

given by:

$$P_{is} = \frac{(\gamma_s Z_i)}{\sum_{s=1}^S (\gamma_s Z_i)}$$

where  $s$  is the latent class, with  $s \in S$ , and  $\gamma$  is the class-specific parameter estimated for the socio-demographic characteristics  $Z$ . In our empirical model the individual characteristics included are age (AGE), annual family income (INCOM) and the number of family members (FAMIL)<sup>2</sup>.

The coefficient  $\gamma_{si}$  enables to capture the influence, positive or negative, of the individual characteristics, to determine the belonging to the different latent classes  $s$ . The value of  $P_{is}$  is included between 0 and 1, and the sum of all  $P_{is}$  is equal to one.

The number of latent class for each country is chosen based on Akaike Information Criterion (AIC) value, with the lowest AIC value corresponding to the optimal number of latent classes.

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<sup>2</sup> AGE and FAMIL are continuous variables. INCOM is a categorical variables referred to annual family income with 8 levels, as reported in Table 3.

The same analysis is conducted for each of the four countries. This approach allows us to identify the variables that influence the choice and the belonging to the different latent classes, and to compare these variables across the different countries analyzed.

## 4 Results

### 4.1 Statistical description

In this section, the main descriptive statistic variables of the surveyed sample are presented. Given the different sample size in each country, we treat the considered variables in percentage terms. A brief summary statistics of the socio-demographic characteristics of the samples is shown in Table 3.

**Table 3.** Main socio-demographic characteristics (percentage of consumers interviewed)

characteristic	group	Greece	Italy	Spain	U.K.
Gender	male	49.0	31.7	47.2	47.1
	female	51.0	68.3	52.8	52.9
Age	18-30 years	27.2	23.8	22.0	21.4
	31-40 years	22.3	22.8	25.2	17.3
	41-50 years	22.3	14.7	22.8	20.4
	51-60 years	19.3	19.0	18.4	21.0
	>60 years	8.9	19.8	11.6	19.8
Education	Primary	0.5	4.5	3.6	1.6
	Secondary	4.0	18.2	13.2	26.8
	Advanced	24.2	25.5	32.4	27.8
	Degree	18.3	18.9	29.2	29.9
	Master	32.7	9.1	14.0	10.3
	Postgraduate	20.3	2.8	7.6	3.6
Annual Family Income	< € 12.000	16.4	18.3	18.8	18.6
	€ 12.001 – € 20.000	22.8	27.7	18.3	29.9
	€ 20.001 – € 30.000	28.0	25.7	20.2	26.7
	€ 30.001 – € 40.000	18.0	14.9	15.9	18.8
	€ 40.001 – € 50.000	7.6	5.4	10.7	4.2
	€ 50.001 – € 70.000	6.4	4.0	10.5	1.2
	€ 70.001 – € 100.000	0.4	2.5	3.8	0.6
	> € 100.000	0.4	1.5	1.8	0.0
Family	1 member	7.4	19.2	8.0	19.2
	2 members	24.3	25.1	29.2	33.1
	3 members	2.8	20.8	28.4	17.7
	4 members	35.6	29.1	23.6	20.0
	>4 members	11.9	5.7	10.8	9.9

With regard to the percentage of purchases of fresh-cut F&V, the result of the sample seems to confirm the report of FAO in 2010, in which the United Kingdom confirms to be a great consumer of fresh-cut, with the 97% of interviewees that buy and consume fresh-cut, followed by Spain (88.4%), Italy (84%) and Greece (70.3%). Table 4 illustrates information about grocery shopping habits and the total household food expenditure. Specifically, Spanish and Italian declared to go grocery shopping almost three times per week, spending respectively about 90.0 and 81.0 Euros per week, respectively. British and Greek declared instead to go to grocery shopping two times per week, with a total spending for food of 73.0 and 96.0 Euros, respectively.

**Table 4.** Frequency of F&V consumption

frequency consumption F&V	Greece		Italy		U. K.		Spain	
	fruit	veget.	fruit	veget.	fruit	veget.	fruit	veget.
3 or more times per week	67.7	74.1	79.2	72.5	63.9	75.6	82.0	70.4
1-2 times per week	26.4	21.9	19.0	22.1	24.2	20.0	15.2	25.2
less than 1 per week	5.0	3.0	1.4	5.0	7.7	3.2	2.8	3.2
less than 1 per month	0.0	0.5	0.4	0.4	2.6	1.0	0.0	1.2
never	0.5	0.5	0.0	0.0	1.6	0.2	0.0	0.0

In addition to the frequency of purchase, interviewees are also asked about the percentage of fresh-cut products purchased. Also in this case, the different attitude of the countries toward the consumptions of these products is confirmed. The average value of fresh-cut on the total of F&V purchased, is 37.2% for U.K consumers, 23.7% for Italian, 23.1% for Spanish and 16.7% for Greek consumers. Another important information about the consumption is the percentage of total fresh-cut products represented by green salads: 52.7% in Greece, 87.0% in Italy, 53.2% in Spain and 36.7% in U.K. Green salads symbolized the fresh-cut sector, embodying about 50% of total consumption, with the exception of Italy where it represents almost the totality of the consumptions.

As reported in table 5, the respondents have also declared the frequency of consumption for every single category of ready-to-eat products, divided in: pre-cut fruit, pre-cut vegetables, ready-to-cook products, crudités, bagged salads (lettuce or radicchio) without dressing and bagged salads (lettuce or radicchio) with dressing. The frequency of purchase is expressed as the time of purchasing per week. By associating the frequency of purchasing to the

consumption of the same products, it could be possible to define the bundle for fresh-cut F&V for each country analyzed. In broad terms, the scenario represented by the table is very close to what stated in the report Rabobank (2010). Pre-cut vegetables and ready-to-cook ones, represent the two categories of products that are purchased with the frequency of two times per week by four different consumers. Also the bagged salads without dressing are purchased with the same frequency by Italian, British and Spanish, while not by Greek. Unequivocally, the two categories less purchased by all consumers in all four countries are pre-cut fruit and the bagged salads with dressing.

**Table 5.** *Frequency in percentage of purchases of fresh-cut F&V*

frequency		Fruit	vegetables	Ready-to-cook	Crudit�	Salads with no dressing	Salads with dressing
GREECE	≥ 3 times per week	4.2	7.7	8.5	6.3	7.0	7.0
	1-2 times per week	21.1	33.8	40.8	22.5	21.8	10.6
	≤ 1 time per week	12.7	26.1	34.5	15.5	26.8	21.1
	≤ 1 time per month	19.7	18.3	9.9	19.0	12.3	12.0
	never	42.3	14.1	6.3	36.6	26.1	49.3
ITALY	≥ 3 times per week	7.6	18.6	20.5	5.9	16.8	5.6
	1-2 times per week	33.3	52.8	42.7	37.5	56.8	12.5
	≤ 1 time per week	17.0	14.2	18.2	21.2	12.0	10.4
	≤ 1 time per month	12.0	7.6	8.2	13.4	8.5	11.1
	never	30.2	6.8	10.4	22.0	5.9	60.4
SPAIN	≥ 3 times per week	10.0	14.9	17.2	17.2	16.7	10.0
	1-2 times per week	18.1	42.5	38.0	40.3	45.3	16.3
	≤ 1 time per week	19.5	22.6	27.6	24.4	21.3	15.4
	≤ 1 time per month	22.6	13.1	10.9	11.3	10.4	14.9
	never	29.9	6.8	6.3	6.8	6.3	43.4
U.K.	≥ 3 times per week	7.0	9.4	11.7	7.2	12.1	4.1
	1-2 times per week	26.8	37.0	36.6	24.7	42.1	15.5
	≤ 1 time per week	20.2	28.0	25.4	25.6	26.6	21.7
	≤ 1 time per month	20.6	16.8	15.8	23.7	13.5	17.6
	never	25.4	8.8	10.6	18.8	5.7	41.1

## 4.2 Latent Class Multinomial Logit Model estimates

The empirical model has been applied to the four countries dataset, and the results are entirely reported in Table 6.

The number of latent class has been chosen based on the AIC information, in which the lowest value represents the optimal number of latent classes. According this criterion, we have two classes for all four countries: Greece, Italy, Spain and U.K..

By examining Table 6 we observe that the majority of the coefficients in the first latent class are negative, while they are positive in the second latent class. This enables to divide consumers in two classes, the ones who do not appreciate the fresh-cut F&V attributes and the ones who appreciate them. Before highlighting the differences among each country, let us notice the common perception of all consumers towards the attribute shelf-life. For the consumers belonging to the first latent class, all fresh-cut F&V attributes have a negative utility in the choice, except for the shelf-life. Results for the second class of consumers yield a different interpretation: for the most part attributes have a positive coefficient, while the shelf-life coefficients have a negative sign, corresponding to a negative utility in the choice, even if not statistically significant for all the countries.

Concerning the interpretations of the coefficients, it is appropriate to recall that the variables *PACK* and *SHELFL* are categorical variables with three different values as previously reported in Table 2. *PRICE* is a continuous variable, while *INERT*, *NAT\_PR* and *TYPE* are dummy variables.

About Greece, we can divide the Greek sample consumers in two latent classes. For the first class, the utility coefficients reveals that the most important attributes considered in the choice of fresh-cut F&V are the packaging, the stabilization with inert gases and safety indicators. Given that all the coefficients are negative, they prefer fresh F&V to fresh-cut ones. However, at the same time they want a product with a longer shelf-life. About the socio-demographic characteristics, only income seems to determine the belonging to the different classes, where consumers with a high income have less probabilities to belong at the first latent class, that are those who prefer the fresh F&V.

Also Italian consumers could be divided in two latent classes. The first one is represented by consumers that do not appreciate any fresh-cut attributes, with the exception of shelf-life. On the other side, the second latent class includes consumers influenced in a positive way by the most part of fresh-cut F&V attributes. In detail, the packaging with the dressing, the mix



compositions of the product, the stabilization with natural preservatives, and the presence of technological safety indicator, have all a positive utility in the consumers' choice. A negative utility is associated with a long shelf-life. For Italian consumers, all three demographic characteristics seem to determine the belonging at two different classes. Older people, or with a lower annual family income, or with more member in the family are more likely to represent the first latent class.

Spanish consumers follow the same behavior of the previous countries presented. They could be divided in two different classes. Those who prefer fresh F&V have a negative utility for packaging, natural preservatives and safety indicator attribute, but they prefer a longer shelf-life. For the consumers included in the second class, the packaging is the most important attribute in their choice: they prefer the product cut-packaged with dressing to the product simply cut and packaged. The socio-demographic characteristics do not determine the belonging to the two different classes.

In U.K., the separation of consumers in two classes seems to be more pronounced, given the statistical significance of each attribute in both classes, except for the inert gases attribute. The first class, represented by fresh F&V consumers have a negative utility by all the fresh-cut attributes. They follow the same behavior as the other countries' consumers belonging to the first latent class, as they prefer fresh products with a longer shelf-life. For the second class that appreciates the fresh-cut F&V, the most important attribute in the choice of F&V are the packaging (cut-packaged with dressing products are preferred to cut-packaged products), the stabilization with natural preservatives and the presence of light signal as safety indicator. Also in this case, the shelf-life has a negative utility in their choice. The age of consumers seems to determine the belonging to two classes, but unlike Italian consumers, younger consumers have less probability to be in the first latent class.

**Table 6. Latent Class Multinomial Logit Model estimates for fresh-cut F&V attributes**

	GREECE	ITALY	SPAIN	UK
AIC	1.285	1.764	1.611	1.471
Class 1 Probability	.632	.518	.471	.520
Class 2 Probability	.368	.482	.529	.480
variable	Coefficient	Coefficient	Coefficient	Coefficient
Utility parameters in latent class -->> 1				
PACK  1	-3.041 (.833)***	-2.454 (.485)***	-5.218 (1.479)***	-2.933 (.499)***
INERT_ 1	1.478 (.607)**	-.911 (.471)*	1.292 (1.120)	.685 (.425)
NAT_PR 1	-33.855 (860)	-3.770 (.873)***	-3.301 (1.989)*	-6.427 (1.573)***
SAF_IN 1	-3.438 (1.277)***	-1.784 (.383)***	-4.542 (1.377)***	-3.791 (.766)***
SHELFL 1	4.270 (1.579)***	2.217 (.587)***	6.151 (1.954)***	4.702 (1.002)***
TYPE  1	-2.294 (1.769)	-.366 (.345)	-.292 (1.234)	-3.218 (.888)***
PRICE  1	-1.676 (3.012)	-.795 (.571)	-5.824 (3.469)*	-.155 (1.152)
Utility parameters in latent class -->> 2				
PACK  2	.187 (.153)	.677 (.094)***	.341 (.118)***	.811 (.085)***
INERT_ 2	.238 (.162)	-.076 (.098)	.026 (.126)	.001 (.096)
NAT_PR 2	-.031 (.736)	1.651 (.440)***	.648 (.535)	1.066 (.414)**
SAF_IN 2	.093 (.308)	1.015 (.176)***	.147 (.223)	.478 (.167)***
SHELFL 2	.071 (.355)	-1.034 (.212)***	-.045 (.257)	-.562 (.199)***
TYPE  2	-.135 (.367)	.699 (.223)***	-.135 (.275)	.355 (.214)*
PRICE  2	-.219 (.466)	-.571 (.283)**	-.472 (.347)	-.783 (.268)***
This is THETA(1) in class probability model				
Constant	2.570 (1.154)**	-.734 (.460)	.716 (.790)	1.963 (.471)***
FAMIL  1	-.199 (.136)	.212 (.091)**	-.173 (.111)	-.123 (.075)
AGE  1	-.010 (.013)	.021 (.006)***	-.008 (.010)	-.022 (.006)***
INCOM  1	-.216 (.104)**	-.278 (.091)***	.097 (.095)	-.002 (.054)

**Notes:** Number total of respondents are: 202, Greece; 451, Italy; 250, Spain; 504, U.K.. (the Italian sample size has been reduced by excluding 54 observations, corresponding to the respondents who did not participate in the choice experiment, out of the 505 total observations)

Log Likelihood = -630, Greece; -1319, Italy; -988, Spain; -1835, U.K..

Pseudo R<sup>2</sup> = 0.43, Greece; 0.47, Italy; 0.28, Spain; 0.34, U.K..

Number in parenthesis are standard errors.

\* Significant at the 10% level.

\*\* Significant at the 5% level.

\*\*\* Significant at the 1% level.

## 5 Conclusions

A similar behavior of fresh-cut F&V consumers for the four European countries, Greece, Italy, Spain and U.K., becomes apparent with the Latent Class Multinomial Logit Model. In broad terms, we can divide the consumers in two different latent classes. The first includes consumers that do not appreciate any fresh-cut F&V attributes and thus they prefer to choose

and consume fresh F&V. Consumers that appreciate the several fresh-cut F&V attributes, even if in different measures across different countries, define the second class.

From our findings, consumers that belong to the first class obtain a negative utility for the majority of the fresh-cut attributes. For this reason, they seem willing to reject the convenience offered by fresh-cut F&V. The sole attribute that is more important to their choice, is the shelf-life of the products, preferring F&V with 5-7 shelf-life days to those with 1-2 shelf-life days, and conversely F&V with 10-12 shelf-life days to those with 5-7 shelf-life days. From this information, we could conclude that this category of consumers, purchasing fresh lettuce, do not value the convenience of the products, but they only care about the possibility of storage life.

We have different interpretations for the second latent class of consumers. First, they seem to appreciate fresh-cut F&V, even if they follow a priority scale in their choice. The packaging is one of the most important attribute appreciated, fresh-cut lettuce already packaged and with dressing has more utility compared to the simple packaged fresh-cut product. They also appreciate the new technology present in the packaging, like the presence of a light signal that indicates the freshness and the safety of the products. Moreover, they prefer the stabilization with natural preservatives to the inert gases process. An important result is represented by the negative utility associated with a long shelf-life. In this way, we can conclude that these consumers are more willing to buy fresh-cut products, mainly for the convenience that they offer, renouncing at the same time to a long shelf-life, hypothesizing that they buy and consume them in few days, without the need to store them for several days.

Consumers' socio-demographic characteristics determine the belonging at the different latent classes. In line with the results of Marshall et al. (1994), Cassady et al. (2007) and Buckley et al. (2007), we can confirm that family income influences fresh-cut F&V consumers' preferences. People with a low family income have a higher probability to belong to the class that prefers fresh products to fresh-cut F&V. Notice that this effect is less marked compared to previous studies, consistent with the increasing purchasing trend for these products, as reported by Rabobank (2011). Also, consumers' age is an important variable in the choice of fresh-cut products, as suggested by Brunner et al. (2010). In this research, the variable "age" seems to be relevant for Italian and English consumers, with the difference that older Italian consumers are more likely to fall in the first class, as opposed to the U.K. consumers, who fall into the second class.

As previously shown by Scholderer et al. (2005), the family size and the number of children are determinant factors in the choice of convenience products. With our findings, we can confirm this result only for the Italian consumers.

In conclusion, packaging, consisting of F&V already cut and packed with the dressing, stabilization process with natural preservatives, and the use of light signal as safety indicator, are the most important factors considered by consumers when choosing fresh-cut F&V, at least in the case of lettuce purchase and consumption. This is informative for the technological sector, which is constantly committed to the improvement of these products.

The cross-country comparison of consumers' preferences has not produced substantial differences across the different countries. These findings enrich the general overview about the fresh-cut F&V market, providing useful information to all companies operating in this sector. They could produce similar products to export and sell in the different countries, with the awareness that the consumers will appreciate them.

Finally, our results have the potential to be improved and enriched by adding further information, such as the consumers' perception about the quality and the convenience, or the consumers' habits to verify a connection with their lifestyle.

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