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Research report

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Understanding apple consumers' expectations in terms of likes and dislikes: use of comment analysis in a cross- cultural study.

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Abstract

Apple consumers' expectations in Argentina and France were studied by comment analysis of open-ended questions. In an on-line survey consumers stated: attributes which defined quality in an apple; visual, flavor and texture characteristics they liked/ did not like to find in an apple. Influence of country, consumption frequency and cultivar knowledge were analyzed by contingency tables, Chi-square per cell tests and Multiple Factor Analysis. Consumers' quality expectations were not the same in both countries. Argentineans and French consumers agreed that quality apples should be juicy (most used term in both countries), tasty, firm and fresh. However, for Argentineans quality was more related to visual characteristics, whereas for French it was driven by flavor. Argentineans used more words but French were more specific, particularly for flavour description. Moreover, frequency of consumption, varieties knowledge and the number of terms given were highly related. Frequent consumers knew more varieties and were more prolific in relation to flavour. Less frequent consumers knew fewer apple varieties and gave more words in the visual category. The use of comment analysis allowed identifying the terms that consumers used in their day to day life to describe apples, finding separately likes and dislikes, in spite of the different languages.

Key words: consumer preference, cross-cultural, open-ended question, MFACT, chi-square per cell.

1. Introduction

Food production in a globalized world is constantly presenting new challenges. Thanks to the internationalization of markets, fruits and vegetables are sold far from their region of origin. Also, due to evident climatic reasons commerce between countries in the southern and northern hemisphere becomes a need and a tool to fulfill consumption needs all year round (Rau, 2010). Therefore, breeders need to adapt their products to consumer populations with differing preference patterns (Jaeger, Andani, Wakeling & MacFie, 1998) and understanding consumers' expectations proves key for production purposes and also for developing detailed communication strategies (Sijtsema, Zimmermann, Cvetković, Stojanovic, Spiroski, Milosevic, Mora., Butigan, Mugosa, Esteve, & Pohar, 2012).

Market researches on apple have shown the increasing importance of quality in the consumer's mind (Hutin, 2008). However, it could be said that there are as many different concepts of quality as there are perspectives in postharvest handling and distribution (Shewfelt, 1999; Opara et al., 2007). Literature has also pointed out that in the case of apple, consumer responses for quality aspects associated with texture, taste and flavour are difficult to assess (Harker, Gunson & Jaeger, 2003).

It is well known that consumer's expectations are highly influenced by the cultural background (Tu, Valentin, Husson & Dacremont, 2010; Jesionkowska, Sijtsema, Symoneaux, Konopacka, & Płocharski, 2008;

Prescott & Bell, 1995; Chung, Chung, Kim, Kim, O'Mahony, Vickers, Cha, Ishii, Baures & Kim, 2012). Cross-cultural studies allow a deeper understanding of the impact of global market integration and can increase communication and interaction across national boundaries (Tu et al., 2010; Douglas & Craig, 1997). Sometimes, in addition to the different cultures, the differences in language add a barrier to understanding consumer's preferences and expectations from one country to another (Zanoni, 1997; Blancher, Chollet, Kesteloot, Hoang, Cuvelier & Sieffermann, 2007). In the particular case of apples, a previous work between British and Danish populations carried out by Jaeger et al. (1998) showed that there was no cultural interaction for sensory preference. However, the use of the descriptive vocabulary by consumers was left unexplored and the two studied cultures were too close in terms of familiarity with the product. As Tu et al. (2010) recently established, even if cross-cultural differences in certain food products might be known, little research has been done on how perception and description varies across cultures.

Cultural parameters also include knowledge of the product, information about it (Tuorila, Meiselman, Cardello & Lesher, 1998) and familiarity via mere exposure (Birch & Marlin, 1982). Since expectations are related to consumers' beliefs about the characteristics of the product (Ares, Piqueras-Fiszman, Varela, Morant Marco, Martín López, & Fiszman, 2011), it is rare for consumers to expect something they have

never experienced. So their level of knowledge is highly attached to their expectations (Tuorila, Cardello & Lesher, 1994). Also, the way in which consumers express themselves could be related to their frequency of consumption and background (Blancher et al., 2007). Here lies the interest of comparing apple consumers in two countries such as France and Argentina. This fruit is common in both countries with an important production (Tons produced in 2008, according to FAO: France 1,940,200; Argentina 1,300,000) and consumption (8kg/person/year in Argentina (Bruzone, 2010) and 12kg/person/year in France (Ministère de l'Agriculture de France, 2011). However, the way the product is exposed and presented to consumers varies considerably. In selling points in France - from small street markets to important supermarkets - apples are always presented with the name of the variety, their general sensory characteristics (e.g. acid, aromatic) and sometimes different usages (e.g. to be cooked - *"pomme à cuire"*). On the contrary, in Argentina products are displayed with no information at all, other than the price. This exposure to information and background could be expected to have a direct impact on the way consumers express themselves (Chollet, 2011).

To increase and optimize the experience of consumption it is essential to use concordant words when describing or communicating the products' sensory attributes to the customer (Swahn, Öström, Larsson & Gustafsson, 2010; Antmann, Ares, Varela, Salvador, Coste, Fiszman,

2011). Given this increased need for consumer data, several methodologies have been developed in order to reduce the breach between trained panels and consumer's descriptive vocabulary. Under the hypothesis that consumers are able to describe products diverse methods are being used (Varela and Ares; 2012; Valentin, Chollet, Lelièvre & Abdi, 2012) such as flash profiling (Dairou & Sieffermann, 2006), free choice profiling (Williams & Langron, 1984; Narain, Paterson & Reid, 2004) and free sorting tasks completed with verbalization (Faye, Brémaud, Durand Daubin, Courcoux, Giboreau & Nicod, 2004 ; Lelièvre, Chollet, Abdi & Valentin, 2008; Chollet, Leliévre, Abdi & Valentin, 2011) or ultra-flash profiles (Perrin & Pagès, 2009). All these methodologies have proved useful in consumer vocabulary generation and as descriptive tools (Moussaoui & Varela, 2012); however, tasting of a product is needed. Other recently encouraged methods in sensory and consumer science to explore vocabulary generation are free listing (Hough & Ferraris, 2010; Rusell Bernard, 2005), word association (Guerrero, Claret, Verbeke, Enderli, Zakowska-Biemans, Vanhonacker, Issanchou, Sajdakowska, Granli, Scalvedi, Contel & Hersleth, 2010) and open-ended questions (Ares, Giménez, Barreiro & Gámbaro, 2010; ten Kleij & Musters, 2003; Symoneaux, Galmarini & Mehinagic, 2011). These have the advantage of allowing vocabulary generation also without tasting a product.

Open ended questions with subsequent comment analysis has proved to be a good methodology for consumer's to describe, in their own personal way, a given product (Ares et al., 2010; Varela and Ares 2012). Moreover, the recent addition of the use of Chi-square per cell has allowed a deeper and more statistically reliable analysis of the contingency table with more accuracy on data interpretation complementing the representation of comments by CA (Symoneaux et al., 2011). Therefore, this methodology could be applied to find out consumers' expectations on a particular product. In addition, a separate insight of what consumers' expect to find and what they do not want to find in a product category could be obtained if asked separately (Symoneaux et al., 2011).

In the present work, comment analysis of open-ended questions was used to study apple consumers' expectations in two different countries (Argentina and France). The aims were to study, by means of an online survey, which characteristics defined quality in an apple for consumers, which characteristics consumers would like and which they would not like to find in an apple. Differences between countries, together with the impact of frequency of consumption and apple varieties knowledge, were analyzed.

2. Materials and methods

157 *2.1 Participants*

158 Data was collected by an on-line survey which was e-mailed to
159 participants. These were recruited from previous consumer data bases
160 considering gender, age and education level. Consumers lived in 3 cities in
161 Argentina (Buenos Aires, Mendoza and Cordoba) and in 3 cities in France
162 (Angers, Lille and Lyon). Only those who answered positively to apple
163 consuming were taken into account obtaining a middle-class adult
164 population segmented by gender and age as detailed in Table 1. In this way,
165 a total of 311 answers were obtained in each country.

166

167 *2.2 Survey*

168 The presented online survey consisted on a total of 13 questions
169 adapted from Hutin (2008) which were expected to be answered in 15
170 minutes or less. Questions were presented one at a time and answering was
171 mandatory in order to pass to the next one.

172 The structure of the questionnaire could be divided in 5 different
173 parts (a through e) as follows: a) frequency of consumption of fresh fruits
174 in general and apples in particular, b) open-ended questions for quality,
175 visual characteristics, flavor, and texture of apples, c) knowledge of apple
176 varieties, d) *apple conception* and e) demographic questions. Each section
177 is detailed below.

a) For frequency of consumption the questions were: 1) How often do you consume fresh fruits?, 2) Which type of fruits do you consume and how often do you consume each one?, and 3) How often do you eat apples during each season (summer, autumn, winter, spring)?. The options for frequency responses were: every day or almost every day, once a week, two or three times a month, once a month, less than once a month, never. As for the types of fruits consumed, they were offered a list with 18 options of fruits present in both countries. Only those consumers who answered positively to apple consumption were allowed to continue with the questionnaire.

b) The open-ended questions allowed the generation of a descriptive vocabulary in terms of positive and negative characteristics in an apple. In the first place consumers were asked to define the parameters which meant for them good quality in an apple (question 4). Then they were inquired about visual characteristics asking separately for what they would like to find and what they would not like to find (questions 5_1 and 5_2). The same was done for flavor (questions 6_1 and 6_2) and texture (questions 7_1 and 7_2). In this way a total of seven open-ended questions was generated.

c) In order to explore consumers' knowledge on apple varieties (question 8) consumers had to point out which varieties they knew, out of a list of 18 options (based on the availability in the country with more

varieties, including therefore the varieties present in both countries) namely: Ariane, Antares, Belchard/Chanteclerc, Belle de Boskoop, Braebum, Elstar, Fuji, Gala/Royal Gala/Rome beauty, Golden delicious, Granny Smith, Idared, Jonagold, Melrose/Mierose, Pink Lady, Mixture of red apples, Reinette Clochard, Reinette grise du Canada, Tentation.

For the subsequent analysis of this information (contingency table), consumers were grouped *a posteriori* into four categories by the following criteria according to the amount of mentioned varieties: none, 1 to 4, 5 to 9, more than ten.

d) To know what consumers thought about apple in each country (hereon referred to as *apple conception*), they were asked to answer a closed question (question 9) using a Likert scale (1= strongly agree to 5= strongly disagree) in order to describe apple as: a good fruit, food, a dessert, a satiating/low calorie product, a small pleasure, a daily fruit, a fruit for kids.

e) For the demographic characteristics consumers were presented four closed questions (questions 10 to 13) asking about gender, age, level of education and city of residence.

2.3 Data analysis

2.3.1 Comment analysis

The analysis of open-ended questions required a particular treatment, since some consumers wrote only words while others gave long sentences explaining what they liked and what they disliked. Therefore, comments were transformed into precise modalities using the process presented by Symoneaux et al. (2011).

In the present manuscript, the dataset was presented in a MSExcel file having for each consumer: a) the different open-ended questions and b) all the initial information provided by each consumer in separate rows. For postcoding transcoders had to: verify typing and/or spelling mistakes; remove connectors, auxiliary terms and adverbs; regroup terms when necessary (Rostaing, Ziegelbaum, Boutin, & Rogeaux, 1998). At this stage of the postcoding a total of six transcoders participated in France and Argentina, completing the whole process in around 40 working hours. Four native Spanish speakers worked together on the Argentinean dataset and two French native speakers on the French one and a bilingual (French-Spanish) speaker was present to harmonize transcoding rules between both countries. In order to standardize the treatment of subtleties the postcoding proposed in Table 2 was used for each language.

Once the re-transcription of the 311 consumers in France and in Argentina for the seven questions was done, all words were translated to English by a French and an Argentinean transcoder (the first one French-

English speaker and the second one Spanish-French-English speaker; both familiar with the culture of both countries). A data set of 459 different terms in English used in Argentina and/or in France, and 577 if all subtleties (a little, too, not, etc; Table 2) were considered, was obtained.

Finally, different contingency tables were obtained crossing these modalities with each question, country, known varieties and consumption frequency. At the same time, the total number of citations per consumer was counted also taking into account the aforementioned categories (country, etc).

2.3.2 Analysis of Variance (ANOVA)

Analysis of variance (ANOVA) was conducted with the data on the Likert scale for question 9, to assess significant differences in the product conception between the two countries.

In addition, to evaluate if the number of words used by consumers was related to the question, country, cultivar knowledge and/or consumption level, two-ways variance analyses with interaction were carried out for each question on number of citations per consumer with two factors: country and apple consumption frequency. Statbox software (Version 6.6, Grimmersoft, Issy les Moulineaux, France) was used.

2.3.3 Global Chi-square and Chi-square per cell

In order to observe differences among the words used in Argentina and in France, contingency tables were obtained crossing each question with country, apple consumption frequency and known varieties.

Then to test the differences between each factor, global Chi-square and Chi-square per cell were used. The present approach had been previously validated by Symoneaux et al (2011) who analyzed open-ended questions by crossing products and consumers' comments in the contingency table. After global Chi-square used for testing the independence between rows and columns of the contingency table, the Chi-square per cell indicates for each cell if the observed values were significantly higher, lower or equal to the theoretical values. In the present work, Chi-square per cell analysis was done with a specific Excel Macro specially developed for users who have no access to statistical softwares.

2.3.4 Multiple Factorial Analysis

Complementary to contingency tables analyses and Chi-square tests, a Multiple Factor Analysis for Contingency Table (MFACT) was performed in order to visualize: 1) the way consumers answered the descriptive apple questions (Q05_1 to Q07_2) and 2) the use of the descriptive terms in each country. MFACT is a principal axes analysis (Bécue-Bertau & Pages, 2004) allowing to compare the structure of several

contingency tables using an extension of the correspondence analysis. The two datasets compared in the present work were the two contingency tables (one per country) with the words generated by consumers in rows, the six questions (Q05_1 to Q07_2) in columns and the number of consumers using each modality for each given question in each cell. This analysis was computed with R language (R Development Core Team, 2011) and FactoMineR (Husson, Bocquet, & Pagès, 2004) using the function MFA precising in the code that data sets are contingency tables.

3. Results

3.1 Consumption frequency of apples.

Apple was the most mentioned fruit in both countries, though it was more mentioned in France than in Argentina ($p<0.001$ between countries, representing 76% of the interviewed population in France and 64% in Argentina). However, the frequency of consumption was a little higher in France ($p<0.001$). In France, 41% of the interviewed consumers ate apples every day or almost every day and 35% once or twice a week while in Argentina those answers were given by 19% and 45% of the interviewed population respectively. In Argentina consumption was stable during the year (equal consumption frequency for every season) while in France it was seasonal (higher during autumn and winter).

309

310 *3.2 Cultivar knowledge*

311 Figure 1 shows the level of knowledge for the different apple
312 varieties in both countries expressed as the % of interviewed consumers
313 who knew the different varieties. It was evident that French consumers had
314 a broader knowledge than Argentineans. In average, Argentineans knew
315 2.6 varieties while French knew 8.8. The only ones known by at least 25%
316 of the interviewed Argentineans were Red apples (70%; the only response
317 higher in Argentina than in France with $p<0.001$), Golden Delicious (59%),
318 Granny Smith (52%) and Gala (31%). The other 14 proposed varieties were
319 known by less than 10% of the Argentineans. It is worth noting that “red
320 apples” is a general term and not a real variety. On the other hand, there
321 were 16 varieties known by at least 25% of the interviewed French; the
322 most important were also Grany Smith (95%), Golden Delicious (91%) and
323 Royal gala (88%), together with Pink lady (80%) and Reinette grise du
324 Canada (73%).

325 Three different factors had an impact on knowledge: gender,
326 frequency of consumption and age. In France women knew more varieties
327 than men ($p<0.01$), while in Argentina there was no difference between
328 genders. Most important, when analyzing known varieties and frequency of
329 consumption, both in France and in Argentina, consumers who eat apples

every day mentioned more varieties than those who eat with a smaller frequency ($p<0.001$ in France and $p<0.1$ in Argentina).

3.3 Apple conception

Apple conception (as defined in Materials and Methods section) in each country is presented in Figure 2. Even if there were some differences ($p<0.01$) between Argentinean and French consumer's (4 criteria out of 7), the conception of apple was always in agreement with the proposed statements (values greater than 3). French associated apple more with pleasure, a dessert and a daily fruit; for Argentineans apple was considered more as a food. Consumers from both countries also agreed in apple being a good fruit revealing a positive perception; which could be expected since they were all consumers of the product.

3.4 Analysis of open-ended questions

3.4.1 Expected Quality

In order to better understand consumer's perception of quality, the words obtained from the answers to question 4 (*"Please mention three characteristics or more that you think best define the quality of an apple")* were grouped (by the transcoders) according to the categories: visual, flavour, texture and other. The total words for each category in each country are presented in Figure 3. It can be observed that in both countries

the most (and equally) important category was texture. Then, in Argentina, the visual and flavour categories followed in order of importance while for French consumers flavour was more important than visual category.

A word by word analysis of Q04 (contingency table) showed that the most mentioned term to describe the expected quality in an apple was the same in both countries: juicy ($p>0.1$), representing the 15.6% and 13.6% of the total citations in Argentina and France respectively. In the second place, the most used descriptors were color (Argentina, 9.8%) and crunchy (France, 12.9%). The third word in order of frequency of mention was sweet for both countries, though it was more cited in France ($p<0.05$). From the top fifteen words used, both countries also had in common tasty, firm (more used in France), texture and fresh (more used in Argentina). For Argentineans apple quality was also related to the terms: flavor, not_sandy, crispy and bright, rarely used by French consumers who used perfume, sour and *acidulé*. This last term was used more often by those consumers who knew more varieties (ten varieties or more, Chi-square $p<0.01$). This is a particular word since it includes both the quality (acid) and the intensity; it has no real translation to English and it means “slightly acid” or “acid like”.

3.4.2 Vocabulary generation

Table 3 shows the mean amount of words used by consumers to answer open-ended questions 4 through 7_2. In the first two columns the full questions and their respective codes are presented. Consumption, country, frequency and their interaction effects were also studied. It could be observed that country was significant ($p<0.05$) for almost all questions, except for flavor liked attributes and for texture liked attributes. Consumption frequency also had a significant effect, except for the liked visual and liked and disliked texture characteristics. Finally, there was no interaction between country and consumption frequency meaning that the difference observed between each segment of consumption was similar from a country to another.

As it can be seen (Table 3, columns 6 and 7), Argentinean consumers gave a larger amount of words for all questions, even if for questions Q06_1 and Q07_1 this was only a tendency ($p=0.144$ and 0.095 respectively). It is to be noted that when asked to describe the characteristics that best defined the quality of an apple (Q04) consumers had to give at least three words, while in the other questions there was neither a minimum nor a maximum of words stated. In this way, when no specification was given, consumers (in both countries) gave in average less than three words. Also in both countries consumers gave more positive than negative attributes ($p<0.001$).

For the characteristics expected to be found in an apple, Argentineans were equally prolific on visual and flavour while for French flavour was more important than visual or texture. The same tendency was observed for the disliked characteristics, but fewer words were given in each country. Finally, in France and in Argentina, consumers cited few words (under 2) relative to texture in comparison to flavour and visual characteristics (average number of citations over 2; $p<0.001$).

As previously mentioned, the impact of consumption level was the same in both countries (no interaction frequency of consumption*country, Table 3). Therefore, the average citations of consumers per frequency of consumption level were analyzed as a whole (Table 3, columns 8 to 11). In this way, it could be observed for questions Q04, Q05_2, Q06_1, Q06_2 that the higher the frequency of consumption, the more prolific consumers were in their answers ($p<0.05$). For the other questions the same tendency was observed. Those consumers who ate apples more regularly generated more flavour attributes than visual and texture. For an intermediate level of consumption, visual and flavour descriptors were equally cited and more numerous than texture ones. Finally, consumers who ate apples rarely gave more words for visual characteristics, less for flavour and even less for texture.

The effect of cultivar knowledge on the amount of words given by consumers was also studied for each country; this is presented in Table 4. Knowledge had a positive impact on the mean amount of words given by consumers and this was more evident in Argentina. Those Argentineans who knew at least one and up to four varieties gave more words than those who did not know any varieties; those who knew between five to nine varieties gave even more words. In France, there was also a positive effect but significantly different for those who knew more than ten varieties (category non existent in Argentina since no consumers knew that many). The significant effect of question in both countries is related to the differences in the amount of words used by consumers in the different categories (quality, flavour, etc.) as previously stated.

Analysis of the different contingency tables crossing used words with country, frequency of consumption and cultivar knowledge showed that the greater differences in the words used was between countries. A Multiple Factor Analysis of the Contingency Table was used to observe these differences. Figure 4 and Figure 5 show the relationship among the 42 most cited words answering to questions 5_1 to 7_2 in both countries analyzed by a MFACT (questions in columns and words in rows).

Figure 4 presents only questions (columns) results; dimension 1 of the MFACT was explained by 24.2% and dimension 2 by 23.1%. It could

438 be observed that the first dimension opposed the liking related terms to the
439 disliking ones. This suggests that, in general, the words used for likes and
440 dislikes were not the same. Moreover, it could be induced that the words
441 used to characterize liked texture and liked flavour (Q07_1 and Q06_1) and
442 disliked texture and dislike flavour (Q07_2 and Q06_2) were respectively
443 the same. However, a closer analysis of the contingency table showed that
444 flavour descriptors (e.g.: sweet, sour) were used only to describe flavour
445 while some texture attributes (namely: juicy, crunchy, firm) were used in
446 both categories: flavour and texture. This did not happen for visual
447 characteristics, where the used terms were clearly different from all others,
448 both for likes (Q05_1) and dislikes (Q05_2).
449
450 The figure 5 presents results from MFACT with words used in both
451 countries. It allows visualizing and comparing the relationship between the
452 42 most used terms in Argentina and in France (in addition to the Chi-
453 square per cell analysis of each question by country). Here, the longer the
454 line the bigger the difference in the frequency of mention between the two
455 countries for the given term; also the location of the word on the graph
456 relates it to the different questions (Figure 4).
457 As for aspect (Figure 5, quadrants III and IV) there were some
458 differences between the two countries. Argentineans expressed that they
459 did not like dull apples and that they did like bright red apples. On the

contrary, for French consumers red color, bright and dull were close together, in-between likes and dislikes showing that there was not such a clear pattern for their preferences, being the term bright highly mentioned in the disliked category. The term wrinkled was a very important disliked characteristic for French. For Argentinean the most important dislikes were the presence of damages and the dull aspect. In both countries consumers mentioned size_big, size_small, no_damages, shape, aspect, shape_round and intense_color in the same way.

For flavour (liked and disliked), an important difference was observed between the two countries. Argentineans used more often the words aroma, taste and flavour as general categories (Figure 5, quadrant I). That is to say, when asked "what do you like finding…" they answered directly "aroma", "taste" or "flavour". On the other hand, French consumers used aromatic descriptors stating "flavor of" (e.g. *fruity flavor*, *flowery flavor*) describig what they liked and what they disliked finding in an apple; therefore "flavour_of" is found near the coordinates axe (Figure 5) and was much more employed by French than by Argentinean consumers. Also in the flavour category, French used the word *acidulé* (as a liked flavour characteristic; Figure 5, quadrant I) differently from sour, which was positioned in the middle as it was a liked attribute for some consumers and a disliked one for others.

Argentinean consumers made no distinction in the use of the words firm and hard (Figure 5, quadrant I) to refer to a desired texture characteristic. French consumers used clearly more often the word firm and only to express something they liked to find in an apple. They rarely used the term hard and when they did it was in the disliked category. Other than these, the terms used to express liked and disliked flavour and texture characteristics were different. For disliked texture, the most used term by French consumers were mealiness and soft while Argentineans did not use mealiness and used sandy and *paposa* instead (no real translation can be presented for *paposa*, it is a familiar Argentinean adjective meaning "potato like"). Tasteless, dry and rough were used in the same way in both countries (Figure 5, quadrant II). In terms of what consumers liked finding as flavour and texture of an apple (Figure 5, quadrant I) the terms juicy, sweet, fresh, tasty and firm were equally used in both countries. But Argentineans used more the terms crispy and tasty. It is to be noted that French consumers did not use the term crispy while Argentineans used both terms, crispy and crunchy, in the same proportion (34 and 43 citations respectively for Q07_1, data obtained from the contingency table).

4. Discussion

It was not surprising that quality perception of apples was influenced by culture. Previous works on apple evaluation by consumers (Cliff,

503 Sanford & Johnston, 1999) showed that even within the same country,
504 differences in quality perception could be found within regions in relation
505 to the familiarity with the apple varieties grown in the region.

506 Argentinean consumers defined apple quality first by texture, then by
507 the visual aspect and finally by flavour. In aspect, color played an
508 important role as something they like to find in an apple while for French
509 this was not important. This reinforces the idea that, particularly in relation
510 to apple, the valorisation of color is highly related to cultural and traditional
511 values (Delhom, 1985). Moreover, since in Argentinean markets apples are
512 not presented with any information concerning taste, as they are presented
513 in France, it is not surprising that consumers rely more on the visual aspect
514 of the fruit. For French, quality was also defined by texture, but then they
515 gave more importance to flavour than to visual aspect. On the other hand,
516 both populations highly agreed that a good quality apple would be defined
517 by: juicy, color, crunchy, sweet, tasty, firm, texture and fresh. Even if held
518 in different countries, previous works showed - by preference mapping -
519 that apple's preference was driven by many of these attributes (Dalliant-
520 Spinnler et al., 1996; Jaeger et al, 1998; Jaeger, Wakeling & MacFie, 2000,
521 Peneau et al, 2006). This is also in agreement with previous work done by
522 Hutin (2008) in the French market. He found, by using closed questions,
523 that French associated quality of an apple to crunchiness, sweetness,
524 juiciness and *acidulé*.

525 It is to be noted that texture was an important category for both
526 countries in terms of quality (Fig.3). When answering to the question
527 *"Please mention the characteristics that best define the quality of an*
528 *apple"* many consumers said directly "*its texture*" and not a descriptor. So,
529 even if texture appeared as the most important indicator of quality, it
530 received the least number of descriptors in the open-ended questions
531 (Q07_1 and Q07_2) for both countries. However, as mentioned in the
532 results section, even if they were few, texture attributes were used also in
533 the flavor category. This could be showing that it is not easy for consumers
534 to distinguish between these two categories, and could be related to the
535 semantic structure of this sensory dimension. At the same time, this reveals
536 that, even if consumers do not have a broad texture vocabulary, certain
537 attributes are very important for consumers and they tend to repeat them.
538
539 The amount of words given in the open-ended questions was
540 influenced by country, cultivar knowledge and frequency of consumption.
541 French consumed more and had a wider knowledge on apple varieties
542 but, surprisingly, Argentineans gave (in general) more words than French
543 (Table 4). Blancher et al (2007) found similar results when comparing
544 French and Vietnamese descriptive vocabulary on jellies. The group that
545 was most in contact with the jellies (the Vietnamese) had smaller
546 vocabulary richness for describing the product, explaining that those

547 subjects more familiar with a product used similar words while those less
548 familiar (the French in this case) had to choose more idiosyncratic words to
549 describe the products. In the present work, there could be in addition an
550 influence of language. Even if languages evolve, it has long been stated
551 that Spanish is a much richer language which also has a higher amount of
552 synonyms than French (Dupuy, 1829). This could be contributing to the
553 larger number of words per person given by Argentineans.

554 An analysis of the words used in each country evidenced that French
555 consumers gave a somewhat more detailed description particularly for
556 flavour. Here, Argentineans used generic terms to refer to their liked
557 characteristics (aroma, taste, flavour) and gave no aromatic disliked
558 characteristics. On the other hand, French consumers described the type of
559 aroma they liked and disliked finding in their apple. Therefore, even if they
560 gave fewer words per person their description (e.g. *fruity flavor, flowery*
561 *flavor*) showed a somewhat more specific aromatic vocabulary. Chollet and
562 Valentin (2000) worked on the description on beer with novices and
563 experts and found that experts tend to be more precise and concrete than
564 novices who use more ambiguous, redundant words. This would be
565 showing that, in our case, familiarity acquired by culture (exposure to the
566 product, knowledge of varieties) would have the same effect as training in
567 the use of descriptive vocabulary. Moreover, Argentineans had only one
568 term to refer to the acid taste and they used it to describe a liked and a

569 disliked characteristic (*ácido* translated as sour). French also used this term
570 (*acide*) but they had the word *acidulé* which includes both the attribute and
571 the intensity and they could use this to describe only a liked flavour. So,
572 even if Argentineans used more words, they were able to give somewhat
573 less information.

574 Some differences were also found in the use of the terms crispy and
575 crunchy. These two are desirable qualities particularly important in the case
576 of fruits and vegetables (Fillion & Kilcast, 2002) sometimes associated to
577 freshness and wholesomeness (Fillion & Kilcast, 2000; Szczesniak, 1988).
578 Fillion & Kilcast (2002) showed that these terms can be difficult to define
579 even by panelists who would say that they could perceive a difference
580 between the two, but then struggled to describe it. In brief, crispy and
581 crunchy are words that are used to describe products that break rather than
582 deform. It was also suggested that crunchiness was more relevant to fruits
583 and vegetables when compared with crispness and that both attributes
584 could represent the same continuum of hardness, the choice of word
585 depending on the intensity level considered. In the present work it was
586 found that the use of the terms crunchy and crispy was different between
587 French and Argentinean consumers. French used the word crunchy
588 (*croquant*) when describing quality and liked texture (and flavor) attributes
589 but never mentioned the word crispy (*croustillant*). On the other hand,
590 Argentineans used both terms (*crocante* and *crujiente* respectively) almost

591 as synonyms especially as liked texture attributes. Jowitt (1974) stated that
592 the sensation of crispness is associated with dry foods while crunchiness
593 would be associated with wet foods. Therefore French consumers would
594 seem more educated in the use of these terms. However, a study on the
595 understanding of the crispy-crunchy sensory perception conducted in Spain
596 and Uruguay revealed cultural differences in the use of these words
597 (Varela, Salvador, Gámbaro & Fiszman 2008). More particularly, a work
598 on consumers' use of texture vocabulary using the free listing method in
599 Argentina, Uruguay and Spain (Antmann et al., 2011) showed that both
600 terms crunchy and crispy were highly present in the Argentinean
601 consumers mind while Spanish consumers did not use the term crunchy
602 (this behavior of Spanish consumers was also found by Varela et al., 2008).
603 This would be supporting the fact that the use of these two terms is highly
604 related to culture other than to the level of knowledge.

605 Both countries used different words to describe disliked texture.
606 French used mostly mealiness (*farineuse*) while Argentineans used sandy
607 (*arenosa*) and *paposa* but did not use the word *harinosa*, which would
608 translate as mealy. Andani, Jaeger, Wakeling & MacFie (2001) studied
609 terms related to mealiness in apple by trained panel and consumers in 5
610 different European countries and found that consumers perceived mealiness
611 similarly but they described their perceptions differently. Among all the
612 consumer panels, except the British, a single term was dominant. These

613 terms (Flemish: melig, Danish: melet, French: farineuse, Spanish: harinosa)
614 all translated into mealy and/or floury in the English language. However,
615 the British consumers did not use the term mealy texture. They used dry,
616 coarse and spongy to characterize this textural sensation. This suggests that
617 mealiness is an umbrella term covering the textural sensations associated
618 with floury, coarse, dry and soft texture in apples. However, in the present
619 work no tasting took place, therefore we can not definitely state that what
620 Argentineans called as sandy and *paposa* reflected the same sensory
621 perception as mealy. This could be a limitation of the use of this
622 methodology for product characterization without tasting.
623
624 Finally, when both populations were stratified according to their
625 frequency of consumption, no interaction (country*frequency of
626 consumption) showing that those who consume more behave in the same
627 manner in both countries. More frequent consumers (and also those who
628 knew more cultivar varieties) gave more words when answering about
629 liked/disliked flavour attributes. Intermediate consumers gave equal
630 amount of flavour and visual characteristics, while the least frequent
631 consumers prioritized visual characteristics. Fenko et al. (2010) found that
632 sensory dominance changes along user-product interaction. Even if this
633 change is highly related to the product, they observed that in general, vision
634 was the dominant sense in the first stage of consumer-product contact,

635 especially at the purchasing point. But, as time passed and consumers'
636 relationship with the product evolved, this sense became less important
637 giving way to an increase in the relevancy of touch, olfaction and taste. We
638 believe that consumers who eat apples with a higher frequency might be
639 passed this first stage of product recognition by sight, and so visual cues
640 become less important when describing a product explaining the higher
641 relevance of flavour attributes. Moreover, results could be showing that a
642 higher knowledge of the product leads the consumer to expect something
643 more beyond appearance. Low frequency consumers expectations are more
644 related to the visual aspect because they don't have enough background to
645 specify what they would like in terms of flavour
646
647
648 **5. Conclusions**
649 Consumers' expectations for quality were not exactly the same in
650 Argentina and in France. Texture played an important role for both
651 countries, but then for Argentineans quality was more related to visual
652 aspects (e.g. color) and for French to flavor (e.g. sweet). As a whole, both
653 populations agreed that a quality apple should be first of all juicy, also
654 tasty, firm and fresh.
655 The two countries gave more positive than negative characteristics in
656 each category and all considered apple to be a good food. Argentineans

were, as a whole, more prolific but French were more specific. Particularly when describing the flavour category they were more prone to give descriptors.

Moreover, frequency of consumption, cultivar knowledge and the amounts of words given were highly related in each country. Those who consumed more often knew more varieties and gave more words in relation to flavour than other categories. Those who consumed less often knew fewer varieties and gave more words in the visual category. Consuming a product with a higher frequency might make consumers overlook the obvious visual cues and make them appreciate more the flavour attributes. On the other hand, not enough knowledge and interaction with the product (low frequency consumers) might lead them to basic expectations more related to appearance.

The most mentioned as disliked attributes for French consumers were mealiness, wrinkled and tasteless and for Argentineans were damages, dull aspect, sandy and *"paposa"*. As for liked attributes French mentioned more: crunchy, "*acidulé"*, smooth and firm. For Argentineans the most liked characteristics of an apple were aroma, taste, crispy, bright and color red. In this way, the use of comment analysis allowed identifying the terms that consumers use to describe an apple revealing that, in general, the terms used to describe liked and disliked characteristics were not the same. Also,

678 the influence of culture was evident since consumers gave priority to
679 different characteristics of this particular fruit.
680
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687

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860

861 **Legends for Figures**

862

863 **Figure 1.** Knowledge of the different apple cultivars in both countries.

864

865 **Figure 2.** Apple conception for French and Argentinean consumers.
866 Answers were given on a Likert scale being 1: I strongly disagree. 5: I
867 strongly agree.
868 **p<0.01; *** p<0.001

869

870 **Figure 3.** Total words elicited by consumers for the categories flavor,
871 visual, texture and other in Argentina and in France to describe apple
872 quality.

873

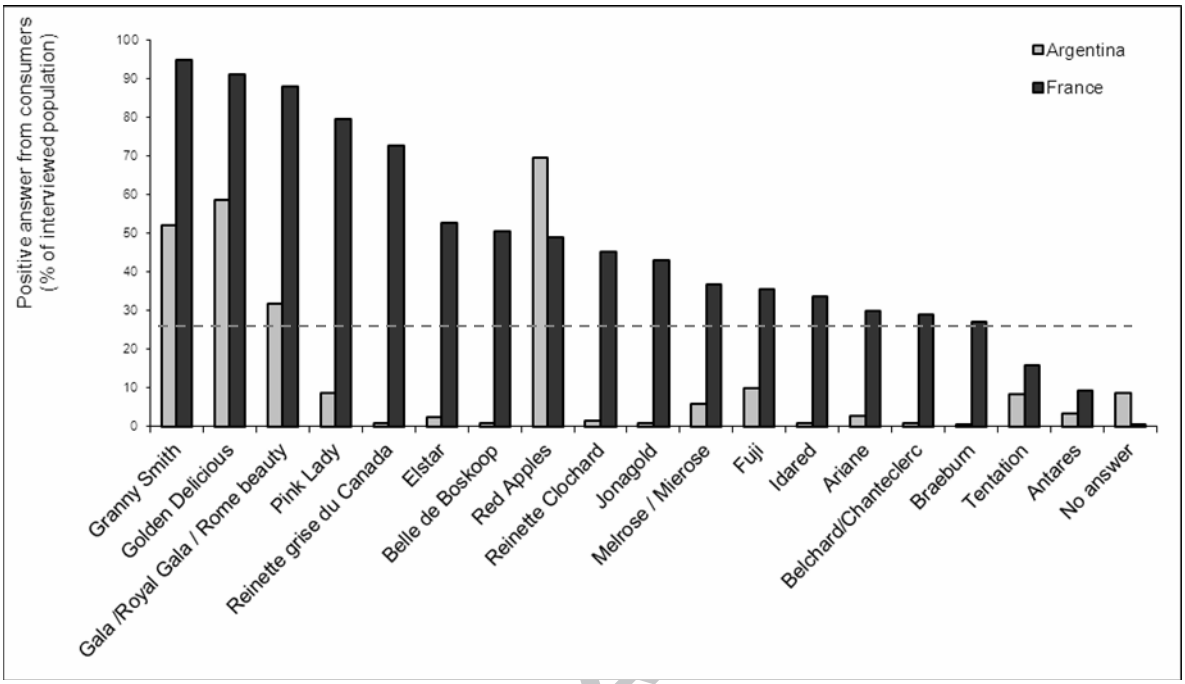
874 **Figure 4**. Multiple Factor Analysis of the Contingency table of the 42
875 words most used to answer questions 5_1 to 7_2 in both countries.
876 Representation of questions (columns).

877

878 **Figure 5.** Multiple Factor Analysis of the Contingency table of the 42
879 words most used to answer questions 5_1 to 7_2 in both countries.
880 Representation of words (rows).

881 Words not (or barely) used by one of the countries would be in the center
882 of coordinates; they are not presented for a clearer presentation.
883 Words used in the same amount by both countries are represented by a dot;
884 when many words were grouped together a brace was used.
885

886



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889 **Figure 1.**

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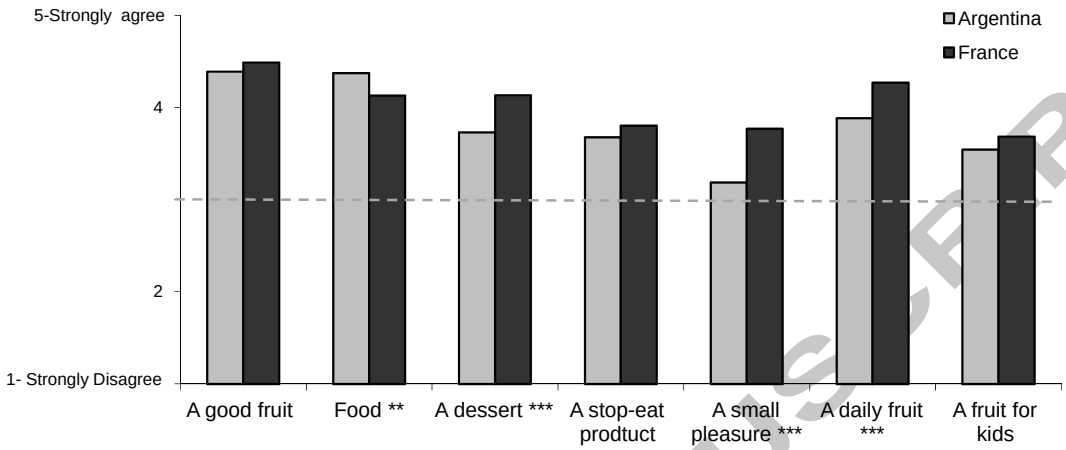

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895 **Figure 2.**

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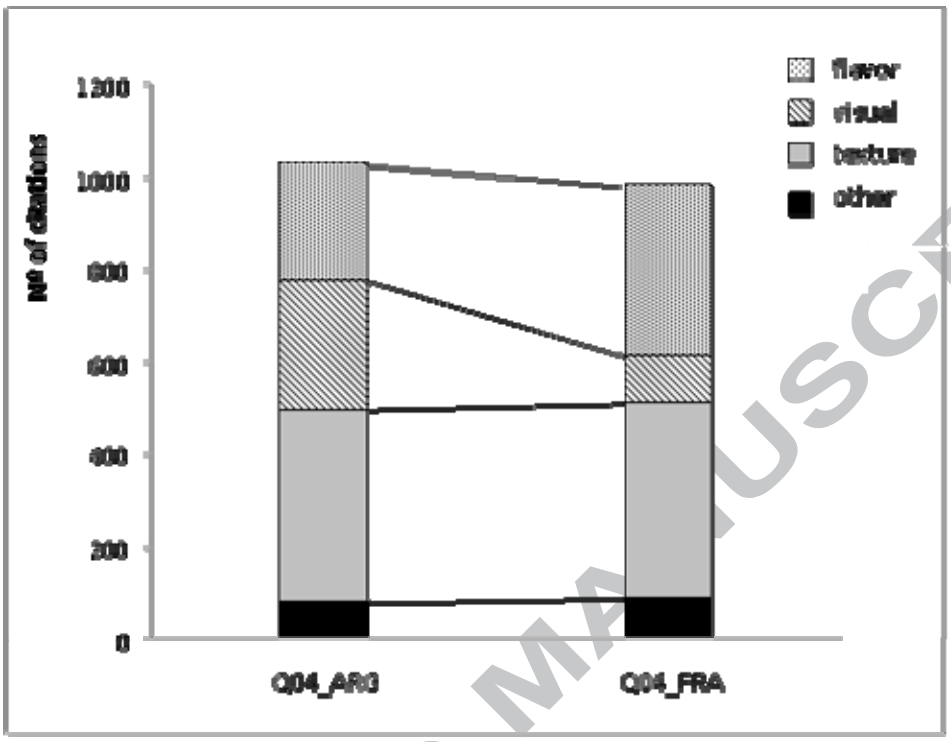

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900 **Figure 3.**

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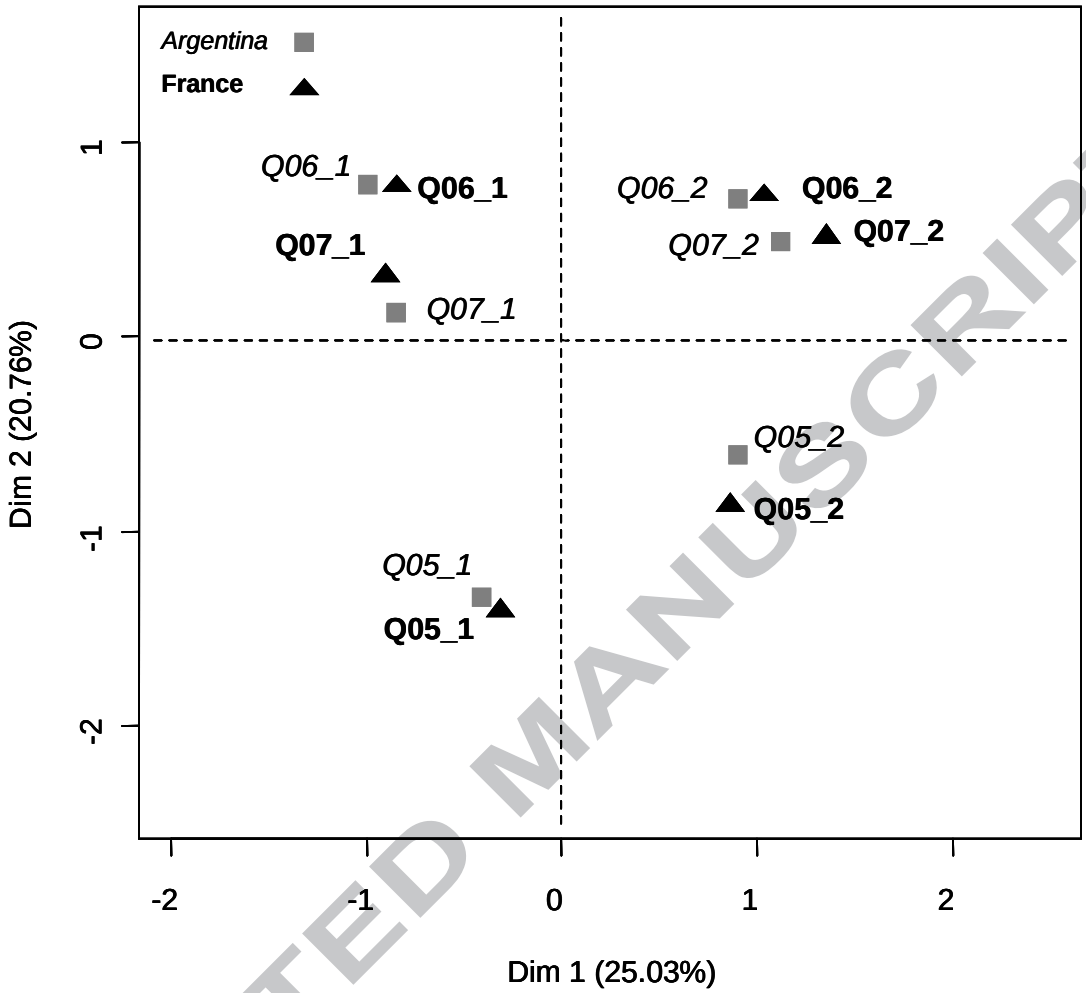
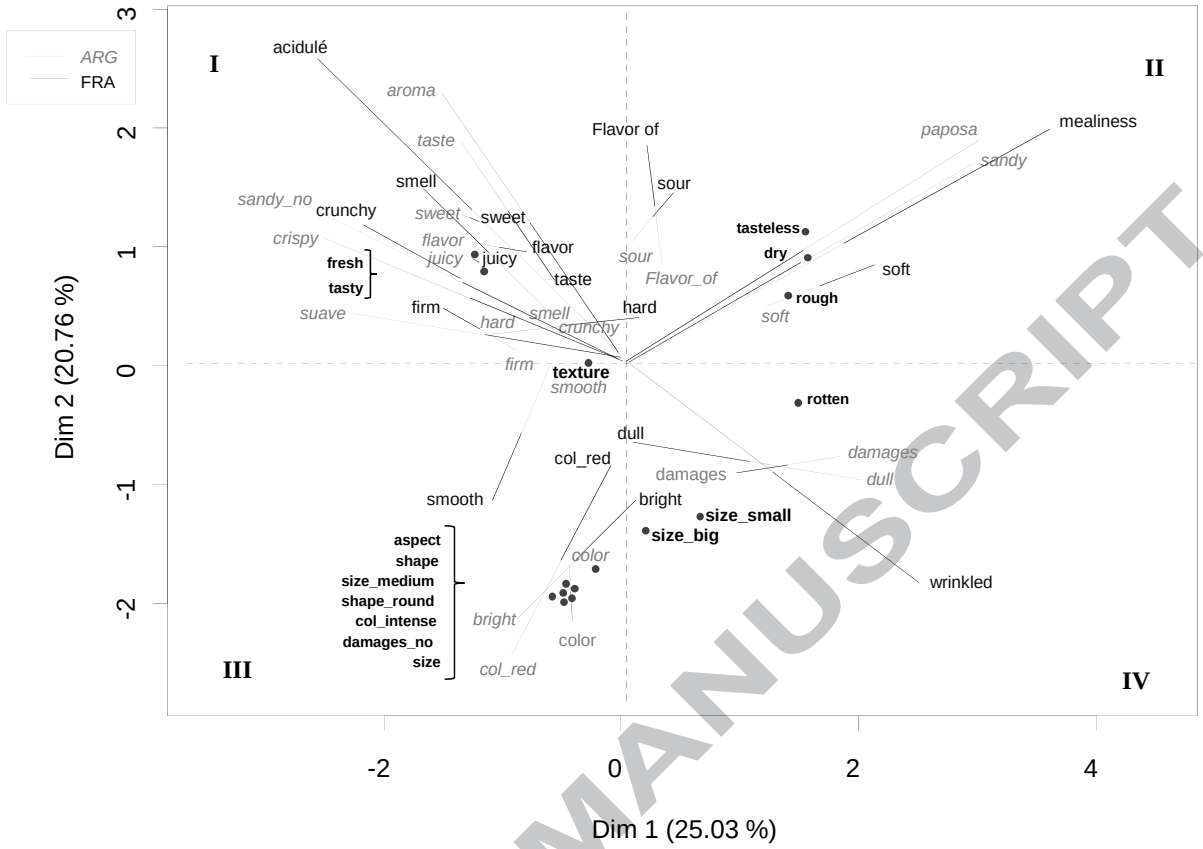


Figure 4.



921

922 **Figure 5**.

923

924

925 **Table 1**. Description of the surveyed population.

926

	Argentina	France	Total
Women 18- 30 years old	93	84	177
Men 18-30 years old	49	56	105
Women 31-70 years old	99	103	202
Men 31-70 years old	70	68	137
Total	311	311	621

927

928

Table 2 Example of the transformation of nuances using the term "sour", from French to English and Spanish to English in questions 6_1 (*Please list all positive flavour characteristics you like finding in an apple*) and 6_2 (*Please list all negative flavour characteristics you dislike finding in an apple*).

Answer given as a positive characteristic: *"Please list all positive flavour characteristics you like finding in an apple."*			Answer given as a negative characteristic: *"Please list all negative flavour characteristics you dislike finding in an apple."*		
Original term	After simplification	*Translated to English*	Original term	After simplification	*Translated to English*
French comment					
Légèrement acide	Un peu acide	*A little sour*	Trop acide	Très acide	*Too sour*
Pas trop acide	Acide	*Sour*	Très acide	Très acide	*Too sour*
Peu acide	Un peu acide	*A little sour*	Beaucoup acide	Très acide	*Too sour*
Non acide	Pas acide	*Not sour*	Manque d'acidité	Pas assez acide	*Not sour enough*
Assez acide	Acide	*Sour*	Pas assez acide	Pas assez acide	*Not sour enough*
Pas acide	Pas acide	*Not sour*	Pas trop acide	Pas assez acide	*Not sour enough*
Relativement acide	Acide	*Sour*	Absence d'acidité	Pas acidite	*Not sour*
Bien acide	Acide	*Sour*	Sans acidité	Pas acidite	*Not sour*
Bonne acidité	Acide	*Sour*	Forte acidité	Très acide	*Too sour*
Plutôt acide	Acide	*Sour*	Trop fort acidité	Très acide	*Too sour*
Sans acidité	Pas acide	*Not sour*	Acidité trop prononcée	Très acide	*Too sour*
Beaucoup acide	Très acide	*Too sour*	Acidité extreme	Très acide	*Too sour*
Léger acidité	Un peu acide	*A little sour*			

Pas très acide	Un peu acide	*A little sour*			
Très acide	Très acide	*Too sour*			
		Spanish comment			
Ausencia de acidez	No ácida	*Not sour*	Demasiado ácida	Muy ácida	*Too sour*
Poco ácida	Un poco ácida	*A little sour*	Muy ácida	Muy ácida	*Too sour*
Más bien ácida	Acida	*Sour*	Excesivamente ácida	Muy ácida	*Too sour*
Levemente ácida	Un poco ácida	*A little sour*	Poca acidez	No ácida	*Not sour*
Ligeramente ácida	Un poco ácida	*A little sour*	Acidez marcada	Muy ácida	*Too sour*
Algo ácida	Un poco ácida	*A little sour*	Ácido intenso	Muy ácido	*Too sour*
Con cierta acidez	Un poco ácida	*A little sour*	Sin acidez	No ácida	*Not sour*
Falta de acidez	No ácida	*Not sour*			
Bien ácida	Acida	*Sour*			
Buena ácidez	Acida	*Sour*			

934

935

Table 3. Mean of the total words used by consumers in each country to answer questions 4 through 7_2.

Question	Code	p-Value			Average of citation per consumer per country		Average of citations of all consumers per frequency of consumption			
		Consumption Level	*Country*	*Consumption Level x Country*	*Argentina*	*France*	*Every Day*	*Once or twice a week*	*Two or three times a month*	*From once a month to less often*
Please mention three characteristics or more that you think best define the quality of an apple.	Q04	**0.011**	**0.040**	0.231	3.32 a	3.14 b	3.42 a	3.27 a	3.24 ab	2.98 b
Please mention all positive visual characteristics that you like finding in an apple.	Q05_1	0.531	< **0.001**	0.359	2.77 a	2.31 b	2.59 ns	2.62 ns	2.57 ns	2.4 ns
Please mention all negative visual characteristics that you dislike finding in an apple.	Q05_2	**0.022**	< **0.001**	0.981	2.66 a	2.17 b	2.55 a	2.47 a	2.57 a	2.08 b
Please mention all positive flavor characteristics that you like finding in an apple.	Q06_1	< **0.001**	0.144	0.940	2.72 ns*	2.56 ns	2.98 a	2.69 b	2.67 b	2.23 c
Please mention all negative flavor characteristics that you dislike finding in an apple.	Q06_2	**0.007**	**0.030**	0.654	2.26 a	2.03 b	2.39 a	2.14 b	2.23 ab	1.84 c

Please mention all positive texture characteristics that you like finding in an apple.	Q07_1	0.085	0.095	0.934	1.77 ns	1.64 ns	1.85 ns	1.70 ns	1.71 ns	1.55 ns
Please mention all negative texture characteristics that you dislike finding in an apple.	Q07_2	0.145	**0.007**	0.888	1.69 a	1.48 b	1.71 ns	1.58 ns	1.61 ns	1.43 ns

*ns: not significant

Lower case letters indicate significant differences ($p<0.05$) according to Student Neuman-Keuls.

Table 4. Mean of the total words used by consumers in each cultivar knowledge category in each country to answer all the questions.

	p-Value			Average of consumers' citations per cultivar knowledge category			
Country	Knowledge	Question	Knowledge x Question	*None*	*One to four*	*Five to nine*	*More than ten*
France	***0.008***	< ***0.001***	*0.139*		2.06 a	2.15 a	2.31 b
Argentina	< ***0.001***	< ***0.001***	*0.782*	2.16 a	2.41 b	2.69 c	

Highlights

Juicy, tasty, firm and fresh defined apple quality in both countries.

Each population also had its own terms for describing quality, likes and dislikes.

Frequent consumers were more descriptive for flavor, than for visual or texture categories.

Comment analysis was used to find terms describing likes and dislikes separately.