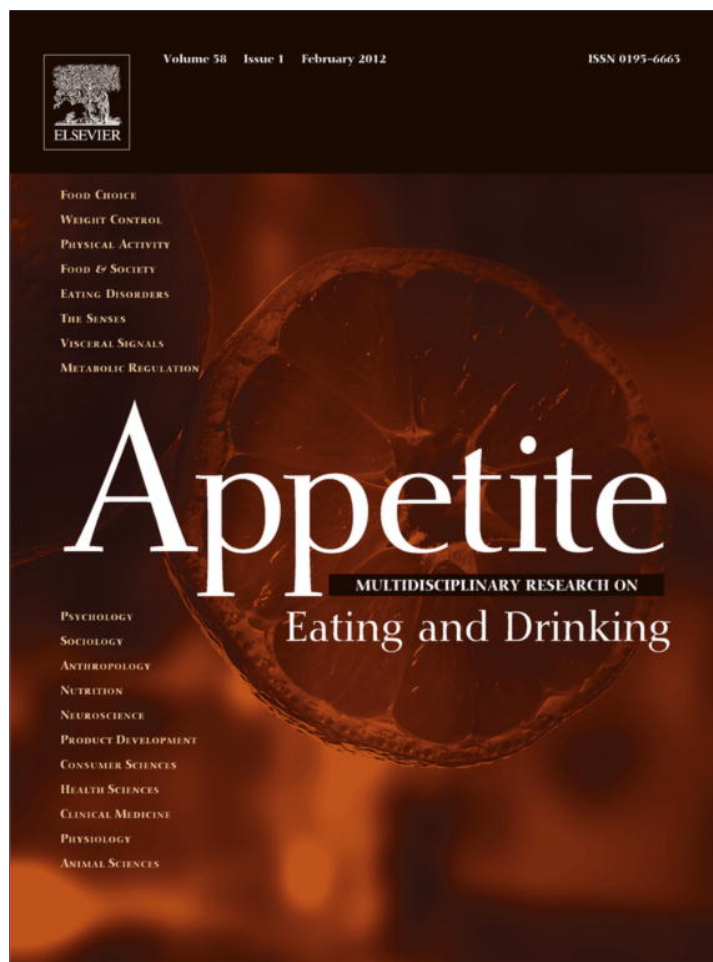


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Research report

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.

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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 et al., 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 (Opara, Al-Said, & Al-Abri, 2007; Shewfelt, 1999). 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 (Chung et al., 2012; Jesionkowska, Sijtsema, Symoneaux, Konopacka, & Plocharski, 2008; Prescott & Bell, 1995; Tu, Valentin, Husson, & Dacremont, 2010). Cross-cultural studies allow a deeper understanding of the impact of global market integration and can increase communication and interaction across national boundaries (Douglas & Craig, 1997; Tu et al., 2010). 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 (Blancher et al., 2007; Zani, 1997). 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,

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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, & Leshner, 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, & 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, & Leshner, 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 1940,200; Argentina 1300,000) and consumption (8 kg/person/year in Argentina (Bruzone, 2010) and 12 kg/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 (Antmann et al., 2011; Swahn, Öström, Larsson, & Gustafsson, 2010). 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 (Narain, Paterson, & Reid, 2004; Williams & Langron, 1984) and free sorting tasks completed with verbalization (Chollet, Lelièvre, Abdi, & Valentin, 2011; Faye et al., 2004; Lelièvre, Chollet, Abdi, & Valentin, 2008) or ultra-flash profiles (Perrin & Pagès, 2009). All these methodologies have proved useful in consumer vocabulary generation and as descriptive tools (Moussaoui & Varela, 2010); 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 et al., 2010) and open-ended questions (Ares, Giménez, Barreiro, & Gámbaro, 2010; Symoneaux, Galmarini, & Mehinagic, 2011; ten Kleij & Musters, 2003). 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 & 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.

Materials and methods

Participants

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

Survey

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

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

Table 1
Description of the surveyed population.

	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

(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, Braeburn, 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, 1–4, 5–9, more than 10.

- (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 10–13) asking about gender, age, level of education and city of residence.

Data analysis

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.).

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.

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.

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–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–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.

Results

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).

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
<i>French comment</i>					
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			
<i>Spanish comment</i>					
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 ácida	Acida	Sour			

Cultivar knowledge

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

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

Apple conception

Apple conception (as defined in Materials and Methods Section) in each country is presented in Fig. 2. Even if there were some differences ($p < 0.01$) between Argentinian 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

Argentinians 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.

Analysis of open-ended questions

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 Fig. 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 Argentinians 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 inten-

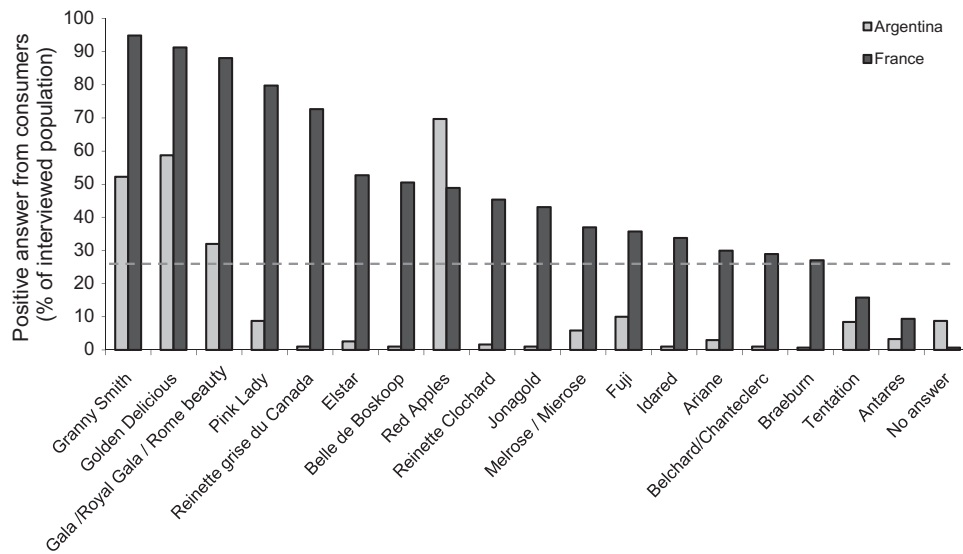


Fig. 1. Knowledge of the different apple cultivars in both countries.

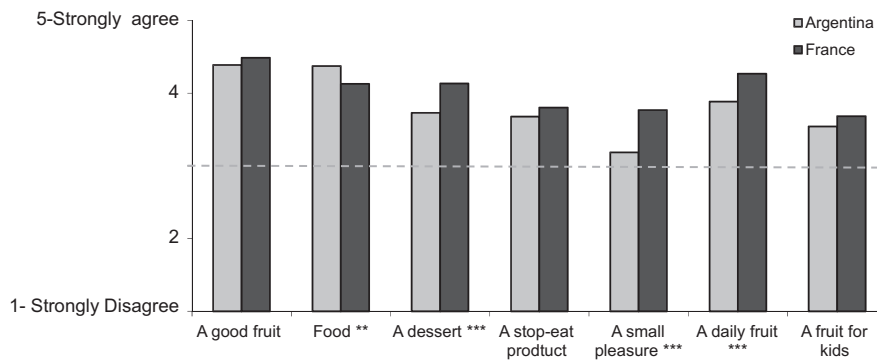


Fig. 2. Apple conception for French and Argentinean consumers. Answers were given on a Likert scale being 1: I strongly disagree. 5: I strongly agree. ** $p < 0.01$; *** $p < 0.001$.

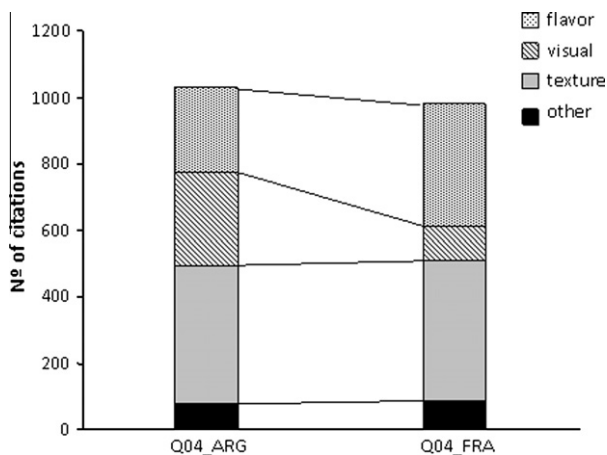


Fig. 3. Total words elicited by consumers for the categories flavor, visual, texture and other in Argentina and in France to describe apple quality.

sity; it has no real translation to English and it means “slightly acid” or “acid like”.

Vocabulary generation

Table 3 shows the mean amount of words used by consumers to answer open-ended questions 4–7_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

Table 3
Mean of the total words used by consumers in each country to answer questions 4–7_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 × 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

Significant effect for country and consumption level are highlighted in bold. Lower case letters indicate significant differences ($p < 0.05$) according to student Neuman–Keuls. * ns: Not significant.

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 8–11). In this way, it could be observed for questions Q04, Q05_2, Q06_1, and 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 Argentinians 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 and 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 (cate-

gory nonexistent 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. Figs. 4 and 5 show the relationship among the 42 most cited words answering to questions 5_1–7_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 be observed that the first dimension opposed the liking related terms to the disliking ones. This suggests that, in general, the words used for likes and dislikes were not the same. Moreover, it could be induced that the words used to characterize liked texture and liked flavour (Q07_1 and Q06_1) and disliked texture and dislike flavour (Q07_2 and Q06_2) were respectively the same. However, a closer analysis of the contingency table showed that flavour descriptors (e.g.: sweet, sour) were used only to describe flavour while some texture attributes (namely: juicy, crunchy, and firm) were used in both categories: flavour and texture. This did not happen for visual characteristics, where the used terms

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 × question	None	1–4	5–9	More than 10
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	

Significant effect of knowledge and question are highlighted in bold italic. Lower case letters indicate significant differences ($p < 0.05$) according to student Neuman–Keuls.

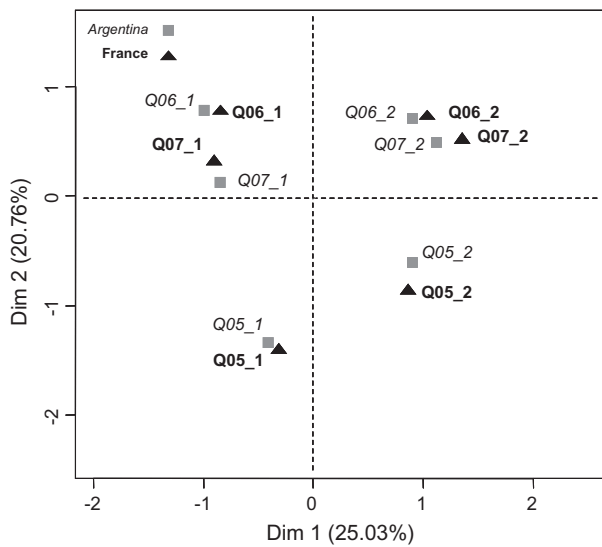


Fig. 4. Multiple Factor Analysis of the Contingency Table of the 42 words most used to answer questions 5_1-7_2 in both countries. Representation of questions (columns).

were clearly different from all others, both for likes (Q05_1) and dislikes (Q05_2).

Figure 5 presents results from MFACT with words used in both countries. It allows visualizing and comparing the relationship between the 42 most used terms in Argentina and in France (in addition to the Chi-square per cell analysis of each question by country). Here, the longer the line the bigger the difference in the frequency of mention between the two countries for the given term; also the location of the word on the graph relates it to the different questions (Fig. 4).

As for aspect (Fig. 5, quadrants III and IV) there were some differences between the two countries. Argentineans expressed that they 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 (Fig. 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*) describing what they liked and what they disliked finding in an apple; therefore “flavour_of” is found near the coordinates axe (Fig. 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; Fig. 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 (Fig. 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

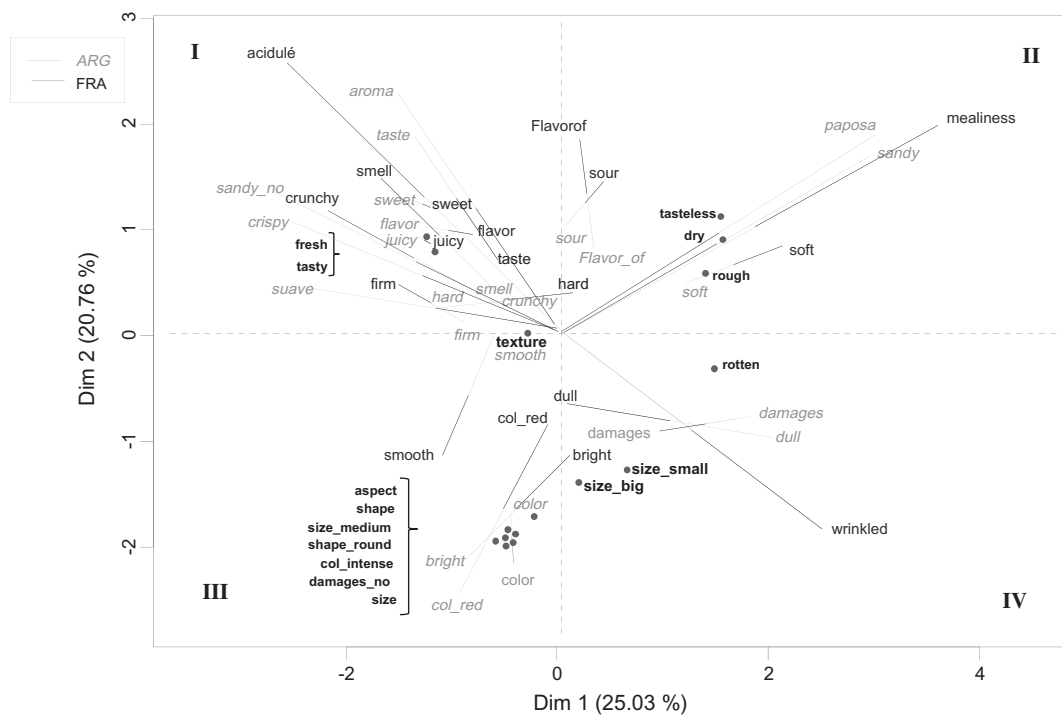


Fig. 5. Multiple Factor Analysis of the Contingency Table of the 42 words most used to answer questions 5_1-7_2 in both countries. Representation of words (rows). Words not (or barely) used by one of the countries would be in the center of coordinates; they are not presented for a clearer presentation. Words used in the same amount by both countries are represented by a dot; when many words were grouped together a brace was used.

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 (Fig. 5, quadrant II). In terms of what consumers liked finding as flavour and texture of an apple (Fig. 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).

Discussion

It was not surprising that quality perception of apples was influenced by culture. Previous works on apple evaluation by consumers (Cliff, Sanford, & Johnston, 1999) showed that even within the same country, differences in quality perception could be found within regions in relation to the familiarity with the apple varieties grown in the region.

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

It is to be noted that texture was an important category for both countries in terms of quality (3). When answering to the question “Please mention the characteristics that best define the quality of an apple” many consumers said directly “its texture” and not a descriptor. So, even if texture appeared as the most important indicator of quality, it received the least number of descriptors in the open-ended questions (Q07_1 and Q07_2) for both countries. However, as mentioned in the results section, even if they were few, texture attributes were used also in the flavor category. This could be showing that it is not easy for consumers to distinguish between these two categories, and could be related to the semantic structure of this sensory dimension. At the same time, this reveals that, even if consumers do not have a broad texture vocabulary, certain attributes are very important for consumers and they tend to repeat them.

The amount of words given in the open-ended questions was influenced by country, cultivar knowledge and frequency of consumption.

French consumed more and had a wider knowledge on apple varieties but, surprisingly, Argentineans gave (in general) more words than French (Table 4). Blancher et al. (2007) found similar results when comparing French and Vietnamese descriptive vocabulary on jellies. The group that was most in contact with the jellies (the Vietnamese) had smaller vocabulary richness for describing

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

An analysis of the words used in each country evidenced that French consumers gave a somewhat more detailed description particularly for flavour. Here, Argentineans used generic terms to refer to their liked characteristics (aroma, taste, and flavour) and gave no aromatic disliked characteristics. On the other hand, French consumers described the type of aroma they liked and disliked finding in their apple. Therefore, even if they gave fewer words per person their description (e.g. *fruity flavor*, and *flowery flavor*) showed a somewhat more specific aromatic vocabulary. Chollet and Valentin (2000) worked on the description on beer with novices and experts and found that experts tend to be more precise and concrete than novices who use more ambiguous, redundant words. This would be showing that, in our case, familiarity acquired by culture (exposure to the product, knowledge of varieties) would have the same effect as training in the use of descriptive vocabulary. Moreover, Argentineans had only one term to refer to the acid taste and they used it to describe a liked and a disliked characteristic (*ácido* translated as sour). French also used this term (*acide*) but they had the word *acidulé* which includes both the attribute and the intensity and they could use this to describe only a liked flavour. So, even if Argentineans used more words, they were able to give somewhat less information.

Some differences were also found in the use of the terms *crispy* and *crunchy*. These two are desirable qualities particularly important in the case of fruits and vegetables (Fillion & Kilcast, 2002) sometimes associated to freshness and wholesomeness (Szczesniak, 1988). Fillion and Kilcast (2002) showed that these terms can be difficult to define even by panelists who would say that they could perceive a difference between the two, but then struggled to describe it. In brief, *crispy* and *crunchy* are words that are used to describe products that break rather than deform. It was also suggested that crunchiness was more relevant to fruits and vegetables when compared with crispness and that both attributes could represent the same continuum of hardness, the choice of word depending on the intensity level considered. In the present work it was found that the use of the terms *crunchy* and *crispy* was different between French and Argentinean consumers. French used the word *crunchy* (*croquant*) when describing quality and liked texture (and flavor) attributes but never mentioned the word *crispy* (*croustillant*). On the other hand, Argentineans used both terms (*crocante* and *crujiente* respectively) almost as synonyms especially as liked texture attributes. Jowitt (1974) stated that the sensation of crispness is associated with dry foods while crunchiness would be associated with wet foods. Therefore French consumers would seem more educated in the use of these terms. However, a study on the understanding of the *crispy*–*crunchy* sensory perception conducted in Spain and Uruguay revealed cultural differences in the use of these words (Varela, Salvador, Gámbaro & Fiszman, 2008). More particularly, a work on consumers' use of texture vocabulary using the free listing method in Argentina, Uruguay and Spain (Antmann et al., 2011) showed that both terms *crunchy* and *crispy* were highly present in the Argentinean consumers mind while Spanish consumers did not use the term *crunchy* (this behavior of Spanish consumers was also found by Varela et al., 2008). This would be supporting the fact that the use of these two terms is highly related to culture other than to the level of knowledge.

Both countries used different words to describe disliked texture. French used mostly mealiness (*farineuse*) while Argentineans used sandy (*arenosa*) and *paposa* but did not use the word *harinosa*, which would translate as mealy. Andani, Jaeger, Wakeling, and MacFie (2001) studied terms related to mealiness in apple by trained panel and consumers in 5 different European countries and found that consumers perceived mealiness similarly but they described their perceptions differently. Among all the consumer panels, except the British, a single term was dominant. These terms (Flemish: melig, Danish: melet, French: farineuse, Spanish: harinosa) all translated into mealy and/or floury in the English language. However, the British consumers did not use the term mealy texture. They used dry, coarse and spongy to characterize this textural sensation. This suggests that mealiness is an umbrella term covering the textural sensations associated with floury, coarse, dry and soft texture in apples. However, in the present work no tasting took place, therefore we cannot definitely state that what Argentineans called as sandy and *paposa* reflected the same sensory perception as mealy. This could be a limitation of the use of this methodology for product characterization without tasting.

Finally, when both populations were stratified according to their frequency of consumption, no interaction (country * frequency of consumption) showing that those who consume more behave in the same manner in both countries. More frequent consumers (and also those who knew more cultivar varieties) gave more words when answering about liked/disliked flavour attributes. Intermediate consumers gave equal amount of flavour and visual characteristics, while the least frequent consumers prioritized visual characteristics. Fenko, Schifferstein, and Hekkert (2010) found that sensory dominance changes along user-product interaction. Even if this change is highly related to the product, they observed that in general, vision was the dominant sense in the first stage of consumer-product contact, especially at the purchasing point. But, as time passed and consumers' relationship with the product evolved, this sense became less important giving way to an increase in the relevancy of touch, olfaction and taste. We believe that consumers who eat apples with a higher frequency might be passed this first stage of product recognition by sight, and so visual cues become less important when describing a product explaining the higher relevance of flavour attributes. Moreover, results could be showing that a higher knowledge of the product leads the consumer to expect something more beyond appearance. Low frequency consumers expectations are more related to the visual aspect because they do not have enough background to specify what they would like in terms of flavour.

Conclusions

Consumers' expectations for quality were not exactly the same in Argentina and in France. Texture played an important role for both countries, but then for Argentineans quality was more related to visual aspects (e.g. color) and for French to flavor (e.g. sweet). As a whole, both populations agreed that a quality apple should be first of all juicy, also tasty, firm and fresh.

The two countries gave more positive than negative characteristics in 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, the influence of culture was evident since consumers gave priority to different characteristics of this particular fruit.

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