Discrimination and sensory characterization of Protected Designation of Origin Salers- and Cantal-type cheeses: An approach using descriptive analysis and consumer insights by check-all-that-apply questions

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Discrimination and sensory characterization of PDO Salers and Cantal type-cheeses: An approach using descriptive analysis and consumer insights by CATA questions

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Abstract

Protected Designation of Origin (PDO) Salers and Cantal are two French uncooked semi-hard cheeses. Despite a quite similar cheese-making process, both types of cheeses exhibit specific sensory attributes. Salers and Cantal cheeses are produced with either Salers milk or with milk from "other cow breeds". The aim of this study is to evaluate the specific sensory properties in order to differentiate both types of cheese: Cantal versus Salers combining a consumer test (n=152) using the CATA method and a sensory profile with a trained panel (n = 9). Ten cheeses (Salers cheeses; n = 6 and Cantal cheeses; n=4) were selected, after 12 months of ripening and storage in the same maturing cellar.

A clear discrimination of Cantal cheeses and Salers cheeses was achieved by using sensory and CATA terms. More precisely, Cantal cheeses were characterized by their texture, whereas Salers cheeses were differentiated by aromatic profile and appearance. The CATA method offers a good description of cheeses (14 attributes out of 16 were discriminant) even if consumer preference scores were slightly close. Although the sensory profile allows a more detailed product characterization than CATA terms, both methods provided similar information about the sensory characterization. Overall, these results suggest the validity of CATA method and once again, show the interest of using it for the sensory characterization by consumers applied on cheese samples with subtle differences.

Practical application

The findings of this study are useful for French artisanal cheese producers as they make it possible to use a sensory approach to differentiate cheese categories from different cheese-making process. This sensory distinction contributes to the improvement of qualities of PDO French cheeses. Hence, these specific sensory attributes could be useful to the supply-chain to communicate and to better explain to consumers the sensory differences between these two cheese categories, which are sometimes poorly distinguished by consumers during purchase. In

addition, the good agreement between sensory profile and the CATA method demonstrated similarities about the sensory description of cheeses. In spite of the fact that the liking scores were very close between the cheeses, consumers were able to distinguish the Salers and Cantal cheeses by using the CATA method.

1. Introduction

France offers a large diversity of cheeses but only 45 of them have obtained a Protected Designation of Origin (PDO) label to promote the quality and preservation of regional products. These products are distinguished by their traditional know-how and their great sensory qualities, respecting strict requirements and specifications. Among the typical French PDO cheeses, the Cantal and Salers are pressed cheeses produced in the Massif Central area (France). They are well known for their sensory specificities and manufacturing methods. Despite cheese-making process similarities, there are some major differences between Cantal and Salers cheeses which can influence their sensory qualities (Bérard et al., 2016).

Salers is an artisanal cheese made exclusively with raw cow's milk curdled in a specific wooden vessel called "Gerle". It has the particularity of being produced at a specific period of the year: from 15th April to 15th November. Different cow breeds can be chosen to get the milk for the production of this kind of cheese, but when only milk from the Massif Central breed of cows also called "Salers" is used in its fabrication, the cheeses obtained are then called "Salers Tradition". Salers Tradition cheese stands out for its reputation in respecting traditional and ancestral know-how. All kinds of Salers cheeses are ripened for at least three months and are usually eaten after five months of ripening.

On the other hand, PDO Cantal cheese is made with Salers milk or with milk from "other breeds of cows". The most important differences in producing Cantal compared to Salers cheese are that Cantal can be made from pasteurized milk and is not submitted to a specific period of the year for production like Salers cheeses. Depending on the ripening times, PDO Cantal cheese

79 is labelled “Cantal Entre-Deux” or “Vieux” if it is ripened for three months or at least 8 months,
80 respectively. The sensory qualities (taste, odor, appearance and texture) of both Salers and
81 Cantal cheeses are dependent on the microbiological and biochemical composition of the milk
82 used and are strongly related to the cheese-making process and ripening technologies (Choisy
83 et al., 2000). Hence, flavor differences could be developed between Cantal and Salers cheeses,
84 and even between ordinary Salers cheese and Salers Tradition, depending on the ripening time.
85 In spite of relevant studies already focused on PDO Salers or Cantal cheeses, scientific studies
86 are very limited regarding the sensory differentiation between these two types of cheeses.
87 Sensory analysis techniques are important tools for product characterization, in developing and
88 reformulating food products or in the definition of consumer preferences (van Kleef et al., 2006;
89 Bruzzone et al., 2015). Sensory profiles performed by trained assessors are used to describe
90 precise qualities of a product. These data correlated with consumer preferences make it possible
91 to explain and understand the dynamic of the hedonic appreciation of products. Nevertheless,
92 other alternative methods can be considered to directly link consumer’s perception and product
93 characteristics. By using consumer opinions, it is possible to obtain a sensory description of the
94 products and better understand consumer preferences (Ares et al., 2017; Caspia et al., 2006;
95 Drake et al., 2009).
96 For this reason, consumer tests often include, in addition to overall liking, supplementary
97 questions such as attribute liking questions, intensity rating questions, open-ended questions or
98 just-about-right questions about the product attributes. Several authors have demonstrated that
99 supplementary questions could slightly influence overall consumer preference (Bruzzone et al.,
100 2015; Popper et al., 2004; Moskowitz, 2001). In recent years, a new approach has been
101 developed and largely used in hedonic tests: Check-all-that-apply (CATA) questions. This
102 methodology consists in checking off all the relevant attributes which characterize products
103 from a list of several attributes (sensory or not). It is an easy method to use, not tedious for

104 consumers (Ares et al., 2014; Jaeger et al., 2013; Jaeger and Ares, 2014; Laureati et al., 2017),
105 requiring minimal instruction and quickly completed. Previous studies have shown that sensory
106 characterization of products via sensory profile and CATA questions provided very good
107 agreement between the methods (Antúnez et al., 2017; Ares et al., 2010; Bruzzone et al., 2012;
108 Dooley et al., 2010). However, some studies have revealed a low discrimination potential in
109 products sets with subtle differences with the CATA method (Ares et al., 2015; Jaeger and Ares,
110 2014; Reinbach et al., 2014).
111 In this context, the aim of this study was (i) to investigate specific sensory characteristics of
112 Salers and Cantal cheeses using sensory characterization performed by trained assessors and by
113 consumers using CATA questions and (ii) to compare characterization results from the two
114 methodologies applied on cheese samples with a similar cheese-making.

115 ## 2. Materials and methods

116 ### 2.1 Sample selection

117 Two categories of cheeses Cantal (Can) and Salers (Sal), specific PDO French cheese samples
118 from the Auvergne region (France), were selected. Each category of cheeses was made from
119 either Salers raw milk (Can_SalM/Sal_SalM) or from milk of other cow breeds
120 (Can_OBM/Sal_OBM). A total of ten cheeses was analyzed (Table 1). In order to be
121 representative of existing sensory diversity, for each of these categories of cheeses stated, three
122 samples were selected, except for (Can_SalM) where a single sample was analyzed. All samples
123 were stored in the same maturing cellar and were analyzed at 12 months of ripening. This
124 process was implemented to control precisely the ripening conditions of the cheeses. Whole
125 cheeses (approximate weight of 40kg) were selected directly in the maturing cellar by supply-
126 chain professionals. Cheeses were stored in cold storage at 1°C for one week prior to analysis.

127 ### 2.2 Sensory Analysis

The sensory analysis by selected assessors was performed at SensCo Lab, VetAgro Sup (Clermont-Ferrand, France). This sensory trained panel with a prior testing experience on sensory characterization of cheeses (over more than 100 h of experience in descriptive analysis of dairy products) was used. The sensory panel consisted of 9 selected panelists (nine females, 40-70 years old). A training session was conducted including six 1-hour sessions. During this step, the panel developed a sensory grid describing samples and agreed upon a list of 26 terms (Table 2). The panel was trained to evaluate the intensity of these attributes on an unstructured scale using external references. A lexicon indicating definition, references and evaluation method for each attribute was elaborated.

Afterward, panel performances (consensus, discrimination and repeatability) were evaluated and verified. The results of two-way mixed-model ANOVA (product and panelists) with interaction obtained from training sessions indicated good discrimination by the panel and a good consensus concerning sensory attributes. The panel was consistent and reliable.

After the training session, samples were evaluated using a 10-cm non-structured scale. The left side of the scale corresponded to the lowest intensity of each attribute (value 0) and the right side corresponded to the highest intensity (value 10).

The rind of the cheese samples was removed and a rectangular portion (10*2 cm^2) weighing 50g was served to each assessor. The cheeses were tempered to 19°C ± 1°C; they were taken out of the cold-storage room 20 minutes before tasting. Mineral water (Evian, France) and unsalted crackers were served to rinse the mouth during the test. Samples were coded using 3-digit random numbers. Each sample was presented monadically according to a Latin square design at an individual booth. Five samples were analysed per one-hour session. Two replicates of each cheese sample were evaluated by each panelist.

All tests took place in individual sensory booths designed in accordance with ISO 8589 (ISO, 2007) and the room temperature was controlled at 21 ± 1°C. Data acquisition for the sensory profile was carried out using Tastel software (ABT Informatique, Rouvroy-sur-Marne, France).

2.3 Hedonic test

A total of one hundred and fifty-two consumers were recruited to participate in this study. They were recruited from previous databases and by e-mail. They were selected according to their consumption of any type of raw milk cheese, more specifically Cantal, Salers and Laguiole and to their ages (adults over 18 years old). The tests were carried out at home because the initial protocol had to be adapted due to the Covid19 sanitary crisis. It consisted of two tasting sessions at the participants' homes according to a defined protocol. Firstly, each participant selected for consumer tests picked up a bag containing: ten anonymized cheese samples of 100g (wrapped in aluminum foil and labelled with three-code numbers), an information sheet with the tasting instructions and two questionnaires called Sensory questionnaire and Survey questionnaire. An instructive video with a demonstration of tests deployment at home was also sent by e-mail to the participants to clearly explain the protocol of tasting and to facilitate the understanding of the assessments. Each participant signed a voluntary informed consent.

Sensory questionnaire: the objective of this questionnaire was to record the hedonic scores given by the participants during the tasting sessions at home. All of the consumer tasting tests lasted a week and each participant agreed to carry out two tasting sessions at home, according to the instructions given, and to record their hedonic perceptions in the questionnaire. In order to avoid inappropriate tasting practice and situations differing from controlled tasting made in a sensory laboratory, some rules were given to the consumer panel. For example, cheeses could not be submitted to cooking before tasting; consumers could not taste the cheeses with bread or other foods; but they could taste the cheeses at any time of the day in a calm environment. During each session (about 30 min), consumers were asked to taste five cheese samples. For

each cheese sample, they were asked to score the cheese sample for overall liking, taste liking and texture liking on a 10-cm non-structured scale from “0 = I don’t like at all” to “10 = I like very much”. Moreover, a CATA task was requested of the consumers with 16 terms to characterize each sample. These 16 terms included sensory terms like some of those used in sensory profiles, as well as general hedonic terms. The CATA list was randomized for each consumer according to recommendations of Ares et al (2014). An optional question about qualities and defects of cheeses was given to complete this characterization. Finally, to control the tasting conditions, the consumers were asked to provide the following information from the home test: the tasting hour, the last meal hour, the consumption of the entire sample and the consumption of the rind, tasting alone or with other people. The serving order was randomized. Consumers were asked to rinse their mouths between two samples with tap water.

A survey: In addition to the sensory questionnaire, a survey was completed to collect information on their consumption habits, consumption frequency and socio-demographic characteristics. This questionnaire was filled in after the participants had completed both tasting sessions. Consumption frequency of different categories of cheeses (Cantal, Salers and other cheeses) was reported. All items were assessed on a 4-point scale: ″Daily″, ″Several times a week″, ″A few times a month″, ″Never”.

2.4 Statistical analysis

Data acquisition for the sensory profile was carried out using Tastel software (ABT Informatique, Rouvroy sur Marne, France). For further statistical analysis, the data were exported and analyzed with XLSTAT statistical software, 2017 (Addinsoft, Paris, France).

2.4.1 Sensory analysis

A three-way mixed model ANOVA (cheese sample, panelist and session) with first-order interactions was performed on the sensory data, considering product and session as a fixed

200 source of variation and the panelist as a random effect, at a significance level of $p \leq 0.05$. A
201 second three-way ANOVA (cheese's category, panelist and session) with first-order
202 interactions were done to identify the effect on cheese's category on the sensory attributes.
203 Significant differences between products were evaluated by a Tukey's test.
204 A Principal component analysis (PCA) was applied on the score means of the discriminant
205 attributes to obtain the sensory map of products. Ten cheeses were selected as active
206 observations and each cheese category mean was selected as supplementary observations.
207 Further, a Hierarchical Cluster Analysis (HCA) was performed using a Ward's criterion and
208 Euclidian distance matrices. In this analysis, three dimensions resulting from PCA were
209 considered.
210 A multiple factor analysis (MFA) was performed to identify the similarity between the product
211 configuration from the sensory profile and CATA task. This method was applied by using two
212 tables, a frequency matrix corresponding to CATA task and another matrix corresponding to
213 score intensity means for the sensory profile. To show a good congruence between the two
214 techniques, a Regression Vector (RV) coefficient was calculated. The significance of the
215 coefficient was evaluated using a permutation test, as suggested by Josse et al. (2008).

216 **2.4.2 Hedonic test**

217 The effects of cheeses or cheese category on the liking scores were studied by using two
218 ANOVA separately. A two-way mixed model analysis of variance (ANOVA) was analysed
219 considering the consumer as a random effect and "cheese" or "cheese category" as a fixed
220 effect. When the effects were significant, significant differences were evaluated using Tukey's
221 test for a confidence level of 95%.
222 In the CATA task, the frequency of each term was calculated by counting the number of
223 consumers that used that term for each product. Cochran's Q test was used to determine a
224 significant difference between the samples for each term. Correspondence analysis was

225 performed on the frequency tables to obtain a bidimensional representation of the relationship
226 between samples and attributes. Finally, a segmentation was performed on the contingency
227 table, using Hierarchical Cluster analysis (HCA) in order to identify clusters of cheeses. A Ward
228 ′s method and Euclidian distance were performed.

229 # 3. Results and discussion

230 ## 3.1 Sensory analysis

231 Descriptive analysis results demonstrated significant differences in appearance, flavor and
232 texture attributes between the different samples of cheeses and between cheese categories as
233 shown in Table 3. Twenty-one sensory attributes out of twenty-six were significant ($p<0.05$).
234 Most sensory attributes discriminated the ten different samples of cheese. For instance, the
235 cheeses J, H and L strongly differed from the others; while cheese H was mainly distinguished
236 by its aromatic profile. Cheese J stood out by its firmness and the rind's thickness. In contrast
237 to these cheeses, cheese L was characterized by its melty and fatty texture.
238 Regarding the four categories of cheeses, significant differences were also observed in the
239 different sensory attributes (20 attributes out of 26). Sal_SalM category was more bitter than
240 the other categories. Sal_OBM had the darkest rind and core and had the thickest rind in
241 comparison with the other cheese categories. Sal_OBM and Sal_SalM had a more intense
242 aromatic profile (i.e Overall_O; Animal_O, Vegetal_O; Atypical_A; Animal_A) than
243 Can_OBM and Can_SalM. Can_SalM was differentiated by its sour taste and pungent sensation
244 in comparison with Sal_SalM.
245 The principal component analysis was performed to visualize the overall positioning between
246 cheeses in relation to significant sensory attributes (Figures 1a and 1b). The mean of all four
247 cheese categories was added as illustrative observations.
248 Three principal components (PC) explained 78.65% of the total variance. The first dimension
249 PC1 (36.67% of the variance) differentiated cheeses by sensory texture such as Firmness (by

250 touch and in mouth), grainy, residue (loading positively). E, F and J cheeses were characterized
251 by these attributes while L, G, K and I cheeses, positioned on the negative side, were
252 characterized by melty and fatty texture.
253 The second dimension (27.58% of the variance) mainly separated cheeses according to the
254 cheese's category (Salers versus Cantal). On the positive side, H cheese seems isolated in
255 comparison with other cheeses thanks to an intense flavor profile, characterized by ammonia
256 aroma, overall odor, Animal aroma and atypical Aroma. This cheese was also characterized by
257 appearance attributes (i.e rind color, rind thickness and core color). In contrast, D and C cheeses
258 presented weak flavor profiles.The third component (results not shown) essentially
259 differentiated cheeses by taste attributes (loading positively): sour and salty tastes and pungent
260 sensation describing Can_SalM
261 A Hierarchical Cluster analysis (HCA) performed on the three first principal components
262 identified three clusters of cheese categories, which are illustrated in Figure 1. The majority of
263 Salers cheeses (G, H, I, K and L cheeses) were found in the first cluster (n=5). The second
264 cluster C2 (n=2) contained one Cant_OBM (D cheese) and one Cant_SalM cheese (C cheese).
265 The third cluster C3 (n=3) was formed by two Can_OBM (F and E cheeses) and one Sal_OBM
266 (J cheese). This result revealed that four cheese categories are not easily distinguished. Indeed,
267 the type of milk does not seem to have any influence on this distinction. The cheese-making
268 practise factor (Salers process versus Cantal process) seems to have more weight in it.
269 Moreover, from these results, a sensory diversity within the same category was observed.
270 Indeed, J cheese did not cluster within the Salers cheese category. Globally, Salers cheeses
271 distinguished more specifically by their strong flavor and by their appearance due to their
272 specific rind while the Cantal category differed by its texture and some appearance elements.
273 Very little previous work has documented the difference between Cantal and Salers cheeses.
274 According to Lebecque et al. (2001), Salers cheeses (3.5 months of ripening) offer a large

diversity of texture in relation to molecular and macroscopic levels. As suggested by Verdier-Metz et al. (2002) and Coulon et al. (2005), the sensory properties of the resulting cheese depend on a large number of factors, related to both the cheese-making practices used and the chemical characteristics and microbiological properties of the raw material used. It is recognized that Salers cheese has a great sensory diversity, which has been associated with a wide diversity of microbial dynamics (Callon et al., 2005, Duthoit et al., 2005). Indeed, one of the most original characteristics of the cheese is that the raw milk directly from milking must be curdled in a wooden vat called "gerle" which plays a key role in the microbial qualities, and hence on the sensory qualities of the cheeses. Even if in the current study, several parameters were taken to reduce external variations such as ripening conditions (same conditions of ripening), differences were observed. This diversity can be explained by the fact that the breeding practices are quite diverse, especially for Salers milk cheeses. For instance, calf sucking before milking reinforces the differences between Salers production (Agabriel et al., 2014)

3.2 Hedonic test

3.2.1 Liking score

Overall, taste and texture liking score means are presented in Table 4. The results of ANOVA showed a significant difference in overall and taste liking scores ($p<0.05$) between ten cheeses but no significant difference was observed in the texture liking score. However, the differences found were very weak. Indeed, liking scores vary from 5.2 to 6.5. More specifically, H cheese obtained the lowest overall liking score and D, F and K cheeses obtained the highest overall liking scores (>6.2). Regarding each cheese category mean, Sal_SalM category was significantly less appreciated than the Can_SalM and Sal_OBM cheeses. The same result was observed for the taste liking score, suggesting a correlation between both criteria. As suggested by Nacef et al. (2019), familiarity can include two elements (consumption frequency and knowledge of the product) and could interact on the liking and expectation of consumers. In

300 this case, consumers are familiar with typical regional cheeses but consumers have a higher
301 frequency of weekly consumption of Cantal (36%) cheese than that of Salers (11%). Moreover,
302 only 29% of consumers know the label "Tradition Salers". As a result, the low frequency
303 consumption and their low level of knowledge could explain these overall liking scores. On the
304 other hand, the taste liking score was slightly lower for Salers cheeses than Cantal cheeses. This
305 could also be explained by the fact that the cheeses were matured for 12 months, developing
306 specific flavors which perhaps are only appreciated by lovers of typical cheeses.
307 In addition, the fact that the consumer test was carried out at home could influence the liking
308 score. Indeed, as suggested by different authors (Cardello et al., 2000; Meiselman, 1992;
309 Kozlowska et al., 2003), the eating environment or social settings may influence the liking
310 perception. Using a laboratory test, consumers focus on the sensory characteristics of the
311 products without being influenced by external variables related to these conditions but this test
312 does not reflect real life consumption. In a study performed on cheese, Hersleth et al., (2005)
313 demonstrated that changing environments and the degree of social interaction in consumer tests
314 had no significant effect on hedonic liking of cheeses.
315 **3.2.2 CATA task**
316 The ranges of total citation for CATA terms within each cheese are revealed in Table 5.
317 Cochran's test showed significant differences between cheeses for the majority of terms except
318 for the following terms: pleasant flavor, tasteless, persistent flavor and strong flavor.
319 The terms 'melty', 'salty', 'firm', and 'rind thickness' showed the highest frequency of use to
320 describe the sensory characteristics of the cheeses. These terms showed an average frequency
321 of use higher than 25%. For instance, the term frequency "rind thickness" was cited more for
322 cheese J than for cheese D.
323 In order to illustrate the dissimilarity between cheese samples using a contingency table, a
324 correspondence analysis was performed (Figure 2). The two first dimensions 1 and 2 explained

an average of 74.8% of the total variance. In addition, an agglomerative Hierarchical Clustering (AHC) was performed on the contingency table. Four distinct cheese clusters were identified. These different clusters were reported in the CA plot. A first group (n=2), located at positive values of the first dimension which explained 48% of the variance, was composed by cheeses C and D and was described with notable characteristics of "Odorless and Tasteless". This first cluster was sorted apart from other cheeses J and H. These latter two cheeses formed the second cluster that located at negative values and were characterised by the following terms: odor intensity (rind), strong odor, dark color of core and rind's thickness. Finally, two groups were identified around the second dimension (26.24% of the variance), with positive values on this dimension. The third cluster consisted of three cheeses F, E and L were characterised by the term "crumbly". By contrast (negative loading of the second dimension), the fourth cluster including cheeses K, G and I, was described using terms such as "Bitter and unpleasant flavor and firm". Overall, consumers were able to discriminate cheeses using these CATA terms and to differentiate two categories of cheeses: Salers and Cantal cheeses. On the other hand, consumers were not able to differentiate the cheeses according to the type of milk used, suggesting that the milk used did not have significant influence on cheese perceptions.

3.3 Comparison of product descriptions by CATA and sensory profile

Individual product maps were created by MFA, using sensory profiles and consumer CATA counts. Figure 3 represents the centroid point resulting from the coordinates of the MFA and the partial points obtained by each method, for each sample cheese, in the two first dimensions of MFA (Figure 2). 64.5% of the variability was explained by the two first MFA dimensions. For each cheese, there are two partial points (one for each sensory method) and they are linked to the centroid point. The closer these partial projections are to the centroid, the greater the similarity between the descriptions obtained by the two methods (Pagès, 2005). The

representations of each method (partial points) are close to the centroid point for the majority of cheeses, indicating that all cheeses were characterized in a similar way except for some cheeses such as L, J and D. Products were better described by sensory profile than those by CATA task in the second dimension. The MFA results were supported by the significant correlation value ($P < 0.05$) between RV CATA_Sensory profile = 0.74. This correlation confirmed an agreement between the two methods but some slight differences were observed. In comparison with other studies, this coefficient RV was weaker than previous studies focused on other products.

Figure 4 shows the variable correlation circle obtained by MFA comparing sensory profile and CATA terms. The vectors show a strong relation between sensory attributes (SP) and those found with CATA terms (C). In this sense, the same direction was observed in the factorial plane for several attributes. Indeed, in the first dimension, attributes Strong-O (C) was related with overall odor (SP) whereas Much Strong Flavor (C) was related with Animal_A (SP), Ammonia_A (SP) or Atypial_A (SP) respectively. In the second dimension, Melty (SP) and Melty (C) are related.

In the same figure, antonymic attributes defined by having opposite directions were observed (i.e., pleasant flavor (C) vs animal_A or Atypical_A), as well as related attributes (i.e., Unpleasant flavor (C) related with animal_A or Atypical_A). By contrast, the salty taste is perceived differently between the two panels and is opposed. This is quite surprising given that it is a term generally used to describe cheeses. According to Ramírez-Rivera et al. (2017b) antonymic attributes can be the result of the differences of perceived intensity and the use of different terms for describing the same sensation. On the other hand, depending on consumers' exposure to more or less salty products and their consumption habits, the perception is not the same. In addition, we can highlight the fact that the temperature was not controlled during the home test, which may have affected certain sensory modalities such as flavor.

375 Our results confirm those already identified in the literature. Indeed, consumers are able to use
376 the CATA task to perform sensory characterization of products and identify significant
377 differences between products (Ares et al., 2015; Da Conceição Jorge et al., 2015).
378 The results of this study showed that the product configuration is similar between both methods
379 but the RV coefficient obtained was to 0.74 (which is significant, p=0.001). This RV coefficient
380 might be slightly weak in comparison with previous studies by comparing CATA task with
381 other sensory methods. Ares et al. (2014) indicated that the instability of product configuration
382 could be explained by the inclusion of hedonic terms in the CATA task because of the consumer
383 preference's heterogeneity. In contrast, Lelièvre et al., (2008) reported that RV coefficients
384 from 0.65 to 0.71 revealed a good agreement between consumer configurations and a trained
385 panel while Lawless and Glatter (1990) considered an RV value of 0.85 as an indicator of good
386 agreement between methods. Furthermore, in our study, 152 consumers participated, a number
387 that seems reasonable to obtain a stable product configuration (Ares et al., 2014). Despite a
388 degree of similarity in the description and configuration, quantitative differences between
389 samples for the same attribute were observed. Consensus on technical or specific terms seems
390 to be more difficult to achieve, especially in relation to flavor. For instance, bitter and salty
391 tastes were significant in both methods but their representation was not the same direction on
392 the plot MFA. As suggested by various authors, confusion between certain attributes by
393 consumers can explain this difference, in particular bitter taste (O'Mahony et al., 1979). As
394 demonstrated by Alexi et al. (2018), a training or a short explanation of complex terms to
395 consumers can improve their understanding and thus their subsequent selection. This
396 observation indicates that even common terms, which seem easy such as salty taste, may require
397 a definition in order to obtain accurate evaluation. In our study, appearance and texture
398 attributes seem to have been the easiest to assess and closest to the description with the
399 descriptive analysis. These authors showed that consumers do not select all the CATA terms

perceived in a given sample, but only those that exceed or dominate in the product. As a result, for a specific sensory attribute, relative differences may appear between samples by differing in the citation frequency and its intensity. Citation frequencies for CATA terms are a good indicator of perceived intensity, but are not a direct measure of intensity (Jaeger et al., 2020). Despite the fact that the liking scores did not indicate a large difference between the ten cheeses, these results showed that consumers are able to describe and qualify the differences between the cheeses and that their perceptions were similar to those identified with sensory profile. However, for more complex attributes in relation with flavors, a CATA task with consumers seems to be insufficiently detailed and not consensual.

The CATA task provides reliable qualitative information similar to the sensory profile. However, for some attributes, as pointed out by other authors (Alexi et al., 2018), citation frequency may be an indicator of the intensity of the attributes but does not represent a direct measure to reflect the real intensity of perceived sensation as rated with an intensity scale. CATA results did not provide the same range of differences with DA, especially for flavors.

The comparison of the configuration of the ten cheeses between sensory profile and CATA task shows a similar configuration but few differences are observed. These results confirm those suggested by other authors (Cruz et al., 2013; Da Conceição Jorge et al., 2015; Dooley et al., 2010; Jaeger et al., 2020) indicating that the links between both approaches provide similar information regarding the main characterization of products. Nevertheless, sensory profile generates a more specific and targeted degree of details in sample description compared to CATA task as suggested by Ares et al. (2015). Indeed, several authors have reported that a trained panel to the recognition of sensory attributes is able to detect smaller differences among products in comparison with an untrained panel (Barton et al., 2020; Guerrero et al., 1996; Labbe et al., 2004). Consumers are able to discriminate and characterize the cheeses using the terms mentioned but do not really know the perceived intensity of these attributes, which can

425 sometimes be the limit of this technique and which may explain the differences in configuration
426 with the sensory profile. However, with the CATA questions, it is possible to insert hedonic
427 terms and thus link them with the more descriptive terms.
428

429 ## 3.4 Limitations and suggestions for additional research

430 Some limitations of the current study should be noted. There is a lack of representativeness
431 concerning one of the categories, which does not make it possible to highlight the impact of
432 milk. Indeed, very few dairy industries produce Cantal with Salers milk which led to an
433 unbalanced experimental design. On the other hand, the fact that this study was carried out at
434 home but with some tasting constraints may have influenced the results and, as a result, the
435 consumers' preference scores were not very discriminating. Similarly, it might have been
436 interesting to put an identical number of terms in the CATA list in order to observe if consumers
437 were able to use the terms in the same way than the qualified panel and if those supplementary
438 specific attributes would allow for better discrimination between cheeses.
439

440 # 4. Conclusion

441 The characterization or differentiation for this type of cheese is usually done by a biochemical
442 or microbiological approach. There is a lack of sensorial studies evaluating acceptance and
443 sensory qualities regarding Salers and Cantal.
444 In this study, a sensory approach was selected to characterize and differentiate 10 uncooked
445 cheeses, Salers and Cantal cheeses, divided into 4 distinct categories. The results showed that
446 the sensory differentiation is more influenced by the cheese-making practise used than milk
447 production. Salers category is distinguished by a more intense aromatic profile than Cantal
448 category. This characterization showed a good agreement and similar results between the
449 sensory profile and the CATA task done by consumers. Although there are few differences

between consumer preferences on the 10 cheeses, it is interesting to highlight that, with the CATA method, consumers are able to distinguish more differences and characterize the cheeses. This result shows the validity of CATA method, which can be considered simple and more natural tasks for consumers to describe the sensory characteristics. Moreover, this method provides additional information in order to better understand the consumer preference of studied products that are very similar.

These results could help the supply-chain to communicate and to better explain to consumers the sensory differences between these two products, which are sometimes poorly distinguished by consumers during purchase. Recognized qualities of Salers cheeses and in particular sensory properties could contribute to its development and a significant gain to various local actors. In addition, it might be interesting to further investigate, in particular by integrating data on breeding practices in order to better understand the sensory differences observed within a cheese category.

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474 TABLE

475 Table 1: Description of the cheeses

Cheeses	Type of milk	Producer / Dairy	Code	Cheese's category
Cantal	Salers milk	Dairy 1	C	**Can_SalM**
Cantal		Dairy 1	D	**Can_OBM**
Cantal	Other cow breed milk	Producer 1	E	**Can_OBM**
Cantal		Producer 2	F	**Can_OBM**
Salers		Producer 3	G	**Sal_SalM**
Salers	Salers milk	Producer 4	H	**Sal_SalM**
Salers		Producer 5	I	**Sal_SalM**
Salers		Producer 6	J	**Sal_OBM**
Salers	Other cow breed milk	Producer 7	K	**Sal_OBM**
Salers		Producer 8	L	**Sal_OBM**

476

477 Table 2: Sensory attributes and definition for the sensory profile of cheeses

Sensory Attribute	Definition
Appearance	
Rind color	Refers to the intensity of the brown color of the rind irrespective of irregular bumps and mold
Rind thickness	Refers to the thickness of the rind
Core Color	Refers to the intensity of the yellow color of the core (from ivory color to dark yellow color)
Color homogeneity_Core	Refers to the color gradient at the surface of the core
Marbled core	Refers to the lighter areas at the surface of the core
Cracked core	Refers to the presence of rift at the surface of the core
Texture evaluated by touch	
Firm_T	Ability of the core to resist to a deformation constraint after being pressed by a finger
Odor	
Overall odor	Overall intensity of odor, including all kinds of odor perceived
Animal odor	Characteristic barn odor or live ruminant animal (mixture of hair, barn, fresh litter, leather).
Mushroom odor	Characteristic fresh mushroom odor (like button mushroom type)
Lactic odor	Characteristic lactic note odor (fresh milk or butter)
Taste	
Salty	Taste of aqueous solutions rich in salt such as sodium chloride
Sour	Taste of aqueous solutions acidified by lactic acid
Bitter	Taste of aqueous solutions rich in bitter substances like caffeine
Pungent	Refers to a tingling sensation in the mouth, which could be felt in the case of aged hard-cheeses
Aroma	
Global aroma	Overall intensity of aroma perception, without distinction of its components of the cheese
Mushroom aroma	Characteristic mushroom aroma (button mushroom type)
Nutty aroma	Refers to the nutty notes, which describe the aroma of nuts (hazelnut, almond…)
Vegetal aroma	Refers to fresh grass, dried grass (cut grass, hay…)
Lactic aroma	Refers to the lactic note (fresh milk or butter)
Ammonia aroma	Characteristic ammonia aroma (like overripe soft cheese, type camembert or Brie)
Animal aroma	Characteristic aroma of barn or live ruminant animal (mixture of hair, barn, fresh litter, leather).
Atypical aroma	Aroma associated with aromas that should not normally be present in cheese (cardboard, plastic, fish, chemical product, etc.)
Persistence	Refers to remnant flavors perceived after swallowing
Texture in mouth	
Sticky	Product that adheres to the palate and teeth
Melty	Product that forms a core with saliva and melts continuously in the mouth and spreads in the mouth.
Crumbly	Product that easily breaks into pieces during chewing
Fatty	Perception of fat contained in the cheese during chewing
Firm_M	Ability of the core to resist to a deformation constraint due to the first chewing
Grainy	Product having a dry, rough, crumbly core in the mouth
Residues	Solid particles remain in the mouth after swallowing

478 T= texture by touch; M = texture in mouth

480 Table 3: score Mean (±SD) for each sensory attribute of ten cheeses and score mean (SD) for each cheese category

	Products	Can_SalM †				Can_OBM †					Sal_SalM †				Sal_OBM †				
	Sensory attributes	C		D		E		F		Mean	G		H		I	Mean	J		K		L	Mean
APPAREANCE; TEXTURE IN FINGER	Rind's thickness	4.1	(1.4)$^{e; D}$	3.4	(1.5)^{e}	6.7	(1.0)^{bc}	6.9	(1.3)^{bc}	5.7 (2.3) ^{C}	5.5	(1.3)^{d}	7.6	(1.3)^{ab}	6.8 (1.3)^{bc}	6.6 (1.8) ^{B}	8.4	(1.3)^{a}	6.5	(1.2)^{cd}	6.6 (1.3)^{c}	7.2 (1.7) ^{A}
	Rind's color	4.1	(1.3)$^{d; D}$	4.0	(1.6)^{d}	7.6	(0.7)^{ab}	7.0	(1.1)^{b}	6.2 (2.2) ^{C}	5.9	(1.1)^{c}	7.3	(1.1)^{b}	6.9 (1.1)^{b}	6.7 (1.7) ^{B}	8.4	(1.1)^{a}	7.6	(0.8)^{ab}	6.9 (1.1)^{b}	7.7 (1.3) ^{A}
	Color homogeneity	7.0	(1.1)$^{a; A}$	6.7	(1.0)^{a}	5.5	(1.1)^{bcd}	5.0	(1.5)^{d}	5.7 (1.8) ^{C}	6.4	(1.5)^{ab}	5.2	(1.5)^{cd}	6.2 (1.5)^{abc}	6.0 (1.9) ^{BC}	4.9	(1.5)^{d}	6.6	(1.3)^{ab}	7.0 (1.0)^{a}	6.2 (2.0) ^{B}
	Color_core	5.7	(1.2)$^{def; C}$	5.0	(1.2)^{f}	6.0	(1.1)^{cde}	5.5	(1.0)^{def}	5.5 (1.4) ^{C}	5.4	(1.0)^{ef}	6.9	(1.0)^{abc}	7.0 (1.0)^{ab}	6.4 (1.6) ^{B}	7.0	(1.0)^{ab}	7.4	(1.0)^{a}	6.3 (1.1)^{bcd}	6.9 (1.6) ^{A}
	Cracked_core	4.3	(1.7)$^{b; B}$	4.9	(1.3)^{ab}	4.2	(1.8)^{b}	5.8	(1.9)^{a}	5.0 (2.2) ^{A}	2.2	(1.9)^{c}	3.9	(1.9)^{b}	3.6 (1.9)^{bc}	3.3 (2.3) ^{D}	4.5	(1.9)^{ab}	3.9	(2.5)^{b}	2.4 (1.9)^{c}	3.7 (2.6) ^{C}
	Marbled_core	4.2	(1.5)$^{d; C}$	4.2	(1.6)^{cd}	5.5	(1.3)^{ab}	5.5	(1.0)^{ab}	5.1 (1.9) ^{AB}	4.4	(1.0)^{bcd}	5.5	(1.0)^{abc}	4.6 (1.0)^{bcd}	4.8 (2.2) ^{B}	6.1	(1.0)^{a}	6.5	(1.3)^{a}	3.8 (2.1)^{d}	5.5 (2.4) ^{A}
	Firm_T	6.2	(1.2)$^{cd; B}$	6.7	(1.2)^{abcd}	7.7	(1.1)^{ab}	7.2	(1.1)^{abc}	6.1 (1.8) ^{A}	6.1	(1.1)^{d}	5.9	(1.1)^{d}	6.0 (1.1)^{d}	5.4 (2.0) ^{B}	7.8	(1.1)^{a}	6.7	(1.3)^{bcd}	5.9 (1.5)^{d}	5.7 (2.1) ^{AB}
FLAVOR	Overall odor	5.7	(1.2)$^{bc; B}$	6.0	(1.0)^{bc}	6.0	(0.9)^{bc}	5.5	(1.2)^{c}	5.8 (2.1) ^{B}	5.9	(1.2)^{bc}	6.9	(1.2)^{a}	6.0 (1.2)^{bc}	6.3 (2.0) ^{A}	6.5	(1.2)^{ab}	6.3	(0.9)^{ab}	6.1 (0.9)^{abc}	6.3 (2.1) ^{A}
	Animal odor	3.1	(1.5)$^{ab; B}$	3.4	(1.3)^{ab}	3.4	(1.8)^{ab}	2.6	(1.6)^{b}	3.1 (2.1) ^{B}	3.7	(1.6)^{ab}	4.2	(1.6)^{a}	3.6 (1.6)^{ab}	3.8 (2.0) ^{A}	3.9	(1.6)^{a}	4.1	(1.7)^{a}	3.6 (1.6)^{ab}	3.9 (2.1) ^{A}
	Mushroom odor	1.5	(1.0)$^{a; AB}$	1.6	(2.0)^{a}	1.3	(1.3)^{a}	1.6	(1.2)^{a}	1.6 (1.8) ^{B}	1.6	(1.2)^{a}	2.2	(1.2)^{a}	1.8 (1.2)^{a}	1.9 (1.9) ^{A}	1.8	(1.2)^{a}	1.7	(2.0)^{a}	1.7 (1.8)^{a}	1.8 (1.9) ^{AB}
	Global aroma	1.7	(1.9)$^{a\ A}$	1.3	(1.8)^{a}	1.1	(1.3)^{a}	0.9	(1.2)^{a}	6.1(1.5) ^{A}	1.5	(1.2)^{a}	2.1	(1.2)^{a}	1.3 (1.2)^{a}	6.4 (1.4) ^{A}	1.5	(1.2)^{a}	1.5	(1.6)^{a}	1.2 (1.6)^{a}	6.3 (1.5) ^{A}
	Animal aroma	2.3	(1.3)$^{ab; BC}$	2.2	(1.8)^{ab}	2.4	(1.3)^{ab}	1.9	(1.1)^{b}	2.2 (1.8) ^{C}	3.2	(1.1)^{a}	3.2	(1.1)^{a}	2.6 (1.1)^{ab}	3.0 (2.0) ^{A}	3,0	(1.1)^{ab}	2.6	(1.4)^{ab}	2.3 (1.2)^{ab}	2.6 (1.9) ^{B}
	Atypical aroma	1.6	(1.6)$^{b; B}$	1.1	(1.5)^{b}	2,0	(1.6)^{b}	2.2	(1.8)^{b}	1.8 (2.2) ^{B}	2.0	(1.8)^{b}	3.6	(1.8)^{a}	2.0 (1.8)^{b}	2.6 (2.5) ^{A}	2.3	(1.8)^{ab}	2.2	(2.4)^{ab}	2.3 (2.0)^{ab}	2.4 (2.5) ^{A}
	Nutty aroma	2.6	(2.2)$^{a; A}$	2.2	(1.8)^{a}	1.9	(1.6)^{a}	2.3	(1.5)^{a}	2.2 (1.9) ^{B}	1.4	(1.5)^{a}	1.6	(1.5)^{a}	2.2 (1.5)^{a}	1.8 (2.0) ^{C}	2.1	(1.5)^{a}	2.0	(1.5)^{a}	1.9 (1.5)^{a}	2.1 (2.0) ^{B}
	Vegetable aroma	3.0	(1.6)$^{a; BC}$	3.2	(1.7)^{a}	2.8	(1.4)^{a}	2.7	(1.3)^{a}	2.9 (1.9) ^{C}	3.5	(1.3)^{a}	3.7	(1.3)^{a}	3.6 (1.3)^{a}	3.6 (2.1) ^{A}	3.6	(1.3)^{a}	3.1	(1.4)^{a}	3.1 (1.6)^{a}	3.3 (2.1) ^{AB}
	Salty	6.8	(1.3)$^{ab; A}$	6.6	(0.6)^{ab}	6.6	(0.9)^{ab}	6.5	(1.0)^{ab}	6.5 (1.2) ^{A}	6.6	(1.0)^{ab}	7.1	(1.0)^{a}	6.3 (1.0)^{b}	6.6 (1.3) ^{A}	6.9	(1.0)^{ab}	6.4	(1.0)^{ab}	6.5 (0.9)^{ab}	6.6 (1.3) ^{A}
	Sour	3.4	(1.6)$^{a\ ; A}$	2.8	(1.6)^{a}	2.9	(1.8)^{a}	3.2	(2.0)^{a}	3.0 (2.2) ^{AB}	2.8	(2.0)^{a}	3.0	(2.0)^{a}	2.3 (2.0)^{a}	2.7 (2.2) ^{C}	3.0	(2.0)^{a}	2.6	(1.7)^{a}	2.8 (1.8)^{a}	2.9 (2.1) ^{BC}
	Bitter	3.3	(1.7)$^{b; B}$	3.2	(1.9)^{b}	3.7	(1.9)^{ab}	3.4	(1.7)^{ab}	3.5 (2.2) ^{B}	4.8	(1.7)^{a}	3.9	(1.7)^{ab}	3.4 (1.7)^{b}	4.0 (2.4) ^{A}	3.8	(1.7)^{ab}	4.0	(2.1)^{ab}	3.2 (1.8)^{b}	3.7 (2.3) ^{B}
	Pungent	4.3	(2.0)$^{a\ ; A}$	3.2	(1.9)^{ab}	3,0	(2.3)^{ab}	3.5	(2.4)^{ab}	3.3 (2.6) ^{B}	3.3	(2.4)^{ab}	3.4	(2.4)^{ab}	2.6 (2.4)^{b}	3.1 (2.7) ^{B}	3.8	(2.4)^{ab}	2.6	(2.0)^{b}	3.1 (2.1)^{ab}	3.2 (2.6) ^{B}
TEXTURE IN MOUTH	Sticky	3.5	(1.5)$^{a; A}$	4.1	(1.2)^{a}	3.5	(1.9)^{a}	3.9	(1.5)^{a}	3.9 (2.0) ^{A}	3.6	(1.5)^{a}	3.8	(1.5)^{a}	3.2 (1.5)^{a}	3.6 (1.8) ^{A}	3.3	(1.5)^{a}	3.7	(1.1)^{a}	4.1 (1.1)^{a}	3.7 (2.0) ^{A}
	Firm_M	5.6	(1.8)$^{cd; C}$	5.5	(1.4)^{cd}	6.8	(1.1)^{ab}	6.0	(1.6)^{abc}	7.2 (1.5) ^{A}	5.6	(1.6)^{bcd}	4.9	(1.6)^{cd}	5.6 (1.6)^{bcd}	6.0 (1.8) ^{C}	6.8	(1.6)^{a}	5.7	(1.5)^{abcd}	4.5 (1.7)^{d}	6.8 (1.9) ^{B}
	Melty	3.7	(1.2)$^{bc; A}$	4.5	(1.5)^{ab}	2.7	(1.5)^{c}	3.3	(1.1)^{bc}	3.6 (2.0) ^{A}	3.8	(1.1)^{bc}	4.5	(1.1)^{ab}	3.5 (1.1)^{bc}	3.9 (2.2) ^{A}	2.7	(1.1)^{c}	3.6	(1.2)^{bc}	5.3 (1.5)^{a}	3.9 (2.2) ^{A}
	Crumbly	3.7	(1.2)$^{bcd; AB}$	3.1	(1.6)^{cd}	4.5	(1.3)^{ab}	4.0	(1.4)^{bc}	3.9 (2.2) ^{A}	3.4	(1.4)^{bcd}	3.3	(1.4)^{bcd}	3.6 (1.4)^{bcd}	3.4 (2.4) ^{B}	5.4	(1.4)^{a}	3.4	(1.5)^{bcd}	2.5 (1.4)^{d}	3.8 (2.2) ^{AB}
	Grainy	4.1	(1.5)$^{abc; AB}$	3.1	(1.4)^{cd}	4.5	(1.3)^{ab}	4.4	(1.6)^{ab}	4.0 (2.0) ^{A}	3.6	(1.6)^{bcd}	3.1	(1.6)^{cd}	3.6 (1.6)^{bcd}	3.5 (2.1) ^{B}	5.1	(1.6)^{a}	3.1	(1.4)^{cd}	2.5 (1.2)^{d}	3.6 (2.1) ^{AB}
	Fatty	4.5	(1.3)$^{bc; B}$	5.0	(1.1)^{abc}	4.0	(1.5)^{c}	4.7	(1.2)^{abc}	4.6 (1.7) ^{B}	4.8	(1.2)^{abc}	5.3	(1.2)^{ab}	4.4 (1.2)^{bc}	4.8 (1.9) ^{AB}	4.4	(1.2)^{bc}	5.1	(1.2)^{abc}	5.7 (1.6)^{a}	5.0 (1.9) ^{A}
	Residue	4.5	(2.0)$^{abc; A}$	3.6	(1.8)^{bc}	4.8	(1.6)^{ab}	4.8	(1.8)^{ab}	4.4 (2.1) ^{A}	4.2	(1.8)^{abc}	3.6	(1.8)^{bc}	4.2 (1.8)^{abc}	4.0 (2.4) ^{B}	5.3	(1.8)^{a}	4.0	(1.9)^{abc}	3.2 (2.1)^{c}	4.2 (2.4) ^{AB}

481

482 *Values corresponding to the mean of intensity scores calculated on nine panelists for the three replications. Intensity of attribute scored on a 10-cm linear scale (0 = no perception. 10 = very
483 intense perception).

484 a. b. c: Different lowercase letters represent significant differences ($p<0.05$) between cheeses according to Tukey's test

485 A. B. C: Different uppercase letters in a row represent significant differences ($p<0.05$) between cheese categories according to Tukey's test

Table 4: Liking attribute mean for ten cheeses and for each cheese category (n = 152 consumers)

Cheese category	Cheeses	Overal liking*	Taste*	Texture*
Can_SalM	C	6.0 (2.1) $^{abc. AB}$	5.6 (2.3) $^{ab. AB}$	6.2 (2.1) $^{a. A}$
Can_OBM	D	6.2 (2.1) ^{ab}	6.1 (2.3) ^{a}	6.3 (2.1) ^{a}
	E	6.0 (2.3) ^{abc}	5.7 (2.4) ^{ab}	5.9 (2.3) ^{a}
	F	6.3 (2.1) ^{a}	6.2 (2.3) ^{a}	6.3 (2.0) ^{a}
	Mean of cheese category	6.2 (2.2) ^{A}	6.0 (2.3) ^{A}	6.2 (2.2) ^{A}
Sal_SalM	**G**	5.7 (2.2) ^{bc}	5.2 (2.4) ^{b}	6.1 (2.2) ^{a}
	H	5.6 (2.4) ^{c}	5.2 (2.7) ^{b}	6.1 (2.2) ^{a}
	I	5.7 (2.2) ^{bc}	5.6 (2.4) ^{ab}	6.5 (2.0) ^{a}
	Mean of cheese category	5.7 (2.3) ^{B}	5.3 (2.5) ^{B}	6.2 (2.1) ^{A}
Sal_OBM	**J**	6.0 (2.3) ^{ab}	5.9 (2.5) ^{ab}	6.3 (2.2) ^{a}
	K	6.2 (2.2) ^{ab}	5.8 (2.5) ^{ab}	6.3 (2.0) ^{a}
	L	6.0 (2.2) ^{abc}	6.1 (2.4) ^{a}	6.3 (2.2) ^{a}
	Mean of cheese category	6.1 (2.2) ^{A}	5.9 (2.5) ^{A}	6.3 (2.1) ^{A}

*Liking scores evaluated on a 10-cm linear scale (0 = dislike very much; 10 = like very much).

a.b.c: Different lowercase letters represent significant differences ($p<0.05$) between cheeses according to Tukey's test

A.B.C: Different uppercase letters in a column represent significant differences ($p<0.05$) between cheese categories according to Tukey's test

494 Table 5: Socio-demographic aspects and cheese consumption of consumers (data expressed as number
495 of participants and as percentage (in brackets))

Gender	
Male	67 (44%)
Female	85 (56%)
Age range	
18-29	26 (17%)
30-45	43 (28%)
45-60	43 (29%)
< 60	40 (26%)
Level of studies completed	
secondary	24 (16%)
superior	127 (83%)
(no answer)	1 (1%)
Marital status	
Single	21 (14%)
Married	69 (45%)
divorced	15 (10%)
Partner	46 (30%)
Monthly household income	
> 2000€	29 (19%)
2001-3000	31 (20%)
3001-4000	38 (25%)
< 4000€	25 (16%)
(no answer)	29 (19%)
Frequency of cheese consumption	
Daily	89 (59%)
Several times a week	54 (36%)
A few times a month	8 (5%)
Frequency of cheese consumption (Salers)	
Several times a week	17 (11%)
A few times a month	99 (65%)
Never	36 (24%)
Frequency of cheese consumption (Cantal)	
Several times a week	62 (40%)
A few times a month	84 (55%)
Never	6 (4%)
Point of sale	
Producer	7 (5%)
At the farm	43 (28%)
Market	78 (51%)
Organic shop	12 (8%)
Specialized shop	54 (36%)
Cheesemonger's	59 (39%)
Hard discount	4 (3%)
Grocery shop	15 (10%)
Supermarket	116 (90%)
Packaging	
Supermarket shelf	13 (9%)
Pre-sliced at deli or pre-packaged	39 (26%)
Custom-cut cheese	100 (66%)
Knowledge of Tradition Salers	
Yes	44 (29%)
No	108 (71%)

496 n = 152 consumers

497

Table 6. Contingence table created from significant CATA terms for each product

Cheeses	Dark color_core	Rind Thickness	Bitter	Unpleasant_ flavor	Taste less	Salty	Strong Flavor	Odor intensity _rind	Stong odor	Pungent	Odorless	Firm	Melty	Crumbly
C Cantal_SalM	3	10	19	15	20	60	18	4	12	44	39	43	50	29
D Cantal_OBM	2	3	13	7	20	57	21	5	15	23	35	30	52	52
E Cantal_OBM	10	45	28	15	16	50	21	30	21	28	26	54	19	50
F Cantal_OBM	11	46	13	12	15	49	13	33	21	29	21	35	36	52
G Salers_SalM	9	22	43	28	14	31	23	18	22	26	19	57	46	16
H Salers_SalM	35	83	37	28	9	56	31	57	56	19	5	29	66	15
I Salers_SalM	27	24	32	24	28	32	15	13	24	17	24	51	54	8
J Salers_OBM	31	95	17	17	11	39	29	46	35	35	16	43	29	54
K Salers_OBM	29	30	43	18	12	37	22	10	21	12	21	55	38	29
L Salers_OBM	13	41	18	17	10	45	16	28	31	31	17	25	72	25
p-value	< 0,0001	< 0,0001	< 0,0001	0,001	0,005	< 0,0001	0,031	< 0,0001	< 0,0001	< 0,0001	< 0,0001	< 0,0001	< 0,0001	< 0,0001

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