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Cosmetic specificities in sensory evaluation and statistical analysis – Study case of deodorant products

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Within cosmetic industry, some type of products required specific sensory evaluation protocols, depending on format, usage, feasibility... It is especially the case with deodorant and antiperspirant products where it is important to consider natural body odor, and which are applied to a volunteer before being smelled by trained judges. Beyond the particular sensory protocol, this induces a specific format of data collected. On the other hand, the strategy for digitizing data and analysis, raises various problematics: data must be analyzed in routine (one-shot study analysis), but we also want to capitalize on the historical data by carrying out meta-analysis (multi-studies analysis).

To meet these specific needs several statistical challenges must be faced:

- How do we consolidate raw data regarding the particular format?

- How to adapt to the different problematics from métiers: routine, meta-analyses?

- Which independent variables (volunteer, judge, product...) should be included in the model depending on the analysis?

- What is the best statistical model to run (choice of adjustment, estimation method...)?

- How to visualize and communicate the final results?

The purpose of this presentation is to explain the methodology and particularities of a specific sensory panel (from protocol to questions our analyzes had to answer), then to focus on statistical analysis performed and solutions implemented.

Keywords: Sensometry, cosmetic, statistical analysis, sensory analysis, scent, antiperspirant and deodorant, meta, analysis

Relating the liking scores to CATA data using multiblock PLS-regression

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INTRODUCTION

The investigation of the relationships between the CATA data and the liking scores is a topic of paramount importance. Penalty-lift analysis that is based on the change in liking associated with the presence or absence of each attribute is a popular method to do so. However, this approach was criticized because correlations between attributes are not accounted for (Meyners *et al.*, 2013).

METHODOLOGY

On the one hand, the liking scores are organized as a data table whose rows are the products and whose columns are the respondents, as it is usually done in preference mapping. On the other hand, we set up as many data tables as there are attributes, whereby each data table reflects the 'effects' of each CATA attribute on the liking scores. This idea draws from ANOVA-Simultaneous-Component-Analysis (ASCA; Jansen et al., 2005) that partitions the variation contained in a data matrix (*i.e.*, the liking scores in our case) with respect to one or several factors (*i.e.*, the attributes in our case). It turns out that the 'effects' of the attributes on the liking scores are tightly linked to the change of liking that are used in penalty analysis.

RESULTS

PCA on each matrix of attributes 'effects' enables us deriving PrefMap analysis conditioned by each attribute. To have an overview and take account of the relationships among the CATA attributes, we propose to perform Multi-Block Partial-Least-Squares (MB-PLS; Westerhuis et al., 1998) considering the liking scores as the predicted dataset and the attributes 'effects' as the predictive datasets.

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CONCLUSIONS

The usual respondents by products centered matrix of liking scores is linked to the attributes 'effects' following the rationale of ASCA. This enables us deriving attribute-conditional internal preference mapping to highlight the "liking importance" of each attribute for each respondent and investigating whether there exist attributes that are liked by some respondents and not by others. Furthermore, the relative importance of each attribute on the liking scores can be investigated through MB-PLS that also provides products and respondents mapping.

Keywords: Check, All, That, Apply (CATA), Preference mapping (PrefMap), Multi, Block Partial, Least, Squares (MP, PLS), ANOVA, Simultaneous, Component, Analysis (ASCA)

Output convergence versus divergence of multiblock methods

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Extracting relevant information from multiblock data by reducing dimensionality, summarizing information in an understandable way, or visualizing multiblock data for interpretation purposes are challenges raised in both sensometrics and chemometrics. Several multiblock methods are proposed in the literature in this purpose (HPCA, CPCA, MCOA, COMDIM, STATIS, RGCCA, ...).

Evaluating these methods on the same dataset is a difficult issue mainly because of the heterogeneity of their outputs. From one method to another, they do not have the same appearance or the same shape, and the user is often lost. Canonical representation of multiblock data is introduced in order to harmonize the outputs of the multiblock methods allowing an easier comparison between methods. The present communication aims to confirm the convergence of results between multiblock methods as mentioned in the literature. In addition, it illustrates on several datasets that divergence (partial or total) between methods can also happen. More precisely, this communication shows how convergence or divergence between methods might be strongly related to the dimensions of data.

 ${\bf Keywords:} \ {\rm multiblock} \ {\rm analysis}$

Quality by Design: principle and Design Space construction methods in the context of Design of Experiments

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The Quality by Design (QbD) approach is a recent concept initiated by quality control which has led to new requirements from regulatory authorities, particularly in the pharmaceutical industry. Among these, the guideline ICHQ8 explains that quality should not be tested on finished products but should be integrated throughout, from design to finished product. This approach is characterised by different steps, one of them is risk assessment. To do this, experiments must be carried out and suitable experimental designs will be performed to identify the critical parameters in a process or formulation (screening), and to model the phenomenon (multi criteria optimisation). The last step consists in representing response surfaces in the experimental space to be explored. In this space, the Food and Drug Administration recommends delimiting a subspace, called "Design Space", characterised by a certain probability that the output parameters comply with the specifications. This Design Space can be defined using different methods of construction that we will detail and compare on a case study.

Keywords: Quality by Design, Design of Experiments, Design Space, Response Surface Methodology

Applying a text mining software for emerging risk identification in the food chain

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Introduction: Emerging risks in the food chain are related to human, animal, and plant health and economic aspects that may be associated with either newly identified hazards for which the exposure of target organisms is significant or due to increased sensitivity and/or exposure to an already known hazard. The aim of identifying emerging risks is to prevent or mitigate risks caused by hazards by collecting and selecting emerging issues that require immediate action from different data sources through a structured screening process.

Methodology: The process starts with different data analytical methods for the identification of potential emerging issues. One method for this is text mining of relevant food chain-related news, which can easily be done with the help of a text mining software application called Infra-Nodus. It draws a graph based on the co-occurrence network of words and identifies different topics with Latent Dirichlet Allocation algorithm. By analyzing the graph and the topics, potential emerging issues can be identified. Then, a multi-step selection procedure is conducted by an expert group to select the emerging risks that need further action to mitigate the adverse effects.

Results: At the end of the multi-step procedure, emerging risks that need further measures are selected and forwarded to the relevant stakeholders. The results can be used in the prevention and development of risk-based control and monitoring systems, as well as the identification of critical points of the food systems.

Conclusions: Text mining algorithms are effective in the timely identification of emerging food chain-related risks and thereby prevention and mitigation actions will help to reduce the adverse effects caused by the risks.

Keywords: Emerging risk identification, Data analysis, Text mining, Food chain safety.

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The investigation of sanitizer resistance genes in listeria monocytogenes Isolated from different food processing facilities

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Sanitiser is widely used for cleaning food facilities, but the continued use of sanitiser may cause increasing sanitiser resistance of pathogenic bacteria. At present, a number of genes have been shown to be related to sanitiser resistance ability of L. monocytogenes. This study aimed to detect the presence of sanitiser resistance genes in Irish sourced L. monocytogenes strains and to explore the association between the presence of resistance genes on the sanitiser resistance of L. monocytogenes experimentally. The presence of 4 resistance genes (mdrl, qacH, bcrABC, emrE) were determined in 150 L. monocytogenes strains collected from Irish food processing facilities. 23 strains contain bcrABC, 42 strains contain qacH, 1 strain contains emrE, and 150 strains contain mdrl. 47 strains were grouped according to the number and type of resistance genes, and the minimal inhibitory concentrations (MIC) of those 47 strains against benzalkonium chloride (BC) were tested. The MICs of each group were 4 ppm (mdrl, bcrABC, qacH), 2-5 ppm (mdrl, bcrABC), 1-5 ppm (mdrl, qacH), 4 ppm (mdrl, emrE), 1-4 ppm (mdrl). Compared with strains with only one resistance gene, strains with two resistance genes showed higher resistance to BC, but strains with three resistance genes did not have higher MIC than those with two resistance genes. In addition, in terms of environmental factors, the percentage of strains collected from mixed food, seafood, vegetable, dairy, and meats processing facilities containing two or more resistance genes are 89.7%, 64.2%, 13.0%, 11.7%, and 13.3%, respectively. Strains from seafood and mixed food processing facilities showed higher resistance to BC.

Keywords: L. monocytogenes, sanitiser resistance, resistance genes

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A Dynamic Model of the Survival of Staphylococcus aureus in a Non-Ready-to-Eat Sausage During Maturation

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Alheira is a traditional non-ready-to-eat sausage elaborated in Northern Portugal, which has shown moderate occurrence and survivability of *Staphylococcus aureus* during processing. Although annatto (*Bixa orellana*) and its extracts have been long used as a natural colourant to provide orange-to-red hues to fat-rich products, recently it has been demonstrated to possess also inhibitory activity against some foodborne pathogens. The aim of this study was to model the effect of annatto extract against *S. aureus* in alheira sausages exerted during maturation. Alheira batter was produced and added with 0.0%, 0.5%, 1.0% or 1.5% of annatto extract (w/w), and stuffed in pre-washed natural casings to reach an individual weight of 80 g. They were then inoculated with a *S. aureus* overnight culture to reach 5 log CFU/g, and hung in a climatic-controlled chamber at 10 $^{\circ}$ C for 13 days. Moisture, pH and *S. aureus* counts were determined every 2 or 3 days. For every treatment, a dynamic model was adjusted that consisted of a log-decay function with tail in differential form as primary model (with varying D-value), coupled to a secondary model Bigelow equation of D-value as a function of pH (with parameters log D* at pH 7.0 and zpH).

The dynamic models adequately fitted to all survival curves with residuals and root mean square errors (RMSE) ranging from 0.0008 to 0.0016 and from 0.029 to 0.040, respectively, producing significant parameter estimates. The addition of extract produced log D* slightly higher (1.040 (SE=0.064), 1.040 (SE=0.294) and 1.079 (SE=0.303)) than the control (1.036 (SE=0.142)), whereas zpH tended to be lower with increasing extracts doses (2.426 (SE=0.561), 2.144 (SE=0.230), 2.113 (SE=1.033) and 2.005 (SE=0.904)). Therefore, the addition of annatto extract significantly decreased the time to achieve one log reduction, which in practical terms corresponded to up to 1.04 (SE=0.08) log CFU/g reduction by the end of maturation.

By means of a novel dynamic predictive microbiology model, this work characterised *S. aureus* survival parameters in alheiras for the first time; and demonstrated that annatto extract has a beneficial effect in controlling this pathogen during the maturation stage.

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Keywords: Log decay model with tail, Bigelow model, D value, zpH

OLIVE LEAF EXTRACTS AS NATURAL PRESERVATIVES IN FOODS: NUTRITIONAL, CHEMICAL AND PHYSICAL ANALYSIS IN QUARK CHEESE

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The olive tree (*Olea europaea* L.) is a typical species from the Mediterranean region, where it has great economic and social influence, mainly due to the production of olives and olive oil. However, the leaves are by-products usually left aside during processing. These leaves could be valuable sources of phenolic compounds that exhibit bioactivity, for instance antioxidant, antimicrobial, anti-inflammatory activities, among others. These bioactive characteristics turn them into alternatives for application in the food industry as natural preservative additives. The tendency to substitute synthetic additives for natural ones has been growing, driven by consumer demands for healthier and more sustainable products. Thus, this work aimed at using extracts of olive leaves as preservatives in quark cheese and to evaluate the nutritional, chemical and physical influences over 7 days. The extracts were obtained applying two different extraction techniques, namely maceration and ultrasound assisted extraction, with subsequent incorporation in two different batches of quark cheese. Nutritional profiling was performed according to the official AOAC methods, as well as texture, colour, sugars, organic and fatty acids that were also analysed. The results showed that the consistency of the cheese increased with time and the maceration extract decreased the L^* (lightness) of the quark external colour. The nutritional profile and the lactic acid content were not influenced, which was expected. Malic acid appeared only in the cheeses with the natural extracts. The extracts helped preserve monounsaturated fatty acids, as well as polyunsaturated ones. In conclusion, the olive leaf extracts showed potential for application as a natural preservative, but further research with a longer shelf life is needed for more robust results for Industrial application.

Keywords: olive leaves, quark cheese, bioactive compounds, shelf, life, natural preserving additives

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