O3 CHEM1

CHEDDAR CHEESE RIPENING STUDY BY LOW-LEVEL DATA FUSION AND ANOVA-SIMULTANEOUS COMPONENT ANALYSIS

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In general, cheese varieties can be divided into two macro-categories: fresh cheeses, which are generally acid-coagulated and a little rennet-coagulated, and mature/ripened cheeses, which are rennet-coagulated. In the latter case, the production process is divided into two steps: the manufacturing step and the ripening, which approximately lasts between two weeks and two years, during which characteristic flavor and texture develop.
Among dairy products, Cheddar is one of the most exported by the European Union; for this reason, the quality control of this commodity has gained importance, especially during the phase of ripening, which directly affects the product outcome due to the possible appearance of unwanted aromas and flavors.
In literature, several methods were proposed to evaluate the ageing of cheese and its effects, but, despite most of them exploit very performing analytical techniques, they are also destructive and/or time-consuming, as in the case of Gas Chromatography–Mass Spectrometry (GC–MS), Enzyme-Linked Immunosorbent Assay (ELISA) and others. In addition, to better understand a chemical process that evolves over time, such as ageing/ripening, a non-destructive and rapid technique would be the most suitable solution for industrial purposes. For this reason, spectroscopy coupled to chemometrics is becoming the best choice for addressing this kind of problem. In particular, ANOVA-Simultaneous Component Analysis (ASCA) [1] combines the experimental design with the multivariate data analysis and this allows evaluating by an exploratory analysis whether a factor in the process under study is significant and, in case, its effect, and also to identify possible interactions among factors.
Furthermore, the possibility of working with many analytical instruments/facilities increased in the last years, so it has become frequent to handle multi-platform data sets. In principle, the diverse data blocks could be individually examined, but it has been demonstrated that handling them by means of data fusion strategies, could increase their performances. Despite multi-block analysis has been widely explored in many contexts (such as in classification or regression problems) [2], in literature, so far, there are no applications in the ASCA context.
Under this perspective, the purpose of this study is evaluating how two factors (*i.e.* ageing time and storage temperature) and their interaction affect the Cheddar cheese ripening by means of Raman and Mid-Infrared (MIR) spectroscopies coupled to ASCA in the framework

of a Low-Level data fusion strategy, which represents a novel approach both from the dairy product analysis and multi-block analysis point of views.
Raman and MIR spectroscopies were chosen because they provide complementary information about the matrix under study and, moreover, they exhibit the advantages of being non-destructive and less expensive and time-consuming with respect to the techniques commonly used in food quality control procedures.
As mentioned above, the first factor (F1) was considered in the study is the storage of the samples; half of them were kept at fridge temperature (4°C), and half of them were kept at room temperature (25°C) in order to evaluate its influence on their ageing. As already mentioned, the second factor (F2) which was taken into account is the ripening time; measurements were carried out within two weeks at a distance of about two days from each other both by means of Raman and MIR spectroscopies. Eventually, their interaction (F12) was evaluated and, in order to have a more comprehensive point of view, the F2 and F12 matrices were modeled together (*i.e.* the corresponding matrices were summed) to highlight not only the average effect of the time, but also how the storage condition differently affect the process of ageing over time.

References

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