INNOVATIVE AT-LINE QUALITY AND PROCESS CONTROL METHODS IN FOOD&BEVERAGE INDUSTRY

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Abstract – In the last few years the quality and process control methods have acquired increasingly importance to ensure health and safety in the food and beverage products. In this paper we present the most important studies in different Food&Beverage sectors made by company CDR. These studies have, as object, the CDR systems with which it is possible to realize a specific quality control directly at-line and monitoring parameters in rapid evolution that need to be controlled in real time.

Keywords: alcohol content, bitterness, milk, oil, beer.

CDR is a company that has been working in the food and beverage diagnostic for about 15 years. Over this time, it has developed a wide range of systems (CDR FoodLab range) able to perform analysis on the most diverse matrices such as milk, oils and fats, eggs, wine, beer, cider and so on. These systems are developed and customized to have as much easy as possible, indeed they are used in QC laboratories but, most of all, they are used directly at-line by no analytical skilled people in the food and beverage industry.
CDR FoodLab systems are constituted by an analyzer “Fig. 1” with its specific reagent kits “Fig. 2” to carry out analyses on a certain kind of matrix. The analyzers are self-contained photometers using LEDs (Light Emitting Diodes) as wavelength sources. They includes an incubator at 37 °C to perform more analysis at the same time. CDR has improved the photometric technology in terms of cost, of the amount of reagent used, and of time for analyses. CDR FoodLab analyzers are based on the using of "micromethods", involving the using of small quantities of sample, allow a significant decrease in the consumption of chemical and biochemical reagents as well.

Fig. 1 Example of CDR analyzer for food and beverage.

Fig. 2 Example of CDR kit.

If they are compared with traditional reference methods, they determine a considerable reduction of waste to be disposed. The advantages of micromethods, and the optimization of the analytical procedures allow to make quality controls directly at the food production line and no

longer require the transfer of samples to remote laboratories, thus saving time and increasing the efficiency of control, especially in the measurement of dynamic parameters in rapid evolution as in oxidative processes. The reagents "Fig. 3", are single pre-filled disposable cuvettes, customized for each matrix [1].

Fig. 3 Pre-filled cuvette reagent.

The calibration of the reagents is already made by CDR laboratories that produces reagent kits ready to use.

In the milk and dairy sector, CDR has developed many. tests such as : lactic acid, ammonia, e-fructosil-lysine, urea, ammonia, chloride, lactose and so on. In dairy products, lactic acid is produced by the fermentation of lactose mainly through microbial activity. Its concentration depends on the total bacterial count and can be a useful indicator of the good state of preservation. In addition the heat treatment at high temperatures, such as UHT milk, reduces the microbial load but does not alter the concentration of lactic acid, which thus becomes an indicator of the "history" of the product. The determination of the lactic acid in milk, mainly as L- isomer, gives useful indications on possible acidity corrections of the milk that would not be noticed otherwise by an acid-base titration: therefore, it seems a useful index of the milk quality. The methods commonly used for the determination of the lactic acid (D/ L) are based on specific enzymatic reactions that needs treatment of the sample and long times of analysis. CDR FoodLab Touch with a method based on Trinder reaction followed by photometric measurement, allows a rapid execution (7 minutes) of a single assay or more assays all togheter performed at the same time (up to 16). The method does not required any sample treatment and it can be performed without analytical skill. CDR lactic acid kit for milk shows more repeatability compared with Boehringer Mannheim kit, due to the less steps and the easiness in the sample preparation [2].

In order to monitor the effects of the different milk heat treatments, food industry uses analytical markers such as furosine, lactulose, and soluble serum proteins. The analysis of these molecules is very time consuming. For this reason rapid methods able to supply reliable data with "practical-technological meaning",are very requested . CDR has developed the e-fructosyl-lisyne test to evaluate the presence of powdered milk in raw and pasteurized milk and for the evaluation of the most widely used heat treatment technologies (pasteurization and direct and indirect UHT treatments), e-fructosyl-lysine, indeed, is an intermediary stable product of the Maillard Reaction. The test is exetremely fast and simple and it doesn't need any preliminary treatment of the sample. The furosine analysis and e-fructosyl-lysine test were performed on the same samples of raw, whole pasteurized and whole UHT milk. The data resulting from the study [3] shows that the e-fructosyl-lysine test can be considered as a parameter capable of distinguishing the various classes of heat treatment and of identifying the addition of powdered milk at 10% in raw milk.

The content of NH_3, as last metabolite of the microbial activity on the nitrogenous components of the milk, has been confirmed as useful and rapid index of the hygienic quality of the large mass raw milk. Ammonia amount, as index of proteolitic residual activity, is useful to the milk selection for different technological process, particularly for the "direct" UHT sterilization and some cheese production. The methods generally reported, for single samples, a potentiometric measures utilizing specific electrode, or automated "segmented flow" system for the analysis in great series that needs dialysis of the samples before photometric determination of the resultant indophenolic derivative. CDR has developed a specific method able to detect ammonia in milk without any treatment. The method, based on Berthelot reaction followed by photometric measurement, allows a rapid execution (8 minutes) of a single test

or more tests all togheter performed at the same time (up to 16). The method does not need any treatment on milk and can be used by people without any analytical skill. CDR FoodLab analysis of ammonia is used also to check the shelf life of cheese [5].

Another very important test performable by CDR FoodLab is urea on milk. Associazione Italiana allevatori with his Laboratorio Standard Latte [6] certified the great accuracy and repeatability of the test on different kind of milk (cow, sheep, and buffalo).

In the oils and fats industry, the simplification and the low energy impact of the CDR analytical protocols allow to develop new techniques of appreciation of oxidative stability, as shown by the study of olive oil samples from the Laboratory of Analytical Chemistry of the University of Athens [7]. CDR Oxitester method is a fast and reliable method for the evaluation of the antioxidant stability of VOO. The extrissima and nominal acidity olive oils showed good correlation with the official Rancimat method. Moreover, CDR Oxitester method appeared to be flavor-dependent; for flavor-defective samples, a lower antioxidant capacity was determined in comparison to the Rancimat method (especially formusty and winey VOO). This is possibly because according to the Oxitester method, the oxidation of VOO is conducted in mild ambient conditions by free radicals, simulating the natural autoxidation process. On the other hand, according to the Rancimat method, olive oils are oxidized at high temperature by a passing stream of purified air. The Oxitester method was found to be indicative of the linolenic acid content “Fig. 4”, a significant degradation parameter, but for the Rancimat method no correlation was proved. In comparison to the Rancimat method, the Oxitester method requires much shorter analysis time (about 20 min, whereas the Rancimat requires about 12 h). It is also a very simple sample treatment, and therefore of lower cost. All of the previous characteristics are essential for monitoring of the industrial production. CDR method is as an alternative to the traditional methods, applied at production line, and it allows the improvements of the quality level of the oil in the food industry. Furthermore, rapid measurement methods of biophenols content in extra virgin olive oil were developed; these methods have a very good correlation with the international reference methods [8].

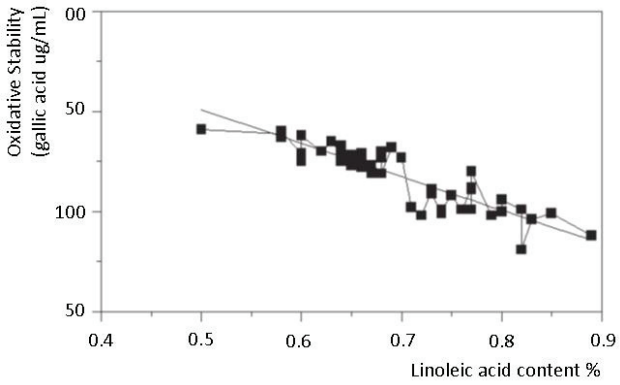

Fig. 4 Linear regression between the linoleic acid content and the antioxidant capacity, as determined by CDR OxiTester method.

CDR analyses of Free Fatty acid, Peroxide value and anisidine value are used to determine the oxidation stability of deep frying oils [9].

Since 2015 CDR has been working in the Beer sector as well. Also in this sector the request of an in-house testing, to ensure the health and the quality of the product is acquiring increasly importance. Campden BRI laboratory an important reference laboratory in UK, for food and beverage has assessed BeerLab Touch concerning pH, alcohol by volume (ABV) colour and bitterness analyses [10]. CDR BeerLab Touch Analyser has been shown to give comparable performance in the measurement of pH, colour, bitterness and alcohol to established methods. Statistical analysis suggested that in the majority of cases and based on current data there is no statistically significant evidence for a difference in bitterness and alcohol measurements for beer when using the BeerLab Touch versus the reference methods. Accuracy of the BeerLab Touch with regards to agreement with the declared values of ABV was very good for all sample types. The low reagent and sample volumes required for analysis not only reduces reagent costs but also reduces the amount of waste produced, thereby providing analysis with a low environmental impact. In “Fig. 5” and in “Fig. 6” are showed the correlation graphs respectively of the analyses of alcohol content by volume and bitterness, with the reference method.

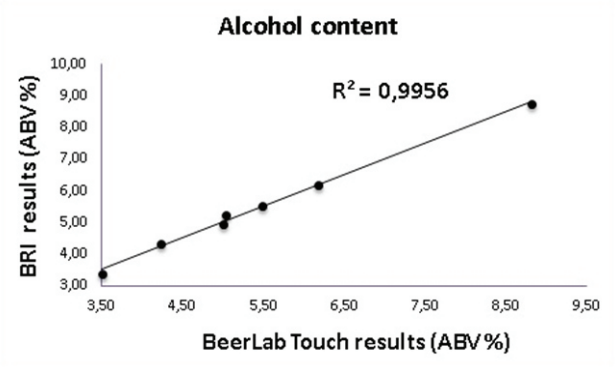

Fig. 5 Linear regression between CDR BeerLab Touch method for alcohol and the reference method.

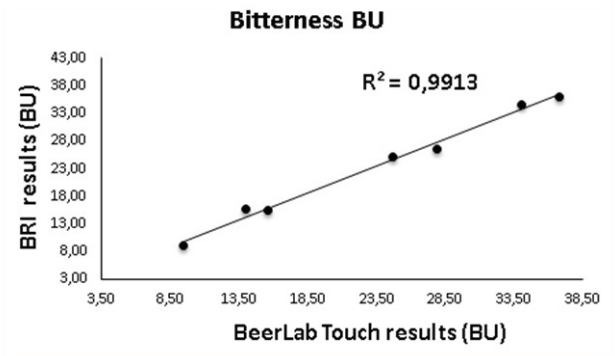

Fig. 6 Linear regression between CDR BeerLab Touch method for bitterness and the reference method.

CONCLUSIONS

In this paper are showed just some of the most important methods developed by CDR over the past 15 years. CDR analyzers and reagent test kits are used in food&beverage industry to assess the quality of the products and to performed test directly at production line.

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