CDR Paper 2503

CDR FoodLab® for quality control in cosmetics.

Dr. Francesca Bruni - Researcher at the CDR Chemical Lab "Francesco Bonicolini"

In the cosmetics industry, quality is not just a matter of regulatory compliance: it is a key element in winning consumer trust and building brand reputation. Ensuring safe, stable products that are consistent with market expectations means offering concrete and lasting value, going beyond mere compliance with laws. The perception of reliability and attention to detail is what drives consumers to choose, and especially to repurchase, a product.

What does it mean to do quality control in cosmetics?
Doing quality control in cosmetics means adopting a structured system of checks that accompanies each stage of the production process, from the selection of raw materials to final packaging. If in the past everything was based on craftsmanship, today controls are supported by objective methods and precise parameters. Modern techniques make it possible to detect, prevent and correct criticalities, helping to improve production efficiency and reduce waste. Quality starts from the ground up: selecting and validating raw materials is the first step to safe, high-performing and market-appreciated formulations.

In the cosmetics industry, quality control of raw materials is essential to ensure safety, efficacy and high standards of finished products. Given the variety and complexity of ingredients used, especially if they come from different geographical areas, it is essential to adopt rigorous and reliable analytical methods.

Among the most popular techniques are:

- **IR e UV-Vis Spectroscopy**, used to identify and quantify active ingredients, preservatives and contaminants;
- **Liquid Chromatography (HPLC) and gas chromatography (GC)**, ideal for analyzing complex formulations;
- **Rheology**, to evaluate consistency and mechanical behavior of creams and lotions;
- **Accelerated and real-time stability testing**, to predict the durability and hold of the product over time.

In addition to these classical methods, accessible and intuitive tools such as **CDR FoodLab®** are becoming increasingly popular, enabling rapid and effective analysis of numerous raw materials, facilitating timely quality control and supporting formulators' research and development activities [1].

Strategic raw materials and analysis philosophy in cosmetic quality control
In the world of cosmetics, certain raw materials stand out for their key role in the formulation of a wide range of products: vegetable oils, vegetable butters, and essential oils. Their natural origin and richness in fatty acids, vitamins and antioxidants make them key to developing effective formulations compatible with different skin types. The complex nature of raw materials requires rigorous quality control, oriented not only to safety and stability, but also to the enhancement of functional properties. This is the context for a **targeted analysis philosophy**, which relies on reliable, rapid and versatile techniques such as those offered by **CDR FoodLab®**. These analyses make it possible to identify spoilage early, compare batches, and select the best raw materials for the development of new products.

An emblematic example is **plant oils**, such as sweet almond, jojoba, argan or olive oil. Each with unique characteristics-emollient, balancing, antioxidant-these oils are used in creams, serums, massage oils and gentle cleansers. Analyzing them means attesting to their freshness and also ensuring that they maintain their functional properties over time, avoiding rancidity or altered lipid profiles. Another mainstay is the use of **vegetable butters**, such as shea or cocoa butter. These naturally derived solid fats are prized for their rich texture, high nourishing capacity, and barrier effect on the skin. Again, monitoring parameters such as oxidation index and free fatty acid content becomes essential to ensure quality and effectiveness in treatments for dry, sensitive or mature skin.

CDRFoodLab®

Strategic chemical analysis: monitoring the quality of oils and butters with rapid, safe, and sustainable methods

In quality control of fats used in cosmetics-plant oils, butters and waxes-chemical analysis is essential to ensure their purity, oxidative stability and skin compatibility. Instruments such as CDR FoodLab® offer an advanced and versatile solution for performing rapid and reliable tests, overcoming many of the limitations of traditional laboratory methods.
These analyses not only allow the selection of high-quality batches, but also prevent formulation and storage defects that would compromise the efficacy and safety of the final product.

Below are the most significant parameters:

- **Peroxides value (PV)**
  It measures primary oxidation, or the formation of peroxides, among the earliest indicators of degradation in unsaturated fats. Values below 10 mmol O_2/kg are ideal for cosmetic use, especially in delicate oils such as rosehip oil. With CDR FoodLab® this analysis takes less than 3 minutes, without the use of toxic reagents or complex glassware.
- **p-Anisidine**
  Assesses advanced oxidation by monitoring by-products such as aldehydes. This is a crucial parameter for oils intended for long shelf life (e.g., macadamia oil). The CDR method, which is rapid and free of hazardous solvents, allows more frequent and safer testing in non-chemical environments.
- **Free Fatty Acids (FFA)**
  Detects the presence of free fatty acids, a sign of hydrolysis or poor storage. High-quality cosmetic oils and butters show values below 0.5 percent in oleic acid. This finding is critical to ensure skin tolerability and stability in emulsions.
- **Soaps**
  A high presence of soaps may indicate unwanted saponification or process residues. It is a key parameter for the compatibility of oils and greases in fine emulsions or anhydrous products.
- **Iodine Value (IV)**
  It indicates the degree of unsaturation: a low value (as in coconut oil) is associated with greater oxidative stability, while a high value (e.g., grape seed oil) signals lightness and absorbency. This parameter guides the choice of fat material based on the required cosmetic function.
- **Polyphenols**
  Polyphenols represent natural antioxidants that can support in “anti-aging” or “protective” action. The analysis is particularly useful for oils such as olive oil, and can help in product differentiation in the market.

Comparative table of analytical methods for quality control in cosmetics

Characteristic	CDR FoodLab®	IR Spectroscopy	HPLC (Liquid Chromatography)
Analysis time	1–5 minutes for parameter	Few minutes	30–60 minutes or more
Sample preparation	Minimal, often without extraction or dilution	Minimal (but it requires a specific sample form)	Requires extraction, filtration and sometimes derivatization
Required skills	Low, it can be used even by non-specialized personnel	Averages, requires technical personnel	High, requires highly specialized personnel
Safety of use	High, no toxic or carcerogenic solvents	High, but with exposition to IR	Low, use of toxic organic solvents, chemical risk
Environmental Sustainability	High: minimal waste and no hazardous reagents	Good, few waste	Low, produces chemical waste for disposal
Versatility on fat matrices	High: oils and butters (including melted), solids and liquids	Limited for solids or complex mixtures	High, but with complex preparations for butters/fats
Utilities for quick control	Excellent: ideal for check in acceptance or production	Good for rapid screening	Limited: time and preparation slow down application
Operating costs	Contents: ready-made reagents and no special disposal	Medium: low maintenance	High: reagents, columns, instrument maintenance

Why choose instruments like the CDR FoodLab®

The advantages of the analytical methods offered by CDR FoodLab® are numerous:

- **Rapidity**: results in a matter of minutes allow immediate quality control, even at the raw material receiving stage or during production.
- **Safety and sustainability**: no toxic solvents, lower environmental impact and greater operator protection than classical methods.
- **Ease of use**: no need for highly specialized personnel, making the analysis accessible even to small manufacturing operations.
- **Versatility**: suitable for both liquid oils and solid fats (such as vegetable butters, after melting), covering a wide range of raw materials.
- **Regulatory Reliability**: validated methods in line with AOCS/ISO standards, which are also useful for audits or quality certifications.

Conclusions

In cosmetic quality control, the choice of analytical method depends on a balance between accuracy, turnaround time, ease of use, and sustainability. Traditional techniques such as HPLC and IR spectroscopy offer high accuracy, but require long lead times, trained personnel, and often the use of chemical solvents.

Rapid and reliable systems such as **CDR FoodLab®** are a viable alternative for analysis of vegetable oils and butters, offering reliable results in minutes, with lower operating costs and greater operator safety. They are particularly suitable for frequent checks, including at acceptance or on the production line.
For realities seeking efficiency without sacrificing quality, these instruments can effectively integrate into control processes, improving responsiveness and management of strategic raw materials.

References

[1] Quality control in cosmetics: Best practices for manufacturers – SkinConsult
https://skinconsult.com/en/blog/quality-control-cosmetics-manufacturers