Multi-omic

AI: Towards a New Standard in Preclinical Screening

Cosmetics R&D is currently facing a major structural challenge: despite huge investments, the transition from test tube to clinical study remains a critical, costly, and statistically uncertain step. Why does this gap persist between the promise of an active ingredient and its biological reality in human trials? The conclusion is clear: traditional evaluation methods have reached their limits.

THE EXPERT

Marc BESSOLES
CEO
Skinomix.ai

From Reductionist Biology to Systemic Understanding

We have long favored a focal approach to skin biology, whereas the current era now requires a panoramic and integrative vision. The era of reductionist screening, focused on isolated targets, is coming to an end. Today, multi-omic artificial intelligence (AI) is changing the game: it no longer simply measures disparate variables, it decodes the systemic and predictive signature of living organisms.

Traditionally, pre-clinical evaluation has relied on siloed markers. We track collagen neosynthesis, quantify a specific enzyme, or observe the expression of a gene of interest. This is a major error in perspective. The skin is not a juxtaposition of linear functions, but a complex ecosystem where billions of molecular interactions intertwine every second. Limiting oneself to a single indicator is like trying to conduct a symphony orchestra while listening only to the triangle. This fragmented view obscures the side effects, compensatory regulations, and metabolic synergies. Indeed, molecular interactions can sometimes help explain why certain actives do not translate into successful clinical outcomes. Yet the biological noise within multi-omic datasets that we ignored yesterday holds the keys to tomorrow's performance.

AI Unlocks the Predictive Power of Multi-Omics

AI is the ultimate tool for extracting the signal from this "chaos" of raw data and transforming it into actionable strategic knowledge. The power of modern screening now lies in the vertical integration of omic layers. Genomics (potential), transcriptomics (activation), proteomics (execution), and metabolomics (functional outcome) are no longer separate disciplines. They merge within algorithms capable of processing terabytes of data to create a dynamic map of cellular response. Thanks to deep learning, we no longer see a simple surface effect or temporary hydration, but the profound and lasting impact of a formula on skin homeostasis.

This technology makes it possible to model the "Hallmarks of Aging" with what could be described as surgical precision. Genomic instability, telomere attrition, epigenetic alterations, loss of proteostasis, nutrient sensing dysregulation, mitochondrial dysfunction, cellular senescence, stem cell exhaustion, and impaired intercellular communication: these nine pillars become the universal benchmark for Laboratory 4.0. AI helps to model or approximate cellular responses based on multi-omic datasets in response to oxidative stress or environmental aggressors (exposome) and generates a predictive indicator that can support efficacy assessment for each ingredient. Does an active ingredient stimulate firmness but silently induce mitochondrial stress or latent inflammation? The algorithm detects it instantly. This multifactorial analysis makes it possible to select the most robust candidates well before committing the first budgets to human panels, drastically reducing the risk of technological "false hopes."

We are entering the age of high-precision cosmetics, where biological evidence precedes and justifies marketing promises.

A Strategic Shift for Cosmetic R&D

For R&D stakeholders, the transition to digital screening via an analytical indicator supporting pre-clinical evaluation completely redefines operational profitability. The primary benefit is critical clinical risk mitigation. By eliminating biologically unstable molecules or those with contradictory effects at an early stage, laboratories secure their strategic assets and protect their brand image. Uncertainty

gives way to the mathematical probability of success. AI helps predict the potential efficacy of an active ingredient and makes it possible to anticipate individual biological responses, explaining why an asset performs well on one skin signature but fails on another, paving the way for personalized cosmetics based on real data.

Secondly, we are seeing spectacular time savings in the development cycle. Virtual screening allows hundreds of galenic combinations to be tested in a matter of days, whereas traditional laboratory testing would require months of tedious manipulation. Time-to-market is no longer a constraint, but a major competitive advantage. AI becomes the formulator's biological compass: it allows dosages to be adjusted with molecular precision, optimizes the bioavailability of active ingredients, and anticipates harmful interactions even before the first drop of product is manufactured. It is a decision-support score for pre-clinical assessment that transforms the researcher's intuition into scientific certainty.

It is crucial to understand that artificial intelligence does not replace human expertise: it enhances the researcher's vision and refines their intuition. It marks the end of the era of empirical trial and error. We are entering the age of high-precision cosmetics, an era where biological evidence precedes and justifies marketing promises. This approach guarantees brands an irrefutable database, capable of withstanding the most stringent international regulatory scrutiny.

Conclusion

In conclusion, the future of cosmetic R&D has definitively moved beyond the isolated test tube. It now lies in the convergence between living biology and computing power. For consumers, this promises performance validated at the very heart of the cell, guaranteeing unprecedented safety and efficacy. R&D decisions are no longer a gamble on the future; they are an exact science driven by AI, putting technology at the service of skin health and beauty. ●