Using Scenario Models to Accelerate Product Development

Addressing Complexity in Personal Care Products

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GEN5 GROUP

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Innovating for Personal Care

Many personal care products aspire to deliver both immediate results as well as prolonged effects over time. Yet, when addressing conditions like body odor, greasy hair, or oily skin, the nature of human biology brings unique challenges to the product development process.

Dynamic Processes. Personal care products face a particularly vexing challenge achieving prolonged effect because the targets of these products – e.g. body odor, body oils, greying hair – are continuously produced by ongoing physiological processes. These dynamic processes are constantly working against the efficacy and longevity of the personal care product. Accordingly, point-in-time hygiene interventions bring only temporary resolution.

Target Area Variability. Further, the highly variable conditions of human biology complicate product development efforts. For example, parameters such as hair type or density can vary widely and the assessment and validation of new ideas must account for this variability. Innovators must weigh the merits of universal solutions versus those targeting a specific market segment – a challenge that is particularly difficult with biological systems.

Methods of Use. Finally, delivery systems and methods of use impact how product reaches the target zone and can affect product efficacy. For example, the efficacy of formulation ingredients can vary depending on the force of application, distance from the target, or product type (e.g., cream, gel, foam, spray). Product developers are well aware that consumers do not always adhere to recommended application instructions.

These complexities can create countless scenarios for developing and evaluating new product ideas and formulations. In the face of so many variables, assessing the relative impact of new ideas through *in vivo (*and *in vitro)* testing can be complicated and costly.

Using Models to Reduce Development Cycle Time

While modeling tools are commonly used across a wide range of products, these tools can be viewed as too complicated or impractical to apply to the physiological processes and variability that are central to personal care products. In the absence of models, comparing the merits of new ideas can be difficult, a complexity that leads to time consuming and costly physical tests as the default method for validating new technologies.

But simplified models can be practical and useful for personal care product development. Leveraging existing scientific knowledge, along with a disciplined focus on the parameters that drive consumer value are central to a pragmatic approach to modeling.

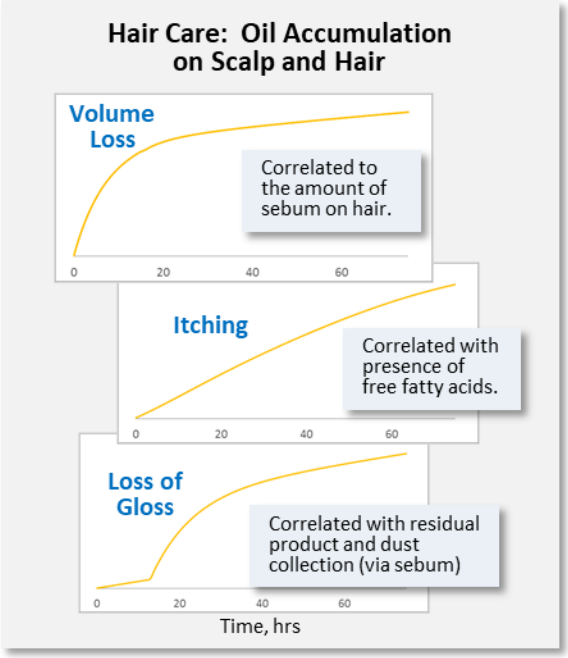
In the context of dynamic physiological processes, three imperatives are vital to effective modeling:

1. Isolate Parameters of Value – *do not try to model everything; stay focused on the parameters that are most important to consumer satisfaction and product purchase.*

   To ensure that models are informative and practical to use, it is essential to focus on the parameters that are most important to consumer satisfaction or main parameters of value (MPVs).

Examples of Hair Care Main Parameters of Value	
• Hair volume	• Convenience
• Hair gloss	• Ease of use
• No skin irritation	• Sustainable packaging
• Pleasant fragrance	• Eco-friendly ingredients
• Coverage	• etc.

   MPV's can be translated to the underlying physical phenomena that drive performance and can be factored into predictive models. Doing so will avoid unnecessary complexity and yield actionable insights. The concept is straightforward: *only model what is most important*.



   Key Modeling Steps

   - Identify the parameters of value that dictate consumer satisfaction and drive purchase decisions.
   - Define relationships between baseline physiological process(es) and identified parameters of value.
   - Specify parameters that will need to be validated through physical experimentation (*in vitro*, *in vivo* testing).

2. Simulate the Biological System – *use research data to build algorithms that simulate how physiological processes evolve in time taking into account inherent product characteristics.*

   By characterizing the behavior of the underlying process (typically as a function of time), models can establish a baseline for measuring performance under different scenarios. Then, as new technologies or compounds are introduced to the model, it is possible to anticipate the impact at the time of application, as well as measure the duration and profile of impact over time.

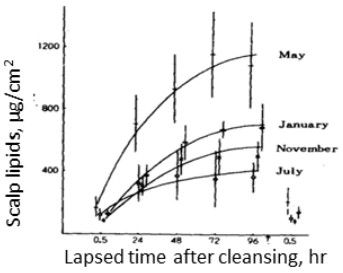
   Key Modeling Steps

   - Establish the known equations that may already exist.

- Search for and leverage existing data resident in technical literature.
- Fit the data to a predictive algorithm that can serve as a baseline for scenario modeling.

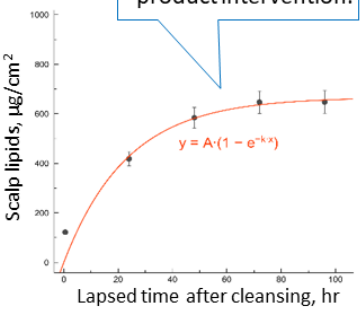
EXAMPLE

Literature search for regreasing kinetics



Digitizing and fitting the data

Evolution of sebum amount prior to product intervention.



3. Run Relevant Scenarios – *use the model to run simulations using different delivery systems, formulations, methods of use, and target area conditions.*

With a baseline algorithm in place (Imperative #2), the model must also account for the variety of factors external to the target substance that impact product performance.

These factors typically can include the delivery system, consumer use practices, elements of the surrounding environment (the supersystem), and the variability of important target system parameters (e.g., hair density, hair follicle thickness).

EXAMPLES OF PRODUCT APPLICATION FACTORS

Deposition Efficiency *Delivery system that moves actives from point A (package) to point B (human body)*	How much of the active ingredients are lost during application and never reach the target zone? *spray force, roll-on surface area, cone angle, bristles geometry, etc.*
Deposition Variability *Consumer usage practices*	How does variability in consumer application methods impact efficiency of delivery? *distance, duration, applied force, size of target area, time of day*
Variability within Target Zone *Human biology*	How does variability of human biology of the target zone impact efficacy of the intervention? *hair type, hydration levels,*
Environmental Conditions *Supersystem*	How does the variability of the supersystem impact product efficacy? *Humidity, temperature,*
Other Interventions *Human behaviors*	What pre- or post-application actions impact product efficacy? *Touching, combing, drying (with hair dryer), other skin care/beauty care products*

Key Modeling Steps

- Identify the application factors that impact product efficacy.

- Develop algorithms for each factor to depict their impact on product performance.
- Understand and reflect any relevant relationships across these factors.
- Run sensitivity analyses to understand the level of precision needed to ensure meaningful outcomes and adjust the model, as necessary.

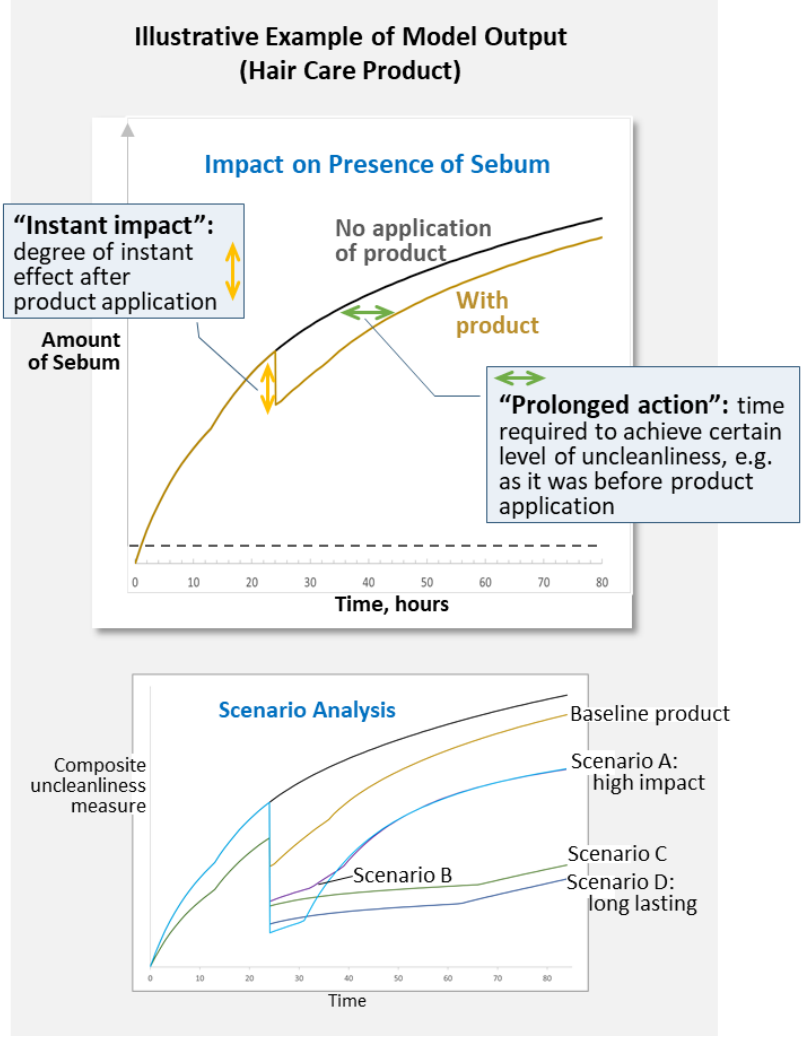
Scenario Modeling and Analysis

After constructing and pressure testing the model, any number of scenarios – combinations of formulations and delivery systems under varying conditions – can be assessed.

The model can be used as a preliminary screen to test concepts and combinations of ideas quickly. Ruling out ideas that may have minimal or adverse impact on product performance will reduce the time and cost of proof of principle testing.

With a simplified model, innovation teams can:

- Screen different compounds to anticipate product performance under varying conditions
- Measure the relative impact of different types of solutions prior to physical testing
- Isolate variables that will require physical test validation
- Set priorities for product development roadmaps.



Conclusion

Even though personal care products often target complex and dynamic biological systems, models do not have to be overly complex to yield powerful insights and time saving results.

To yield meaningful outcomes, simplified models require:

- Disciplined focus on main parameters of customer value to ensure alignment with market needs
- Algorithms to simulate important underlying physiological processes
- Scenario capabilities to test against system variability and combinations of ideas.

Effective modeling can yield insights into product performance potential at the point of action and over time. Running candidate solutions under different model scenarios will lead to a focused program of physical testing and reduce product development cycle times.