

TECHNOLOGY OVERVIEW

Opertech Bio's Pioneering Approach to Sensory Technology

MOG is an entirely new approach to taste testing and measurement for both humans and animals. MOG is an *automated high throughput system* with the capacity to determine the taste characteristics of hundreds of samples in less than an hour. Testing with MOG does not rely on subjective rating scales of taste sensation and is done with 3 to 4 subjects for either humans or animals. Taste sample sizes are small—a fraction of the amounts required for traditional taste tests—translating to dramatic savings in costs associated with synthesizing or purifying new ingredients.

More data means greater informative power. The comparatively large datasets that are rapidly generated by MOG are amenable to sophisticated computational and analytic tools not practical for the limited information from traditional taste assessment. Among the many advantages that result are vastly reduced errors, greater precision in detecting taste effects, improved consistency and predictive value of test outcomes, and the ability to more quickly and broadly test across a diversity of human subjects.

Current Taste Testing Across the Industry

Although scientific understanding of taste biology has advanced dramatically in recent years, taste testing methods have remained essentially unchanged over the last century. Human taste panels typically are composed of 20 to 60 participants and require large quantities of compounds, ingredients or formulations to carry out a taste evaluation. Never the less only a few samples can be evaluated per test, which might take an entire day or more to conduct, and results can be unreliable given the many factors that influence a person's daily subjective experience of taste.

The MOG System for Taste Evaluation

MOG is a new way to quantify taste properties of compounds, ingredients or formulations that surpasses the shortcomings of traditional taste testing. All models of the MOG system operate under a common set of unique principles:

Automation. Every aspect of the MOG system is automated—sample delivery, recording a subject's responses, data storage and analysis—minimizing the variability and mistakes due to manual operations that normally occur in traditional taste tests.

High Throughput. The MOG is the first high throughput taste evaluation system, with a capacity for evaluating hundreds of samples in a day. Sample volumes typically are less than a milliliter, minimizing the costs of ingredients needed for testing.

Data-driven Process. The high throughput nature of MOG systems enables the rapid generation of large, robust datasets. As a result, only a few subjects are needed for any given test. Each MOG system automatically moves the data from all tests, along with subject variables and details on samples and test protocols, into a database where it can subsequently be mined and analyzed through directed queries.

Objective Measurement. All MOG systems are designed for objective measurement of taste—no subjective ranking scales or verbal reports.

Simultaneous Measurement of Taste Quality and Palatability. MOG quantifies two critical aspects of taste—taste quality (what does a sample taste like?) and palatability (how much do I like it?) on each trial for every sample.

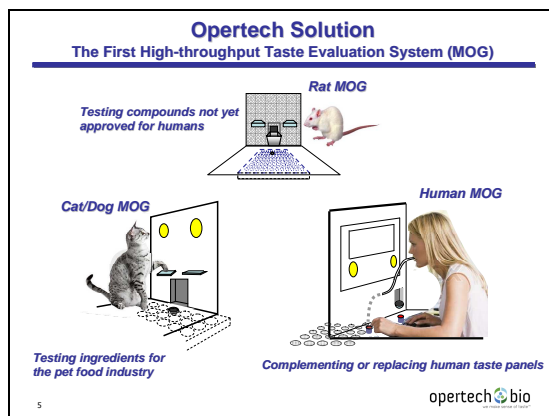
MOG Applications

MOG systems are in operation or are being developed for use with different species to meet the various needs of our clientele.

The Rat MOG (rMOG)—Particularly useful for determining the taste properties of compounds not yet approved for human use. Rats are opportunistic omnivores whose food preferences evolved side-by-side with those of humans and therefore are excellent surrogate subjects.

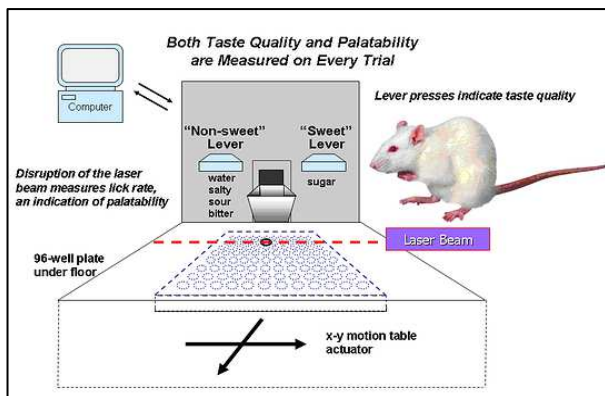
The Human MOG (hMOG)—A fully functional prototype now has been built for use with human subjects. The goal of the human MOG program is to dramatically reduce the expenditure of resources in time and costs associated with traditional human taste panels.

The Cat MOG (cMOG)—MOG systems for companion animals are under development that will enhance the pace of ingredient discovery and optimization of formulations in the pet food industry.



Details of the rMOG. Taste quality measurement is achieved through the experimental paradigm of *operant taste discrimination*. Rats are trained to press two levers for a food pellet reward after they have tasted sample solutions presented to them in a 96-well plate. To receive the reward, the rats must press the right lever if the solution is a standard (for example, a sweet sugar solution) and the left lever if the solution presented has any other taste. By comparing the percentage of the presses on the right (standard) lever, the degree of similarity between a novel taste stimulus and the taste standard can be quantified.

Palatability of the sample solutions in the 96-well plate is determined by a laser beam counting the number of times a rat licks the sample. The more licks the more palatable.



Schematic diagram depiction of the central components of the Microtiter Operant Gustometer (MOG), the first high throughput chemosensory system for in vivo testing

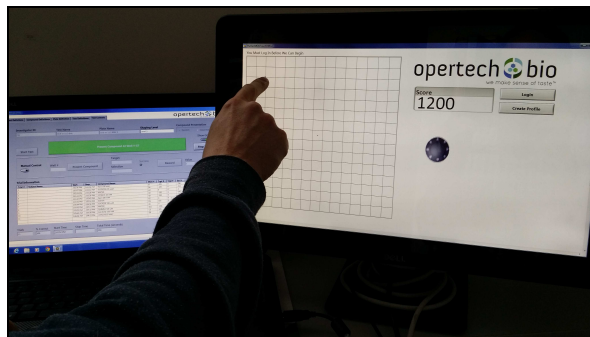


Opertech owns 8 Microtiter Operant Gustometers. The MOG technology is protected by U.S. and foreign patents and patent applications

Because of its ability to measure both taste quality and palatability in a high throughput capacity, the rMOG has proven particularly useful in the discovery of new flavor ingredients. MOG-trained rats are exceptionally efficient at screening large collections of natural products or other compounds for desirable taste properties. They also provide the ability to evaluate compounds not yet approved for use by humans. On behalf of our clients we have used our rMOG to discover novel all natural sweeteners and sweetness enhancers that have been subsequently validated with human taste panels and are currently under consideration for development.

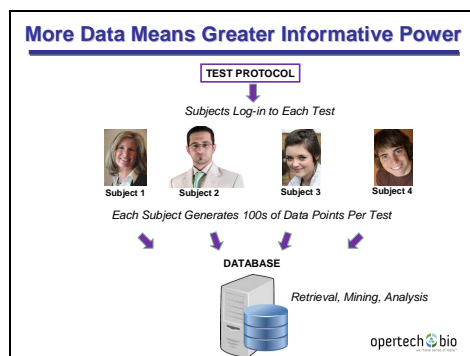
Details of the hMOG. A fully functional prototype of the MOG now has been built for use with human subjects. The goal of the hMOG program is to dramatically reduce the exclusive reliance on traditional taste panel testing and the associated expenditure of resources in time and costs.

The hMOG is a portable work station with an automated system for delivering small samples (usually between 200 and 300 microliters) in rapid succession to a seated subject. The subject is not given explicit instruction on how to respond, but is trained through an interactive algorithm to make responses that are dependent on his or her ability to detect and distinguish taste stimuli. The response device is a touch-sensitive monitor. Through the algorithm, which operates like a game, subjects learn to simultaneously record both taste quality and palatability for each sample by touching specific locations on the monitor. Responses are rewarded with an incremental point system that incentivizes both sensory acuity and rate of responding. The subjects may not even be aware that their taste sensitivities and preferences are being recorded—from the subject’s perspective the focus is on winning points, which are translated to actual money for remuneration at the end of the session. With the hMOG reliable datasets are generated from approximately 100 samples in less than an hour using as few as 4 subjects. Desensitization across the many trials during a typical training or test session is prevented through our proprietary protocols.





Subject responds on the hMOG touch-sensitive monitor for a blue chip reward

hMOG Database. Subjects create a user profile that includes information on individual characteristics (such as smoker/non-smoker, current medications, height and weight, zip code, etc.) that could be associated with taste responsiveness. At the start of a session, subject logs in with their username and password. Each response on every trial is treated as a discrete datum that is linked to all individual characteristics in the user profile and dumped to a database upon completion of the session. The database can be queried to search for correlations among the taste variables (for example, correlation between sensitivities to quinine and stevia, male vs female subjects, or responses of smokers to 30 mM sucrose.)



Details of the cMOG. MOG technology currently is being adapted to accommodate both cats and dogs. This apparatus will be designed as a recreational play station that will capture data with respect to taste evaluation. MOGs for companion animals deliver small samples in rapid succession by means of a multi-well plate. Operant conditioning techniques are used to train the animals to compare test samples to a standard for taste quality measurement, and lick rate gives the indication of palatability. As with the rats, only 4 companion animals will be needed to conduct a test since hundreds to thousands of data points can be collected in a very short time frame. Accordingly, cMOG will be able to directly quantify the taste preferences in the target population, a strong incentive for pet food companies to use this technology.

MOG Technology Potential to Advance the Pet Food Industry		
	Current Industry Standard	The Opertech Solution
		
Palatability	Weigh bowl before and after	Lick Rate
Throughput	Very low	High
# subjects required	Hundreds of cats	4 cats per cohort
Resources	Large investment in staff and facilities	Very economical

opertech bio
an innovator in taste

MOG Advantages

- Quantifies both taste quality and palatability simultaneously
- Broad utility
 - Tastant discovery—any taste system
 - Flavor formulation optimization
 - Basic research
- Small quantities of test compound required
- Enables testing of blends, mixtures, and natural products
 - Particularly useful for revealing synergistic combinations of ingredients
- Throughput of hundreds of test samples per day
- Experimental flexibility
- Four subjects (human or animal) per cohort
- Once trained, individual subjects (human or animal) can be tested again and again over weeks, months or years.

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