

Better Botanical Extracts through Advanced Extraction Technology

Evolving from commodities to cutting-edge ingredients

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It is the nature of our industry—of any industry—to answer needs and to fill niches. Thus, there is no shortage of botanical extracts in the marketplace, though few of these products approach the technical or hedonic ideal. Given market pressures, it's hard to blame producers who tailor their operations to create ingredients that suit commodity status. Yet there is also a niche for producers who can pioneer the creation of cutting-edge premium botanical extracts.

Co-existing alongside the trend toward ingredient commoditization, there is another, somewhat opposite trend driving today's food and fragrance ingredient markets—the trend toward high-quality, so-called “luxury” consumer products. Today, the resources are readily available to ingredient manufacturers who are willing to make the investment in the talent and technology necessary to create truly superior botanical extracts, just as there are opportunities for consumer product manufacturers who are visionary enough to use them.

In setting out to build the best botanical ingredient, one must travel the world to source the highest-quality raw materials, then work directly with selected growers and processors. An expert lab can then determine the strength of key active ingredients, providing a first indication toward selecting the appropriate extraction parameters. But the production of the optimal botanical extract is not only a matter of capturing the unique qualities of nature; it is also about going the extra mile to find the highest possible level of consistency.

At one time in the premium botanical ingredients industry, traditional methods of manufacturing employed elaborate, time-consuming processes that evolved over centuries of trial and error. Many ingredients made in this way necessarily involved the skillful art of master chemists who kept their recipes and processes under the closest guard. Individual batches were then blended to smooth out fluctuations of parameters affecting the composition, aroma and taste of the finished product.

The one parameter one could never fully control is nature, and for this reason many traditionally manufactured products could never escape fluctuations in quality from year to year. In fact, another challenge has recently emerged. As world markets continue to expand, many botanicals that grow wild are threatened by over-harvesting. This makes it ever more important to attain

the utmost level of efficiency in extracting the valuable constituents from precious raw materials.

Today's luxury product markets, characterized by unforgiving manufacturing processes, complex applications and discerning customers, are expectant of more than just quality—they require consistent quality. This becomes crucial as everyone in the supply chain is looking for ingredients that are more and more directly derived from natural plant materials. All of these demands—plus the pursuit of the “clean label,” as driven by heightened consumer consciousness—have introduced new challenges to high-end flavor, fragrance, food and personal care ingredient suppliers.

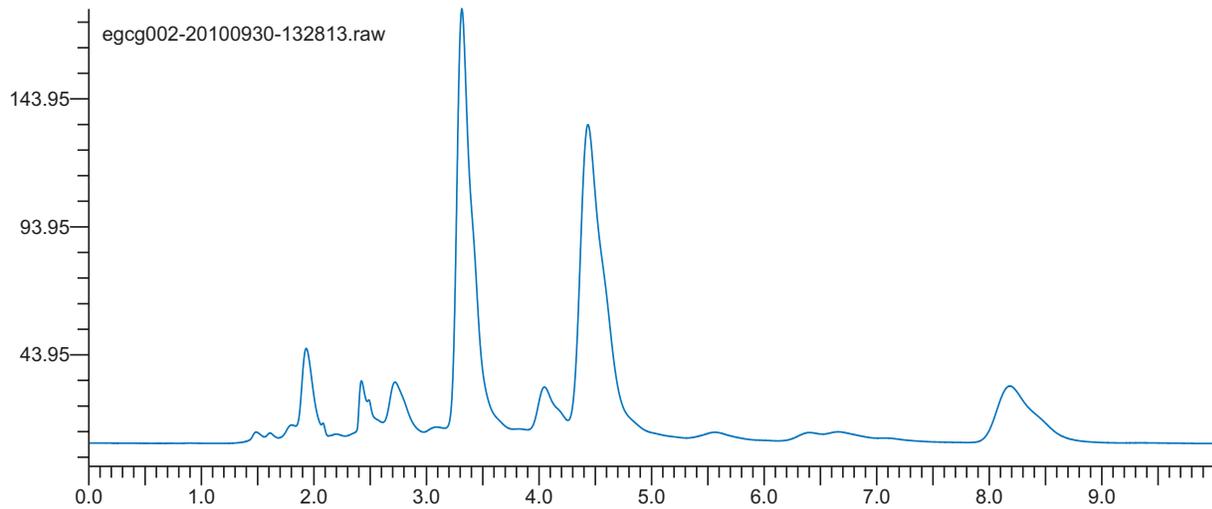
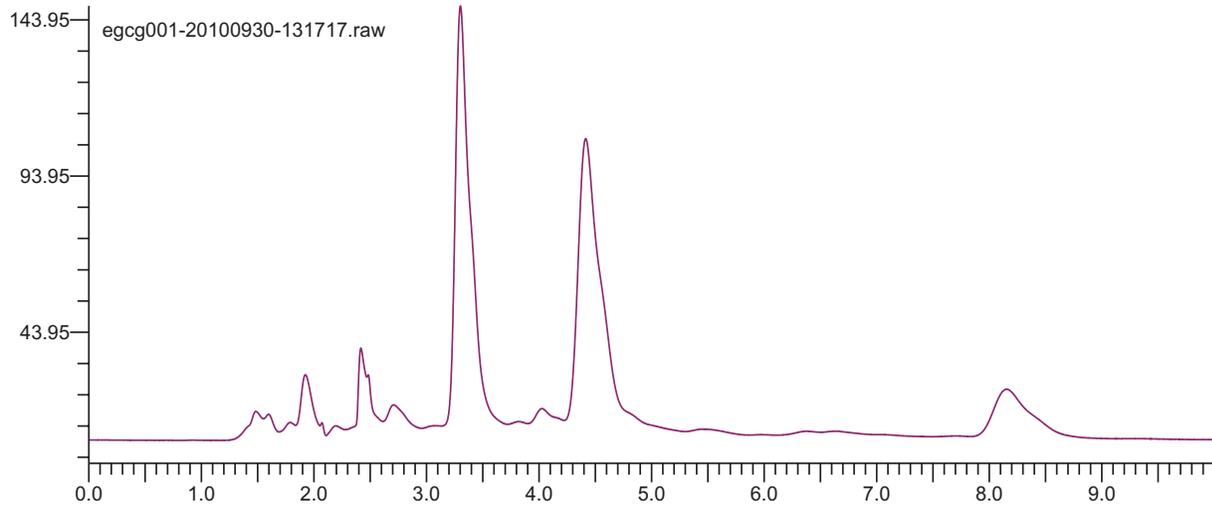
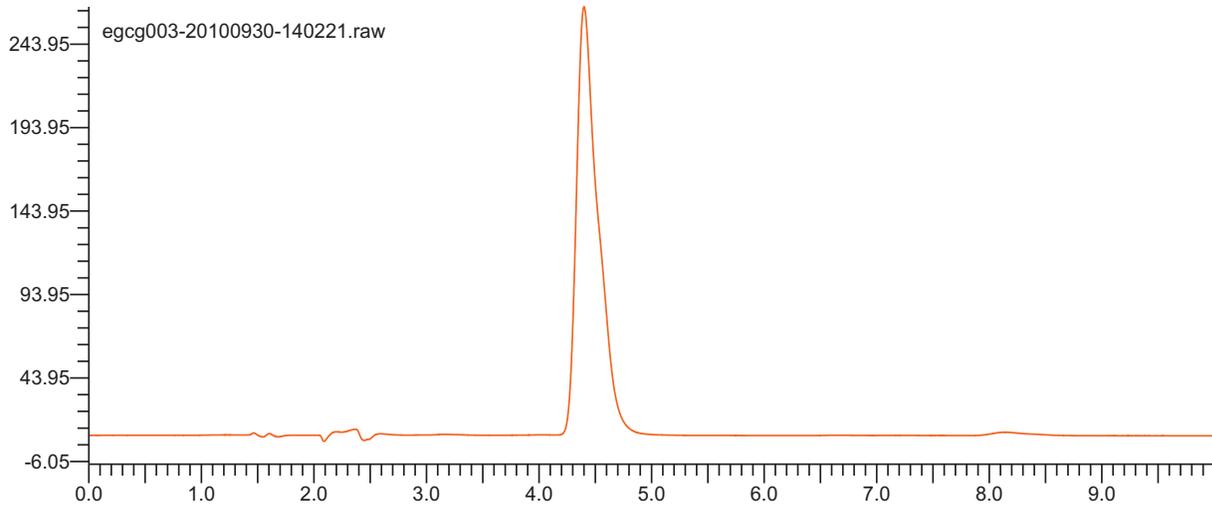
In this new market of heightened expectations, the inherent inefficiencies and limited scales of traditional manufacturing methods often render them inadequate. Technology offers a better solution, wherein the key to the successful extraction of a known product profile is a comprehensive understanding of the effect of production parameters on the outcome of specific ingredients in the extraction.

The first type of extraction process botanicals such as green tea, coffee beans, vanilla beans or chamomile flowers may undergo is distillation. Unlike traditional distillation apparatuses, today producers have access to newly developed computer-controlled equipment that allows for the precise monitoring and adjustment of the key parameters of time, temperature and pressure.

Using this technology, each variable (e.g. pressure) can be isolated and optimized specific to the requirements of that particular product. For example, manufacturers can test the effect of different degrees of pressure on the extraction of tea leaves or vanilla beans by testing the efficiency of the extraction of markers such as epigallocatechingallate (EGCG) or vanillin on GC/MS and/or HPLC. The pressure can then be varied and tested again, with technicians continuing to go back and forth from the pilot plant to the lab until they have found the optimal pressure for the extraction of EGCG from tea (see **F-1**), or vanillin from vanilla beans. The technicians can then do the same test isolating the temperature variable and then the time, and finally discover how multiple variable manipulations might affect the extraction. This technique can be applied to EGCG, caffeine and any other marker for which one wishes to test.

GCs of three extractions of EGCG from green tea (standard 1, orange; competing standard 2, purple; and an extraction produced by a controlled process system featuring a 25% increase in EGCG over conventional extracts, blue), plus an overlay

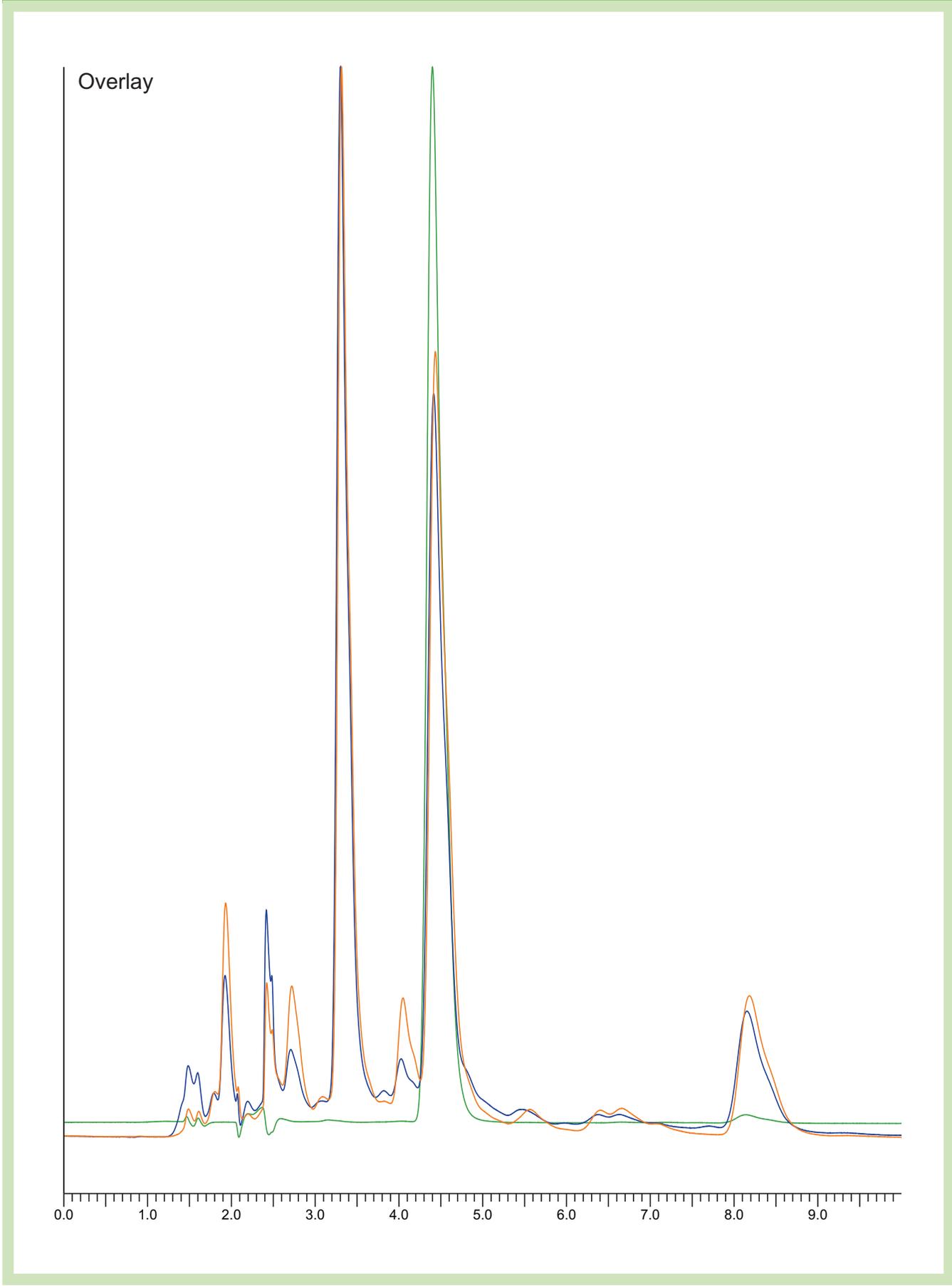
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Overlay of GCs of three extractions of EGCG from green tea (standard 1, orange; competing standard 2, purple; and an extraction produced by a controlled process system featuring a 25% increase in EGCG over conventional extracts, blue), plus an overlay

F-1
(Cont.)



Each routine is stored in a computer file so that it can be repeated to create identical distillation cycles in each different batch produced. Distillate portions can be collected at various stages of the process for analysis using HPLC-GC/MS lab equipment. Using these methods, one is able to produce a virtually endless combination of water-white distillates from practically any botanical material available. Not only do these products create valuable new natural options for the flavor, fragrance, food and personal care industries, they are also highly consistent in quality.

What truly elevates these processes into the future of manufacturing is their application to full-spectrum, ingredient-focused liquid botanical extractions. The same equipment that handles distillation can be used to do extracts and tinctures. The use of state-of-the-art equipment with processes that can produce an efficient extraction presents a next-generation alternative to time-consuming (two weeks or longer) maceration procedures that require bulky, difficult to control tank farms.

The advantages are just beginning. The processing conditions of time, temperature and pressure are precisely controlled for this new generation of ingredients, while a unique "reverse flow" extraction process enables the extraction yield to be increased by up to 30% compared to traditional procedures. To add another dimension to the process, all of the extracts so produced can be concentrated using low-temperature concentration procedures to ensure that the flavor qualities and active ingredients of the original materials remain virtually intact.

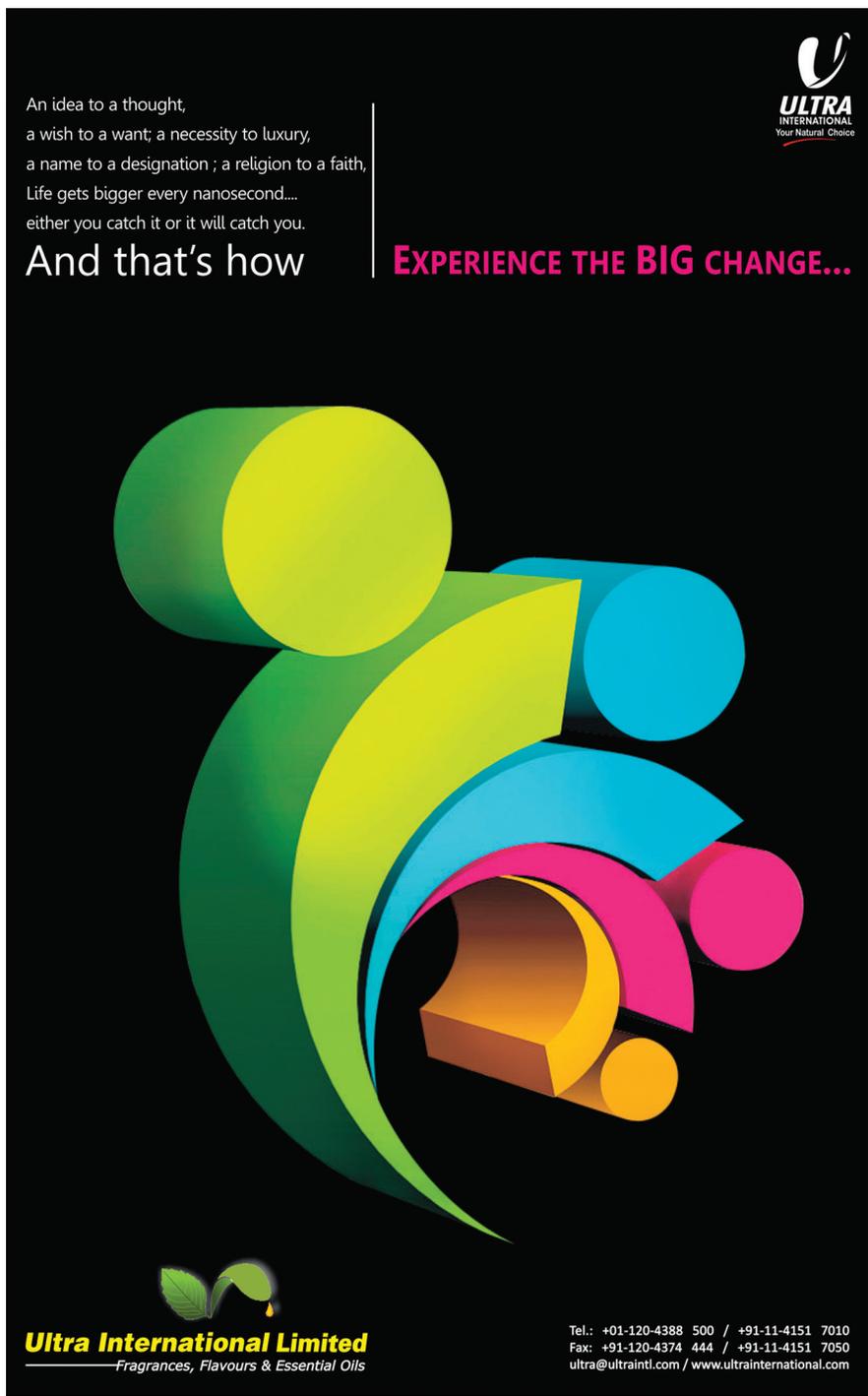
By utilizing unique and ultra-modern extraction equipment in conjunction with concise research and development methodologies, the industry can manufacture products that match or exceed the overall quality and selected parameters of traditionally manufactured products. Technicians can create them more efficiently, in greater quantities, and with far greater consistency than was ever before possible. Plus, one is able to go a step further to design and manufacture products specifically tailored to the individual requirements of any one of a wide variety of applications—previously unattainable levels of potential customization, exclusivity and formulation readiness.

With each passing day, more consumer brands across a full range of industries are being revitalized using

this new supply of premium natural botanical extracts. Bit by bit, forward-thinking suppliers are contributing to a silent yet salient revolution of tastes, introducing more of the exciting, original dimensions of nature to flavor and fragrance profiles of products around the world, bringing new areas of profitability to clients, and offering enhanced levels of enjoyment to the consumers whose interests the flavor and fragrance industry ultimately serves.

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