Medicinal Herb Quality in the United States

Toward Bridging Perspectives th Integrity

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Summary

Increasing consumer concerns about the quality and safety of medicinal herbs in the United States has now caught the full attention of scientists and regulatory agencies. Officials are confronted with numerous challenges to better define and delineate product quality, from production through processing to final products used by consumers. Resident practitioners of Chinese Medicine (CM) have highly vested interests in these issues because of the central role for medicinal herbs in the CM system of practice. But established scientific and regulatory organizations that rely upon biomedical understandings of pathology do not accept the definitions for medicinal herb quality used by CM practitioners. Domestic growers of medicinal herbs also receive unclear signals from the marketplace about the desired qualities of the medicinal herbs they produce. Amidst this context, a Medicinal Herb Network was organized to develop locally grown, high quality medicinal herbs by bringing together medicinal herb growers and CM health-care practitioners. A participatory research approach allowed participants to define problems and develop solutions to issues they experience from the context they bring to the table. Issues of medicinal herb quality are presented below from perspectives of both biomedicine and CM theory. We briefly touch upon the dilemma of protecting the integrity of CM in the face of biomedical advances. We then offer a cross-cultural investigative approach that bypasses constraints and problems frequently imposed by prevailing scientific norms. Our approach uses descriptive sensory analysis procedures (a sub-discipline of contemporary food science) in service to CM theory by communicating understandings of medicinal herb quality congruent with basic CM principles. This approach avoids the problems of deferral to chemical and pharmacological analysis, which are ancillary to CM theory. Results obtained thus far suggest that a vocabulary of organoleptic (taste, smell, appearance) quality descriptors may be developed and used to create understandings of quality consistent with CM theory. More broadly, this work illustrates possibilities for innovative research that preserves the coherence of CM theory while using contemporary methods from an established scientific discipline.

Quality as Viewed From a Biomedical Perspective

In the US, medicinal herbs are categorized and regulated as botanical dietary supplements according to Dietary Supplement and Health Education Act legislation (DSHEA, 1994). The intent of this legislation was to make nutritional and botanical supplement alternatives more available to Americans with the hope of improved public health and reduced future health care cost (DSHEA 1994; Nesheim, 1999). Subsequently, use of botanical and dietary supplements has become more popular among the American public (Eisenberg et al., 1998), to sales exceeding $600 million (Brevoort, 1998). A recent report indicates 19% of US adults now use natural products, including herbal medicines (Barnes, et al., 2004). Yet DSHEA legislation offers little in

the way of definition of quality or guidance to growers, processors, distributors, health-care providers, or consumers hoping to understand, maintain, or improve the quality of medicinal herbs as tools to improve health (Matthews et al., 1999).

Increasing consumer demand within the context of regulatory ambiguities has focused attention toward product quality, understood here as encompassing aspects of both safety and expected health benefits (efficacy). Observers within biomedical science have mapped a broad spectrum of scientific challenges "from seed to shelf" facing the botanical supplement industry (Cardellina, 2002; Costello and Coates, 2001). "Good agricultural practices" (GAP) that would include growing conditions, local soil and climate, herbivores, weeds, plant pathogens, time of harvest and drying/storage conditions are suggested to provide a framework for the research needed to monitor product quality (Cardellina, 2002). GAP guidelines could address adulteration, contamination and counterfeiting issues associated with supply of high-quality "raw" or "bulk" herbs, and would require specific research devoted to each herb grown for medicinal purposes. Some 2048 individual medicinal herbs are delineated in the new reference proposed for use by US regulators (McGuffin et al., 2000). Finding the resources needed to create research-based GAP guidelines for each herb of commerce is unlikely, but the means for creating them is currently possible.

A more daunting task for biomedical scientists is the challenge of determining with assurance that the final product will deliver the maximum health benefits possible (efficacy) to expecting consumers or clinicians. The prevailing approach to medicinal herb quality seeks a narrow target with one or very few active ingredients. This pharmacological approach has proven enormously successful for extracting single-component pharmaceuticals derived from plants. But the plant matrix of herbal medicine (pharmacognosy) is much more complex scientifically, and less lucrative economically than pharmaceutical medicine. This complexity creates difficulties when attempting to decipher with authority the pharmacologically "active" constituents of a plant matrix containing many hundreds or thousands of chemical compounds (Lee, 2000; Yan 1999). In current practice, the physiologic effects of an herb are reduced to putative marker molecular constituent(s) that serve as a surrogate for precise pharmacologic understandings. Frequently, manufacturers then attempt to create "standardization" with respect to the concentration of the identified marker constituents (Calixto, 2000; Harkey et al., 2001; He, 2000; Newall et al., 1996; Yan, 1999). But the shortcomings of this approach to "quality" are becoming apparent. Contradictory reports of "bioactive molecules" attributed to physiologic activity and clinical outcomes of various medicinal herbs reveal tentative, not conclusive understandings (Butterweck, 2003). Authoritative pharmacologic understanding requires scientists to more fully delineate the chemical complexity associated with the naturally occurring plant matrix, and then deal with the difficulties of attributing pharmacologic response, or clinical outcome, to a spectrum of specific chemical entities. The complexity becomes greater still when individual herbs are combined into a therapeutic formula, as typically occurs in CM. This complexity is a virtue within CM, but becomes a greater stumbling block for pharmaceutical researchers attempting to focus therapeutic effects narrowly within the context of a few isolated active ingredients (Lampert, 2004).

No medicinal herb to date has been completely characterized with respect to its precise chemical composition (Cardellina, 2002). State-of-the-art chemical analyses yield a "fingerprint" profile of molecular composition but without positive identification of the individual constituents (Harkey, 2001). Scientists may capably differentiate products with respect to their overall chemical profile or pattern, yet in many cases lack the means to confirm the identity of the differentiating components involved (He, 2000; Yan, 1999). Associating clinical outcomes with specific chemical components is further complicated by the likelihood of interactions among several or many bioactive compounds within the plant material (Chang, 1999). Our best understandings suggest the therapeutic benefits associated with medicinal herbs in many cases come from a complex array of different compound classes within the plant (Lee, 2000; Yan, 1999, Butterweck, 2003). Not surprisingly, the bioactive constituents of any given herb are not known with certainty in most cases (Cardellina, 2002). Thus, there exists no simple or direct chemical assay or analysis that can be used with certainty to predict "quality" of medicinal herbs with respect to user efficacy or clinical outcome (Cardellina, 2002).

This state of affairs is highly problematic for biomedical professionals who rely on standards for product quality based upon chemical analysis and pharmacological response (Calixto, 2000; Harkey et al., 2001; Lee, 2000; NCCAM, 2000; Yan et al., 1999). In the absence of assays to determine quality of clinical outcome, current measures resort to chemical analysis of identifiable "marker" compounds in an attempt to provide final products with greater homogeneity and product uniformity (Cardellina, 2002; Costello and Coates, 2001). Uniformity and consistency with respect to "marker compounds" offer some measure of quality with respect to product identity (does the product contain what the label states?) and to some extent product safety, but are not necessarily related to maximizing clinical benefits. In this sense, biomedical efforts to standardize botanical products are concerned with minimizing fraud and possibly adverse effects, but should not be construed as a process of ensuring the best health outcome for patients taking these products.

Given these limitations, chemical analysis and fingerprinting methods may offer more utility as means to flag substandard quality (such as a contaminated or adulterated product) than as tools for determining optimal quality or clinical efficacy. Efforts to chemically "fingerprint" each botanical can yield different chemical profiles depending upon where the plant is grown, when it is harvested, how it is processed and stored

(Harkey, 2001; Cardellina, 2002). Significant costs are associated with compositional analysis, and interpreting the pharmacological significance of different "fingerprints" is ambiguous at best (Harkey, 2001; Chang, 1999). Conclusive understandings of bioactive "cause and effect" pharmacology for dose/response and clinical efficacy comparisons requires expensive randomized controlled trial (RCT) design. The cost for one well-executed RCT can range from under $ 1 million to many millions, depending upon the size and duration of the protocol. RCT costs are a significant part of the escalating costs associated with pharmaceutical products, where patent protection is used to recover these formidable investments. Medicinal herbs lie beyond patent protection, so it is unrealistic to expect such costs to be recovered from the marketplace. Cardellina (2002) suggests that if simple, cost-effective bioassays could be established and linked to performance in RCTs, the challenge of defining standards of quality from a biomedical perspective could become more viable. Given the magnitude of the challenges described above, one might question whether developing scientifically sound and reliable bioassays can be accomplished without adding significant cost to final products. DSHEA legislation was enacted to provide consumers with alternatives to reduce health care costs (DSHEA 1994; Nesheim, 1999), not to raise them further. But perhaps it may be possible to create cost-effective bioassays through a process of respectful dialogue and communication with other, well-established knowledge systems already in place.

Quality as Viewed from a Perspective of Chinese Medical Theory

Biomedical-based standards of medicinal herb quality offer CM practitioners little help with quality assurance on the one hand, and on the other hand create a series of significant obstacles to providing patients with the best possible health outcomes (Chevallier, 1996; Chiu, 1997; Hassel, 2002; Yang 2002). Aside from the challenges posed above, practitioners of CM use a different language, systems of logic, and criteria for understanding health and diagnosing illness (Chevallier, 1996; Leslie and Young, 1992). The fundamental ideas upon which Chinese medical theory rests do not fit well within a biomedical model, and are often discounted or ignored (Leslie and Young, 1992). Consequently, ideas of medicinal herb quality as understood and used within CM (Bensky and Gamble, 1993; Chiu, 1997, Hsu, 1986; Yang 2002) are not well recognized by established biomedical scientific and regulatory organizations. Yet CM practitioners face the prospect of mounting restrictions, increased costs, and continued disregard by US regulations oriented exclusively toward biomedical understandings (Hassel et al., 2002).

Based on the fundamental theory of yin and yang, there are two general categories of Chinese medicine (Kaptchuk, 2000; Maciocia, 1989). The first category includes everything dedicated to understanding, diagnosing, and developing strategies to resolve patterns of disharmony. The second category includes that body of knowledge dedicated to identifying, understanding, and classifying qualities and forces in nature in terms of yin and yang, and the effects these qualities and forces have upon the relationship between yin and yang in human beings. Combining the knowledge gained in these two categories provides the practitioner of Chinese medicine with the rationale and information necessary to manipulate the forces in nature and thereby promote good health and prevent or treat illness through harmonization of yin and yang in the patient (Maciocia, 1989).

Quality Discrimination Using CM

Chinese Medicine does not rely upon the chemical composition of food or herbs as a basis for understanding medicinal efficacy, safety or quality. In Chinese dietary and herbal therapies the yin/yang qualities that are inherent in foods and medicinal herbs are identified and classified through the sensory attributes that naturally occur in these substances. These sensory attributes are called "property" and "flavour" (Bensky and Gamble, 1993; Hsu et al. 1986; Yang, 2002; Veith, 1949).

CM offers a system that recognizes and discriminates characteristics of all food and medicinal substances in terms of these sensory attributes. Some 5,700 different plant, mineral, and animal derived substances are characterized and categorized according to "property" and "flavour" attributes within the Zhong Yao Da Zi Dian (*Encyclopedia of Traditional Chinese Medicinal Substances)*, representing classification during the past 2500 years (Bensky and Gamble, 1993; Hsu et al., 1986; Yang, 2002; Veith, 1949). As with biomedicine, CM recognizes that altering soil, growing, harvest, processing and storage conditions can change the qualities of any given food or herb. Unlike biomedicine, CM recognizes physiologic manifestations of medicinal herb qualities that are subjectively experienced by the senses. Discriminating CM practitioners and pharmacists can independently assess quality of medicinal herbs through careful assessment of sensory qualities, by recognizing the "property" and "flavor" attributes found in the plant material (Bensky and Gamble, 1993; Veith, 1949; Yang, 2002;). This process is akin to recognizing the quality of a fine meal by discrimination of sensory qualities associated with each food. Indeed, CM does not make distinctions between food and medicinal herbs in terms of quality assessment. CM thus offers an alternative system through which to understand, determine and guide appropriate use of medicinal herbs for treating patterns of disharmony and to restore and maintain health.

CM practitioners have expressed frustration over the lack of serious attention by most biomedical research to medicinal herb quality as understood by CM or other autonomous knowledge systems (Hassel, 2002). As stated earlier, biomedical approaches may improve product uniformity with respect to selected "marker" compounds. But this greater uniformity could represent a lateral or even backward step in terms of end-use efficacy, because the "standardization" process does not take into account the characteristics of medicinal herbs as understood by CM (Chevialler, 1996; Hassel, 2002).

Regulations to ensure public safety in the US offer a further source of frustration among CM practitioners (Hassel, 2004). The insistence of regulators to rely exclusively upon a pharmaceutical approach, combined with under-appreciation for the coherence of CM as a knowledge base for determining appropriate use of medicinal herbs has led to regulatory responses that further compromises the practice of CM. In a clinical study in Europe of a weight loss product including Chinese herbs, a number of patients developed severe nephrotoxicity after Aristolochia fangchi had been inappropriately substituted for the expected Stephania tetranda (Vanherweghem, 1999). This unfortunate mistake was probably the result of confusion with Chinese names for the two plants (Guang fang ji and Han fang ji, respectively) by clinicians lacking sufficient training in CM. The subsequent adverse effects were linked to aristolochic acid, a constituent of Aristolochia. The US Food and Drug Administration (FDA) responded by issuing warnings and a recall of all supplements containing aristolochic acid. The FDA recall was very broad, including approximately 600 species plants, many of which contain little or no detectable aristolochic acid (Cardellina, 2002). The broad recall includes many plants that have been safely and effectively used in CM for millennia, compromising the practice of knowledgeable CM practitioners and the health benefits of patients across the US.

On one hand, the FDA cannot be faulted for acting quickly to protect public safety. But over-attachment to a pharmaceutical approach and a lack of understanding for the coherence of CM as an autonomous knowledge base per se has led to a regulatory response that further erodes the practice of CM. Focus by regulators on chemical identification and pharmacology as the exclusive means to determine appropriate use of medicinal herbs furthers disregard for the fundamental principles and logical coherence of CM. If biomedical models continue to form the exclusive basis for regulation, medicinal herbs available to practitioners would likely become unavailable or more expensive, while quality, as understood from a CM perspective, could actually decrease.

Dilemma of "Integrating" Two Divergent Epistemologies

A growing issue is the dilemma of whether or how to integrate CM theory with biomedical understandings (Unschuld, 1992; Fruehauf, 1999; Lampert, 2004). Historically, CM represents a heterogeneous array of ideas and practices developed over the past three thousand years (Unschuld, 1985). Over the past century, CM has been exposed to increasing influence from outside forces, such as Marxism and Western science (Unschuld, 1992). Given the advancement and hegemony of biomedical science, many indigenous medical systems, including CM, have suffered disintegration and dismantling of their philosophical underpinnings (Aldrete, 1996; Fruehauf, 1999; Semali and Kincheloe, 1999, Smith, 1999). This disintegration is a result of biomedical inquiry into the tools of practice employed by the systems under investigation (Fruehauf, 1999; Leslie and Young, 1992).

From a biomedical perspective, CM presents itself as a series of potentially useful and exploitable technologies (tangible artifacts or practices like medicinal herbs or acupuncture), each to be evaluated through well-conducted RCT methodology. The purpose of such inspection is to expand the realm of biomedical practice by including specific herbs or practices proven efficacious or safe through controlled scientific experiment (or as illustrated in the case above, to exclude by regulation specific herbs proclaimed as unsafe). Left behind is the underlying theory and epistemology (like Qi and Yin/Yang theory) that do not fit with the biomedical model (Fruehauf, 1999; Leslie and Young, 1992). The vast majority of biomedical researchers do not consider these ideas (Leslie and Young, 1992).

From the perspective of CM practitioners, the safety and efficacy of CM lie not just with the toolbox of specific herbs or practices used, but also with underlying concepts that determine and govern their appropriate use (Unschuld, 1987). Biomedical inspection of the herbs and procedures of CM propagates expansion and hegemony of the biomedical paradigm, at the expense of the underlying integrity of the CM perspective (Fruehauf, 1999). This form of "integration", sometimes termed "biomedicalization" is seen as threatening by many CM practitioners. While some CM practitioners welcome the increased attention and recognition that may come with biomedical testing of CM technologies, movement toward statutory regulation has raised fears among many that CM may increasingly be judged in accordance with biomedical concepts and criteria, with a consequent loss of autonomy and ability to make a unique contribution to healthcare (Lampert, 2004). Such fears may lead many practitioners to take whatever steps are needed to protect CM in the face of ongoing attempts to "integrate" through biomedical expansion (Farquhar, 1987; Fruehauf, 1999; Scheid, 1999; Lampert, 2004). The protectionist impulse -"good fences make good neighbors"- might reduce the destructive forces of "biomedicalization", but could serve to slowly strangulate CM if all opportunity for dialogue, learning and interaction are lost in the process (Scheid, 2002). These issues of integration highlight the importance of protecting the knowledge base of the tradition while remaining open to change (Lampert, 2004).

Alternative models for integration are needed that recognize and respect the autonomy and diversity of different knowledge traditions. By "recognize and respect" we are specific about including intact the underlying theory, concepts and worldview with their corresponding forms of discourse, diagnosis and treatment. We offer below what we see as a viable model for respectful integration of CM and biomedicine, and include the context that provided the nurturance for this approach.

Founding a Medicinal Herb Network

In 1998, a Medicinal Herb Network was formed in the Upper-Midwestern US to establish a marketing, communication, and programmatic relationship between health-care practitioners seeking quality medicinal herb products and farmers looking for opportunities to diversify operations and increase profitability (Hassel et al., 2002). The purpose of the Network was to bring together expertise among medicinal herb growers and health-care practitioners to explore opportunities in the production, processing, marketing, and use of botanicals. An extensive web search for similar endeavors begun elsewhere revealed several organizations comprised of either medicinal herb growers or herbalist health-care practitioners, but none that deliberately included both within the same network. A participatory, community-based action research approach (Greenwood and Levin, 1998) was employed where participants defined issues and research questions, developed agendas and conducted research based upon areas of opportunity identified by ongoing discussion.

Network members quickly came to the understanding that disconnections between medicinal herb producers and end-user practitioners kept both groups from realizing the significant benefits and opportunities that might exist for domestically grown herbal medicines. Local herb growers expressed their readiness to grow a variety of medicinal herbs, but had concerns related to profitability and sustainability. Price volatility observed over the course of the growing season heightened a sense of uncertainty of the demand for and potential for profit generated by their products. They reported receiving mixed messages from distributors concerning future prices for given herbs, and on premium pricing for "higher quality" products. They indicated poor definition, understanding, and communication around the concept of "high quality" within the marketplace. When growers engaged in contract negotiations, processors/ distributors were often unclear about the desired qualities of the medicinal herbs to be produced.

CM practitioners indicated that they relied significantly upon products imported from Asia, South America, and Europe, but were suspicious of dubious quality, including concerns of contamination and/or adulteration. Because of DSHEA regulations and poor oversight of imported products, they had no way of certifying authenticity or the conditions under which the product was produced or processed. Practitioners suggested that locally grown herbs produced with specific attention to generating a high quality product would provide added value to their practice. One practitioner indicated, "My diagnosis can be flawless, yet if the herbs I prescribe are of substandard quality, the patient will not see the best results" (Hassel, et al., 2002).

Network initiatives

Practitioners expressed confidence that higher quality medicinal herbs would translate into better health care for patients. The Network produced a survey that was distributed to CM practitioners in the Upper Midwest to gather data of specific medicinal herb product use, and sought insights regarding quality concerns with available products (Cooperative Development Services, 2000). The survey was part of a larger broad-based market research study of medicinal herbs conducted by the Minnesota Grown Opportunities Project. Practitioners stated their willingness to pay a premium price for assurance of quality as recognized within the system of CM practice (Cooperative Development Services, 2000).

Another initiative resulted in the development of an Organic Herb Producers Cooperative to focus specifically on producing and marketing high quality medicinal herbs. The cooperative brings together organic herb growers with a wide range of backgrounds and expertise throughout the Upper-Midwest to deal with issues around growing, harvesting, post-harvest processing, including dry-cut/sift and essential oil production, and marketing. Some eighty different medicinal herbs used in CM were propagated and field-tested by Cooperative members. Growers are especially interested in a means to assess quality throughout the production and processing cycle - as a means to capture maximum value - without having to rely upon the time and expense associated with chemical analysis procedures.

A third activity directly addresses the issues of medicinal quality described above. Indications from the practitioner survey suggest standards of quality would enhance market opportunities for domestic growers by making their products more attractive to CM practitioners. A product certified under a system that could verify growing, harvest, processing and storage conditions would give producers a market advantage by providing practitioners with medicinal herbs assured to meet certain criteria for quality. Quality benchmarks would include certification of organic production, botanical authenticity, and post-harvest processing methods and practice. Most importantly, quality recommendations would include a means of assessment that would employ the fundamental principles of CM as a basis for clinical efficacy and safety.

Quality as Determined Using CM

Practitioners suggested that quality assessment using CM principles already in place may offer an alternative perspective to chemical analysis and standardization efforts that predominate in the pharmaceutical industry (Bensky and Gamble, 1993; Hsu et al., 1986; Yang, 2002; Veith, 1949). As described above, CM recognizes and discriminates characteristics of medicinal herbs - and indeed categorizes them - in terms of their property Si Xing) and flavor Wei attributes as accessed by the senses. CM practitioners with expertise in classical principles of CM have the capacity to evaluate the quality and potential for clinical efficacy of a given herb by its smell and/or taste characteristics (Chiu, 1997; Hsu, 1986; Yang 2002). The Medicinal Herb Network has developed a project to bring together CM theory and descriptive sensory analysis, a sub-discipline within food science where panelists are trained to detect specific sensory characteristics ("attributes" or "notes") present in food (Hootman, 1992: Gacula, 1997).

This project takes advantage of the correspondence between CM theory and descriptive sensory analysis, defined as "a sensory method by which the attributes of a food or product are identified and quantified using human subjects specifically trained for this purpose" (Hootman, 1992). The approach includes expertise of both CM practitioners with experience in the evaluation of medicinal herbs and graduate food scientists trained in the procedures of descriptive sensory analysis. Its purpose is to establish a means of communicating the concepts of quality as understood by CM practitioners using a vocabulary of terms developed by descriptive sensory analysis procedures. A given herb is selected for analysis and a wide variety of samples (both imported and domestic) are procured from the marketplace. Expert CM practitioners are then asked to evaluate the overall quality of the herb samples with regard to their Si Xing and Wei characteristics, and to offer a cursory description of its taste/smell characteristics. The graduate food scientist panelists are then employed to more fully elucidate and identify the sensory attributes or "notes" inherent within the spectrum of samples for a given species of medicinal herb (Hootman, 1992; Gacula, 1997). Once the attributes are discriminated, identified, described, and labeled, intensity scores for each attribute in each sample can be assessed. In this way, different sources of the same herb species can be compared and evaluated with respect to the presence and intensity of sensory attributes. The assessment of quality by CM practitioners can then be correlated with presence and intensity of attributes as determined by the panelists using descriptive sensory analysis.

By evaluating several different species of medicinal herbs, a dictionary of attributes can be compiled that might be used to convey information about medicinal herb characteristics and qualities. CM practitioners envision that as more species are analyzed, the redundancy of attributes would increase, so that a fairly complete dictionary of attributes could be derived from several species of medicinal herbs. Such a dictionary of attributes would form a lexicon (vocabulary) that could be used to communicate a sense of quality, as understood from the CM knowledge system, to others less familiar with CM. The lexicon would not replace chemical analysis, but could offer a different and perhaps more cost-effective means to perceive and distinguish medicinal herb qualities, using the lens of CM theory. The lexicon is envisioned as a means to communicate understandings of quality that would not depend solely upon more expensive and exhaustive chemical analysis methodologies. In addition, growers could potentially use sensory assessment as a means to add value to their products, making them more attractive to CM practitioners seeking quality products.

The Medicinal Herb Network has been working on a pilot study to test the feasibility of these ideas, using a cross-section of eight-ten samples of two different herbs (both imported and locally-grown origin) of varying quality. Briefly, a critical mass of local and knowledgeable CM practitioners was assembled to offer an initial quality assessment of each herb sample. Practitioners were asked to judge overall quality for clinical use and then to describe briefly sensory characteristics for each sample. Descriptive analysis sensory panels were organized using graduate students trained at the Sensory Center in the Department of Food Science & Nutrition at the University of Minnesota. Student panelists were trained using individual descriptor element reference "attribute" standards, deciphered from initial descriptive analysis of the herb samples.

During these sessions, eleven students developed their ability to discern and rate the intensity of the individual attributes for a given sample. Based upon the practice sessions, students were able to discern some thirty individual notes or descriptor characteristics found among the herb samples. Once trained, panelists were asked to identify the presence and intensity of the sensory attributes for each herb sample. Intensity scores for each attribute were aggregated into mean data for each individual herb sample. Interestingly, the food science graduate students had no difficulty discerning qualitative differences among a cross-section of samples of a given herb. Also, the mean intensity scores of attributes as rated by the students were statistically correlated with medicinal herb quality as assessed by qualified practitioners (Hassel, 2002). Thus, establishment of a lexicon of quality attributes based upon descriptive sensory analysis appears feasible. Additional studies and analysis of several other

medicinal herb species will yield a lexicon that could be incorporated into clinical trials that include the CM system of diagnosis and treatment as part of the randomization protocol. If successful in such trials, a lexicon could potentially offer medicinal herb growers a means through which to target growing and processing protocols, thereby adding value and quality to locally grown products sought by practitioners of CM.

More broadly, this project demonstrates how a research methodology from contemporary food science (descriptive sensory analysis) can be used in a way that recognizes and respects the autonomy and validity of CM theory and its traditions. It presents an alternative for integration of biomedical and CM traditions by using modern methodologies not as replacement for CM theory, but rather in service to its communication and promulgation as a coherent system of knowledge and practice that offers society a useful system of healthcare.

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