

Herbal Therapy: Can Omics Technology Create Order from Chaos?

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Abstract

Herbal therapy (HT), a plant-based management of diseases, has been the sole remedy available for centuries. With the advent of standardized Western medicine, multifaceted uncertainties “black-box” arose for HT that was related to herb’s quality, components, safety, and mode of action. The omics techniques (prompt, information-rich, large-scale analyses that include genomics, proteomics and metabolomics) have availed a timely, profound, and overall picture of multiple events occurring in a cell or tissue. Omics, introduced by the year 2000, unraveled and revolutionized diverse botanical and activity issues for HT, such as authentication, quality control, dosing and safety profiles. Furthermore, omics fostered a new capable aspect of drug “synergy” in which the rational use of multi-components (mixtures) improved the efficacy or reduced toxicity of herbs. Having now made a “black-box” transparent, omics future endeavors should consider securing a pipeline strategy towards consistent and precise evaluation of herbs. Omics, likewise, with their achieved breakthroughs, should gain new future approaches to optimize the utility of HT and expedite its merge with Western medicine.

Introduction and Background

Herbal therapy (HT) is the use of plants, their extracts or derived drugs for the management or prevention of diseases. HT is a prime component of “alternative and complementary medicine”, a quite dispirable approach from that of the standardized Western drug model. For eras, HT had been the sole option available for cure. Now, it is estimated that about 38 percent of U.S. adults are using some form of alternative medicine [1-3]. Nevertheless, growing concerns, uncertainties and controversies have surrounded the safety, efficacy and reproducibility of HT. These latter variables for HT translated into an elusive “black-box” approach that fueled a long-standing (race/conflict) between Western- and herbal-therapy [4]. In this vein, this review first highlights the pros and cons of HT, then addresses how recent advances in drug discovery/evaluation (as per the omics technology) have revolutionized our knowledge and judgements of HT. Lastly, it tackles whether, and how far then, such breakthroughs with omics can help reconcile HT with Western medicine.

The potential pros and cons of HT

The potential pros (benefits), often reported by “public” for HT, include:

- **Effectiveness and safety:** Because they are natural, there is a general perception that herbal remedies are better for the body and that they pose less hazardous reactions than pharmaceutical drugs.
- **Convenience:** Herbs are handy, available at all times with no need for making a clinic visit or getting a prescription.
- **Cost:** Herbs are much cheaper than their Western drug counterparts.
- **Moral reasons:** These include a stance against animal testing; and hence, the desire not to support pharmaceutical companies.

On the other hand, the most relevant HT cons (disadvantages): As reported by professional healthcare givers include a general failure to fully appreciate medicinal qualities of herbs that may escalate to reach a denial of their value as medicines. Underpinnings of such dogma encompass:

- Potential of overdose, adverse reactions, and drug interactions: Simply because one or more of the reasons that the exact ingredients,

their concentrations, likely body targets, metabolic profiles and clearance routes, are largely undefined.

- Perception that quality, efficacy, onset and reproducibility of herbs are far inferior to those of standardized pharmaceutical drugs that undertake meticulous formulation and strict quality control procedures. In other words, a paucity of information is usually available on herb’s pharmacokinetic/pharmacodynamic profiles.
- Potential inconsistency in strength or dosing: As entailed by a high risk of variation among batches or during extraction and preparations [1,4].

“Omics technology” and its Impact on HT:

This refers to a group of “prompt, information-rich, large-scale analyses” in which each “omic” science measures a collection of related biological samples. Literally, the suffix “omic” was derived from “ome” that was first coined for genome, which is the collection of human genes and chromosomes. Accordingly, “Genomics” targets genome analysis in a cell or tissue, “Proteomics” involves analysis of proteins, while “Metabolomics” is concerned with determining all arising metabolites in a biological system. Accordingly, the omics technology has now availed a timely, overall (zoom-out) picture of multiple events occurring in a cell or tissue. Conceivably, therefore, a great deal of overlap and interplay may well exist between omics and “systems biology”, a newer integrative approach with the outreaching aims of unraveling and delineating the entire (holistic) properties of cells, tissues, or organisms that function as a biological system [5,6].

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Given the aforementioned limitations of HT (typically also represented by Chinese medicine, CM), the omics techniques appear to introduce relevant, multifaceted, and evidence-based answers to many of the challenging mysteries of HT. For centuries, the acceptance of CM in Western medical practice had been hampered by many uncertainties and reservations. Thanks to the omics technology now, this unenthusiastic view has been markedly changed. HT has been regarded as a holistic (pool-in) action of numerous components whose exact biologic contribution (whether positive or negative?) remained largely illusive [1,5]. This enigmatic (black box) view had long impeded the potential to improve the quality of HT. With omics techniques, it has now become possible to dissect out the individual impact of numerous components, assess their sole and combined effects, and identify their precise mode of action, molecular triggers, and possible hazards. Accordingly, a fingerprint of biological and safety profiles of an herb can now be inferred [6]. Thus, the omics technology, via its information-rich tools, has now secured a means of integrated knowledge to make the black-box of HT transparent.

Additionally, it is worthwhile contemplating upon the chronological developments of omics and the ways they associated with and influenced HT. The origin of omics-techniques goes back to the beginning of this century. The early years of omics actions (2000-2004) were merely dedicated to botanical identification, and have mostly employed genomics, like DNA sequencing and microarrays. Subsequent years (2004-2007) sought, moreover, authentication, fingerprinting, and quality control of herbs. Likewise, metabolomic profiling was also concurrently employed to substantiate data on identification and fingerprinting [7-12]. It was not, however, before 2008 when omics were introduced to boost the yet traditional herbal activity studies. The latter studies addressed pharmacodynamic aspects (such as delineation of drug activity, cellular and molecular targets, and possible toxicity), as well as pharmacokinetic ones (such as duration and dosing, metabolic fates, and clearance of herbal components). To achieve this, the utilized omics techniques encompassed proteomics, metabolomics, genomics and transcriptomics. Such trials also, at the clinical level, were directed against diverse neuronal anomalies like epilepsy, and prime killing ones such as cardiovascular disease and cancer [13-17].

Furthermore, the recent application of a plethora of elaborative, meticulous omics techniques like DNA-microarrays and gene-profiling has fueled and furthered the concept of drug "synergy". This paradigm made use of phytocomplexes, either as multi-component or herbal-mixtures, to improve the efficacy and/or reduce toxicity, thereby augmenting the overall drug therapeutic value. This newer "synergy" concept promoted a superb potential, and availed a new machinery in fighting many catastrophic diseases, including cancer and autoimmune ones [18,19].

Conclusions and Future Considerations

The omics technology is endowed with high-caliber and capable techniques that can afford profound, extensive, evidence-based and meaningful data on herbs. Therefore, it has helped immensely in bridging a big deficit in HT concerning quality control and reproducibility of the assay material, as well as in monitoring of its biological effects in a carefully designed and operated platform. Conceivably, this omics technology has fostered a favorable drug discovery environment in which the margin of error and attrition of candidate drugs are largely minimized. Besides, omics technology has, unequivocally, permitted scientists to rationally pool different herbs in quest for synergy and accentuation of therapeutic action. Not surprisingly, therefore,

numerous attempts have managed to fruitfully merge HT with Western recipes in clinics and research, thereby enriching the drug armamentarium and availing new horizons to ameliorate suffering from disease.

Although the HT black-box's lid is now off, future omics endeavors should consider securing a pipeline strategy of omics methods for consistent, elaborative evaluation of herbs. This scenario should permit higher precision to also counterbalance an occasionally lacked experience in dealing with omics techniques. Given the breakthroughs accomplished in the last decade, it is anticipated that omics techniques attract newer capable approaches to expedite the standardization, acceptance and application of HT.

References

1. Firenzuoli F, Gori L (2007) Herbal medicine today: clinical and research issues. *Evid Based Complementary Altern Med* 4: 37-40.
2. El-Mowafy AM, Al-Gayyar MM, Salem HA, El-Mesery ME, Darweish MM (2010) Novel chemotherapeutic and renal protective effects for the green tea (EGCG): role of oxidative stress and inflammatory-cytokine signaling. *Phytomedicine* 17: 1067-1075.
3. El-Mowafy AM, Alkhalaf M, Nassar NN (2009) Resveratrol reverses ET-1-evoked mitogenic effects in human coronary arterial cells by activating the kinase-G to inhibit ERK-enzymes. *Int J Cardiol* 136: 263-269.
4. Gardiner P, Graham R, Legedza AT, Ahn AC, Eisenberg DM, et al. (2007) Factors associated with herbal therapy use by adults in the United States. *Altern Ther Health Med* 13: 22-29.
5. Kandpal R, Saviola B, Felton J (2009) The era of 'omics unlimited. *Biotechniques* 46: 351-352, 354-355.
6. Naylor S, Chen JY (2010) Unraveling human complexity and disease with systems biology and personalized medicine. *Personalized Medicine* 7: 275-289.
7. Sucher NJ, Carles MC (2008) Genome-based approaches to the authentication of medicinal plants. *Planta Med* 74: 603-623.
8. Heubl G (2010) New aspects of DNA-based authentication of Chinese medicinal plants by molecular biological techniques. *Planta Med* 76: 1963-1974.
9. Hung YC, Wang PW, Pan TL (2010) Functional proteomics reveal the effect of *Salvia miltiorrhiza* aqueous extract against vascular atherosclerotic lesions. *Biochim Biophys Acta* 1804: 1310-1321.
10. Kang YJ (2008) Herbogenomics: from traditional Chinese medicine to novel therapeutics. *Exp Biol Med (Maywood)* 233: 1059-1065.
11. Kim HK, Choi YH, Verpoorte R (2011) NMR-based plant metabolomics: where do we stand, where do we go? *Trends Biotechnol* 29: 267-275.
12. Buriani A, Garcia-Bermejo ML, Bosisio E, Xu Q, Li H, et al. (2012) Omic techniques in systems biology approaches to traditional Chinese medicine research: present and future. *J Ethnopharmacol* 140: 535-544.
13. Guo L, Mei N, Liao W, Chan PC, Fu PP (2010) *Ginkgo biloba* extract induces gene expression changes in xenobiotics metabolism and the Myc-centered network. *OMICS* 14: 75-90.
14. Liang YZ, Xie PS, Chan K (2010) Chromatographic fingerprinting and metabolomics for quality control of TCM. *Comb Chem High Throughput Screen* 13: 943-953.
15. Wen Z, Wang Z, Wang S, Ravula R, Yang L, et al. (2011) Discovery of molecular mechanisms of traditional Chinese medicinal formula Si-Wu-Tang using gene expression microarray and connectivity map. *PLoS ONE* 6: e18278.
16. Ouedraogo M, Baudoux T, Stévigny C, Nortier J, Colet JM, et al. (2012) Review of current and "omics" methods for assessing the toxicity (genotoxicity, teratogenicity and nephrotoxicity) of herbal medicines and mushrooms. *J Ethnopharmacol* 140: 492-512.
17. Pelkonen O, Pasanen M, Lindon JC, Chan K, Zhao L, et al. (2012) Omics and its potential impact on R&D and regulation of complex herbal products. *J Ethnopharmacol* 140: 587-593.

18. Ulrich-Merzenich G, Panek D, Zeitler H, Wagner H, Vetter H (2009) New perspectives for synergy research with the "omic"-technologies. *Phytomedicine* 16: 495-508.
19. El-Mowafy AM, El-Mesery ME, Salem HA, Al-Gayyar MM, Darweish MM (2010) Prominent chemopreventive and chemoenhancing effects for resveratrol: unraveling molecular targets and the role of C-reactive protein. *Chemotherapy* 56: 60-65.