Network pharmacology: A new approach to unveiling Traditional Chinese Medicine

WU Xiao-Ming¹, WU Chun-Fu²

¹School of Pharmacy, China Pharmaceutical University, Nanjing 210009, China; ²School of Life Science and Biopharmaceutics, Shenyang Pharmaceutical University, Shenyang 110016, China

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Traditional Chinese medicine (TCM) has thousands-years of history in using herbal formulae (Fang-Ji in Chinese) that consist of many medicinal herbs for holistic treatment of various disorders. Due to the complex nature rooted in both medicinal herbs and human body, the mechanisms of actions for most TCMs remain unclear, especially for those clinically effective herbal formulae. With the advent of the big data era in the biomedical and biopharmaceutical research and development, network pharmacology is coming as a systematic approach to shifting the current “one target, one drug” paradigm in drug discovery and development. The network pharmacology approach is capable of describing complex interactions among biological systems, drugs, and diseases from a network perspective, sharing a similar holistic thinking of TCM.

Bringing together the ancient and evolving TCM and the newly developed network pharmacology gives birth to an exciting new interdisciplinary frontier, termed TCM network pharmacology (TCM-NP), which would promote TCM research and development in a systematic fashion. Among leading investigators in the field, Prof. Shao Li at Tsinghua University is regarded as a pioneer in this rapid growing field. Based on ten-year explorations and researches in his laboratory, Li has recently published a comprehensive review article in CJNM on the theory, methodology, and application of TCM-NP [¹], which has been recorded in ESI as a “Highly Cited Paper”. Additionally, Prof. Li was a leading scientist of the 86th Academic Salon on TCM Network Pharmacology, organized by China Association for Science and Technology and hosted by CJNM in October 2013. This successful meeting resulted in the first book in the research field of TCM-NP [²], in which Li serves as the leading editor, along with other eminent scientists as co-editors. As a leading Guest Editor, Li has also organized the special issue “Network Pharmacology in Traditional Chinese Medicine” in the journal Evidence-Based Complementary and Alternative Medicine (ECAM) [³], an international scientific journal in the field.

Recently, Li and colleagues have made new discovery in TCM-NP and published a cover article in Molecular Systems [⁴]. In this work, a systematic analysis has been created to understand how herbal medicine works and how a new indication of a given herbal formulae can be predicted. They have proposed a working hypothesis that many ingredients in an herbal formula can act on a “network target” and lead to the emergence of therapeutic effects. Based on the hypothesis, a network pharmacology analysis is performed to predict and calculate the target profiles, bioactive ingredients, responsive biological processes and potentially treatable diseases of a given herbal formula. They have illustrated the effectiveness of the method using the TCM formula Liu-wei-di-huang as an example, validating their predictive results through experimental data and literatures. The study suggests that different groups of active ingredients of Liu-wei-di-huang can act on the networked targets underlying metabolic and immune disorders, nicely interpreting the traditional efficacy of “tonifying Yin” of this formula and the principle of “same treatment for different diseases” in TCM. Their results further predict that this formula has a potential new indication of preventing the progress from inflammation to cancer. By combining measurements of network pharmacology and systems biology, they also have made significant progress in identifying biomolecular and tongue-coating microbe network biomarkers related to metabolism-immune imbalance in chronic gastritis patients with typical Cold Syndrome or Hot Syndrome, a pair of typical Yin-Yang imbalance conditions in TCM [⁵-⁹]. These new data made the headlines in The Wall Street Journal with the title of “New data on ancient remedies” on November 4, 2014.

With the continually growing and rapidly developing in the TCM-NP field, this novel approach is leading a promising
way to unveil the mystery of TCM, offering valuable insights into modern drug discovery and development.

References


