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Incorporation of Artificial Intelligence to Compute the Drug Efficacies of Ayurvedic Formulations a Theoretical Approach

Abhilash Mullasseril.,

Mullasseril, Veliyanad POST., Ernakulam-682 313. India

*Corresponding author: Abhilash Mullasseril,   Email: mabhilash@hotmail.com

ABSTRACT:

The Indian System of Medicine especially Ayurveda contributes significantly for the development of global healthcare. It has a very strong conceptual base and has been uninterruptedly practicing not only in India but also in many foreign countries. The introduction of Artificial Intelligence to the field of the Ayurveda to compute the Efficacies of various formulations based on its philosophical bases were successfully carried out. A new term called Drug Efficacy Index Q(VPK) is introduced to the scientific literatures. The Natural Language Processing (NLP) tools based on the Paninian perspective can also be successfully utilized to translate and interpret the terminologies used.

Keyword: *Efficacies of Ayurvedic Formulatins, Artificial Intelligence, Drug Efficacy Index Q(VPK).*

INTRODUCTION:

Ayurveda being a wholistic system of medicine it considers all aspects of health including mental, physical and socioeconomic components and hence has a potential to become a more global system. This system has a wide range of well-defined categorization and numerous formulations that are very relevant even in this modern era. These formulations vary from a single component to multi component ones. Chemically most of them are not a single entity like modern medicine counterparts. But they are multi chemical entities that might contain chemicals yet to be isolated, structurally elucidated and identified or classified scientifically. Hence the efficacy computation of traditional *Ayurvedic* formulations were found highly competitive one. These complexities of the ingredients and lack of proper clinical studies as per the modern methods that are to be required for computation even though all those formulations are time proven ones. The modern medicine defines the affinity of a drug for a receptor is a measure of how strongly that drug binds to the receptor and the term efficacy of drug as the measure of how effectively an agonist activates a receptor. From these definitions it is crystal clear that a drug may have high affinity to strongly bound to the receptor but possibly have low efficacy. Hence the efficacy can be considered as a measure of the maximum biological effect that a drug can produce as a result of receptor binding. The radioligand labeling method is used by modern scientists to calculate the affinity of a drug or agonist by measuring the amount of radioactivity present in the cells or tissue (bound) and the radioactivity that was removed by washing (unbound). From these the equilibrium constant for bound versus unbound radioligand and the total number of receptors present are calculated graphically from Scatchard plots plotted based on many trials of various concentrations. The affinity of a novel drug can be estimated by repeating the trials in presence of the unlabelled test compound that competes with the radioligand for receptors binding sites. This method is not a suitable one for predicting the efficacies of Ayurvedic medicines as many of the Ayurvedic formulations are polyherbal in nature those contain numerous identified and unidentified chemical entities. Thus the alternative system of medicines like Ayurveda needs a suitable method for computing the efficacies and that can only be achieved by considering the traditional methodologies and philosophical or theoretical discussions as the functional bases of the research. The effective incorporation of Artificial Intelligence or simply machine intelligence based on these traditional backgrounds alone can definitely lead to a successful solution. The authentic literatures of Ayurveda are written in the classic language Sanskrit. The successful algorithms for Ayurveda related works must be based on these classical literatures. Hence this is worthwhile to recall the Natural Language Processing (NLP) based on the *Paninian* concepts for building models for machine translations [1]. Similarly the computation of efficacies of Ayurvedic medicines should incorporate algorithms and data structures based on its philosophy. This process for computing the efficacies should include the inherit results from various modern fields like Medicinal Chemistry, Computer Science, Linguistics, Logic and relevant Philosophy of Ayurveda as explained in classical texts, and modern concepts like Artificial Intelligence, QSAR and Drug Designing. The definitions of the *Aushadha* and Drug are also compared to show that the philosophical or theoretical bases of Ayurveda are strong enough to compete with the most modern technologies.

Artificial Intelligence and Healthcare

The field of research in the area related to healthcare became multidimensional and is in a boom of swift development by the effective introduction of the concept of computers and artificial intelligence. The father of Artificial Intelligence, John McCarthy defines it as "The science and engineering of making intelligent machines, especially intelligent computer programs". In a broader sense it is a way of making a computer, a computer controlled robot or a software think intelligently, and in the similar manner the humans with natural intelligence think. It is a multidisciplinary field that incorporates disciplines like computer science, basic sciences, medicine, psychology, linguistics, mathematics, engineering and technology etc. for its interventions in the development of computer functions associated with human intelligence such as reasoning, learning and problem solving. The use of Artificial Intelligence in healthcare involves the use of machine learning algorithms and software to approximate human cognition in the analysis of complex medical data without direct or with minimum human input to gain information, process it intelligently to give a well-defined output. The machine learning algorithms are capable for recognizing patterns in behavior and create its own logic. These machine learning or artificial intelligence algorithms can predict extremely precise but not the cause or answer the why. They being literal ones behave differently from natural intelligence and can be considered as black boxes. The primary aim of healthcare

related Artificial Intelligence applications that have been developed and applied to practice various processes like diagnosis, treatment protocol development, drug discovery and development etc. is to analyze precisely the relationships between prevention and treatment or research techniques and correlate with patient or product outcomes. The computing speed of Artificial Intelligence over the Natural Intelligence made the applied field of research more machine dependent and considerably reduced the human interventions but increased the urgent need of interdisciplinary skilled persons. The machine can perform as per the algorithm and the success of it varies with the interdisciplinary skills of the programming scientist who designed the machine algorithm. The success of any algorithm highly depends on the interdisciplinary knowledge with clear understanding and programming skill of the designer who does the works behind it.

Ayurveda and Artificial Intelligence

The system of Ayurveda being the most ancient one, as old as Vedas, of all medical sciences and hence the application of the most recent scientific concept like Artificial Intelligence to this field is quite challenging. Ayurveda that has a rich heritage handed down to us by the ancient Hindu sages (*Rshis*) of divine insight and unique experiences (*Mantra Drsthara*) is the only medical science that was withstood the ravages of time and is still thriving steadily and triumphantly even amidst the modern medical sciences of the West. The Ayurveda is a vast store house of knowledge and a fruitful source of research even in this modern era of medicines. The physiology of Ayurveda is based on the Principle of *Tridosa* but very few have any clear idea what is really meant by the terms *Vayu*, *Pitta* and *Kapha* even though these are very frequently used words in the common parlance. The researches on these physiological terms usually do not come with unanimously acceptable conclusions. But when we read the Vedic literatures of Ayurveda the ancient scholars gave prime importance to these terms and hence must be studied well before interpreting the terms further by applying the Natural Language Processing (NLP) methods based on *Paninian* concepts. *Caraka* and *Susruta* have mainly followed the *Nyaya- Vaisesika* and *Patanjala* systems of Philosophy and occasionally the Vedanta view of the *Bhutas* (the elements). The *Sankhya* assumes the existence of unmanifested *Prakrti* that is the ultimate basis of the empirical universe. The world is considered as the *parinama* (transformation) of this fundamental substance *Prakrti* evolved under the influence of *Purusa* by means of three constituent powers (Tri *Gunas*) of it viz. *Sattva* (potential consciousness), *Rajas* (source of all activity) and *Tamas*(inertia that resists activity). According to the philosophy of Ayurveda this body is *Pancabhautika* (Penta elemental) and constantly is in association with the three entities *Vayu*, *Pitta* and *Kapha* from its birth to death. The aim of Ayurveda is to preserve the health of the healthy and to cure the patient of his disease. Any disturbances in the normal proportion of the five *bhutas* (elements) which go to make up the whole body constitute the disease. These disturbances may occur due to infinite number of ways and that cause an infinite number diseases thus indicating an infinite variety of *Penta* elemental matter. So it is certain that we can select a particular kind of matter to get rid of a particular kind of disease; because, for any abnormal proportion of *penta* elements in the body, we can find out a particular substance in which the proportion of the elements is just opposite [2-5]. This later substance when used as a medicine will bring about the normal condition again. Hence according to Ayurveda there is no substance in this universe that cannot be used as a medicine. The methodology rooted to this philosophical approach alone can come with a suitable solution that can compute the efficacies of various Ayurvedic formulations. There are recently reported researches that effectively utilize the Artificial Intelligence to calculate the *Prakrti* of the subject matter and the vitiated *dosha*. This present study correlate the *Aushadha* concept of Ayurveda to the most modern definition of drug and the compute the efficacies of various Ayurvedic formulations based on the method rooted to the traditional concepts. The computed efficacy is numerically expressed and is termed as Drug Efficacy Index $Q_{(VPK)}$[6].

The *Aushadha* Concept and Drug Concept

The problem to define the word Drug accurately and precisely is still under great controversy in front of medicinal chemists. The introduction of computers and programming to the research field boosted the need of accurate and precise definition. The same drug can be bad and good and this itself is quite confusing. The introduction of the *Prakrti* and *Aushadha* concept of Ayurveda can give a solution for this challenging problem. The modified modern definition of the Drug is that a chemical that prevents disease or assists in restoring health to diseased individuals and is comparable with the definition of *Ausadha* by *Caraka* that also includes health tonics. Computational scientists need more precise and fool proof definition as they have to be incorporated in programming. This problem was solved by Lipinski and coworkers by formulating certain rules known as Lipinski Rule of Five or simply the Rule of Five. It is also interesting to correlate the *penta* elemental concept to it as both contain the magic number Five. This is reported in one of the earlier published papers in detail [7].

Computing the Efficacy of Ayurvedic Formulation

According to Ayurveda all this material world is *penta* elemental (*Panca bhautika*) in nature with three qualities (Tri *Guna*) and somatic humours (Tri *Dosha*). There are many lexicons that describe the nature of the materials with their *Rasa*, *Guna*, *Veerya* and *Vipaka*. The suitable combination of these materials can alter the *prakrti* thus can cure the disease. When we analyze the literatures we can understand the capacities of the individual drugs based on these terminologies. Based on these properties many formulations or *yogas* that can effectively applied for reestablishing the *Prakrti* and cure the disease completely. The arbitrarily assigned numerical values for the *Rasa* (based on their intensities) and *Guna* added together as fist additive entity, *Virya* (Hot or Cold) as the second additive or thermodynamic entity and *Vipaka* as the third additive entity are substituted to the computed equation to get the numerical value of the Drug Efficacy Index Q(VPK).

Figure : Equation for computing Drug Efficacy Index $Q_{(VPK)}$

$$Q_{(VPK)} = \left| \frac{\sum\limits_{(V,P,K)} q_{(i)}}{100} \right| + \Pi \leq 1$$

Where $Q_{(VPK)}$ is the Drug Efficacy Index, VPK represents *Vata*, *Pitta* and *Kapha* respectively and $q_{(i)}$ is the individual components for the *Tridoshas* and the Π represents the *Prabhava* the corrective entity that can govern the therapeutic value of the formulation that observed in the real practical world. Various drugs understudies were also classified according to their respective classes based on the computed efficacies and were compared scientifically. The computational studies categorized the formulations understudy according to their pharmacological activities. For explaining the process of

computation the *Triphala* the combination of *Terminalia chebula*(Haritaki), *Terminalia belerica* (Vibhetaki) and *Embilica officinalisis* (Amalaki) in different percentage combinations was taken and computed the respective Q(VPK). They are classified to their respective pharmacological classes and are found comparable with the literatures of the classical texts. This is reported in a previously published research paper. The concept was very successfully applied to compute the efficacies of various traditional formulations and found in support to the claimed pharmacological effects. This developed method was found successful not only to the traditional Ayurvedic formulations but also to many formulations of Siddha. This method was also found successful in explaining the efficacies of some of the modern drugs that can be classified in the traditional way without any prejudices. The respective computed results for many formulations were published in various other research communications [8].

CONCLUSION

The philosophical bases of Ayurveda are comparable with the modern concepts like Lipinski Rules of Five. Hence the application of Artificial Intelligence can be successfully incorporated to the field of Ayurveda. Thus the developed concept of Drug Efficacy Index Q(VPK) was able to introduce and implement successfully to theoretically compute the efficacies. The Natural Language Processing (NLP) tools based on the *Paninian* perspective can also be successfully utilized to translate and interpret the terminologies used. The concept of Prabhava the corrective entity has to be developed further. More researches are to be carried out for developing software version that could be useful for computing the efficacies.

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