

Assessing the Role of Ayurvedic ‘Bhasms’ as Ethno-nanomedicine in the Metal Based Nanomedicine Patent Regime

Sanjeeta Paul and Archana Chugh†*

Rajiv Gandhi School of Intellectual Property Law, Indian Institute of Technology, Kharagpur, West Bengal 721 302

Received 9 March 2011, revised 20 June 2011

The traditional medicine system is gaining wider popularity in the present times leading to increase in its commercialization at an international level. The present study is an attempt to analyse various facets of the patent regime of metal-based contemporary nanomedicine, with focus on Ayurvedic ‘Bhasms’ (alternative traditional medicine) used for various disease treatments. The study proposes a new dimension of understanding of Ayurvedic Bhasms as ethno-nanomedicine in the surging era of nanomedicine. The study proposes to have organized open-sourcing of the knowledge associated with Ayurvedic Bhasms, so that both, the ethno-nanomedicine as well as the emerging metal-based nanomedicine systems can co-exist symbiotically, thereby preventing misuse of traditional knowledge and promoting cumulative benefit to mankind.

Keywords: Ayurvedic Bhasm, copyleft, ethno-nanomedicine, intellectual property, nanoparticle, open source, prior art, traditional knowledge

Traditional medicine, as an alternate medicine system, has gained wider popularity over the years, not only in the developing, but also in the developed nations. This alternative medicine system is no more restricted to healing the ailments of the poor people, but has penetrated substantially into the health care sector of the developed nations where allopathic medicine system already has a strong hold. With the frequent use of traditional medicine globally, the associated traditional knowledge and know-how involved in medicine preparation by individual communities, has also gained importance. Ayurveda, one of the ancient systems of medicine, holds a vast domain of traditional knowledge within itself. It is considered as the science of life and has been practiced in India since times immemorial.

Ayurveda advocates the use of herbs and herbal preparations for the treatment of various ailments. The system frequently employs unique metallic preparations known as Bhasms with extracts of herbal juices for curing diseases. The herbo-metallic drug preparation is unique to the Ayurveda and Unani systems of medicine.^{1,2} The essence of these metal-based drugs is that they function best when converted from their original metals to metal oxide forms. A very

systematic and elaborate step-wise procedure known as ‘bhasmikanana’ converts the metal from its zero valent state to a form with higher oxidation state, which is crucial from the point of view that during this synthetic process the toxic nature of the metal and its oxide is fully destroyed while rendering the metal oxide with high medicinal value.³ In the first step, the toxic substances of the herbo-metal are detoxified, converting it to a homogenous form, removing any adulteration from it, enhancing its quality so that it is effectively used by the body. The second step includes mixing the transformed metal with herbal decoction and introducing it to fire to turn it to ashes, a process called incineration. In this process, the metallic drug is converted from a heavy, hard and rough structure to a light, soft and smooth powder and the macro sized particles are reduced to their nano form (usually 10-50 nm) as established by modern microscopic and spectroscopic techniques. Thus, the drug or the Bhasm is imparted with distinct characteristics of absorption and assimilation into the human body.⁴ In other words, the use of Bhasms is nothing but ethno-nanomedicine since it is not only an ancient traditional medicine system but also uses nanoparticulate size of metals for disease treatment.

Interestingly, contemporary medicine is witnessing the emergence of nanotechnology in the field of human healthcare. Nanotechnology involves creation

†E-mail: Corresponding author: achugh@bioschool.iitd.ac.in

*Present address: Kusuma School of Biological Sciences
Indian Institute of Technology Delhi, Hauz Khas, New Delhi

and use of materials and devices at the level of molecules and atoms and is based on the novel physical and chemical properties of nanometre-sized metallic and carbon based materials. On similar lines, researchers have developed miniature tools that can safely operate inside living cells of the body, more appropriately categorized under the term 'nanomedicine'. These engineered nanoscale structures have the potential to lead to more specific treatment of diseased or damaged tissues. Modern metal-based nanomedicine is a western concept, which utilizes the metals in very fine particulate forms (<100 nm), for disease treatment. The present study has revealed some interesting and pertinent information regarding metal-based nanomedicines evolving in the present day laboratories that use modern biomolecular and biochemical techniques, which overlap significantly with Ayurvedic Bhasms.

Ayurvedic Bhasms and Nanomedicine

The use of specific nanoparticulate metals for the treatment of diseases has been a common practice in Ayurveda. It is believed that Bhasms are more powerful than any other healing system because the constituent metals and minerals do not react with the tissues of the body. These tiny particles being insoluble can enter into the blood stream and are more biocompatible as compared to any chemically produced entity, a property similar to biologically produced nanoparticles. The metals are combined with herbs which help in assimilation and delivery of the ingredients into the human body.^{5,6} Bhasms as compared to their plant drug counterparts are stable over longer periods of time, require lower dosages, are easy to store and have sustainable availability.^{1,2}

The use of metals in traditional medicines is very often seen as a matter of concern, and many of the Bhasms contain highly toxic inorganic elements such as arsenic, mercury, lead, etc.^{1,2,7} This issue has lately given rise to the question of quality, safety and efficacy of these medicines as their production may not match contemporary good manufacturing practices and do not comply with modern scientific validation. The issue becomes all the more sensitive when it comes to the export of these products into the regulated markets of the west.^{2,6,7} However, a review of the relevant literature corroborates the non-toxic nature of these Bhasms and also substantiates their free radical scavenging activity due to their antioxidant property.^{2,7,8} It is an accepted fact that the

association of the Bhasms with the organic macromolecules shows increased superoxide dismutase and catalase activity, thus reducing free radical concentration.¹

The plethora of advantages offered by the Bhasms have attracted the corporate pharmaceutical sector to enter into R & D associated with metal-based medicines and develop drugs that may potentially get them proprietorship, in the form of patents. A large number of patents exist that are based on metallic medicinal preparations used for treating a vast range of ailments. Keeping this in view, a study aiming at collating and landscaping patents based on metal nanoparticles employed for disease treatment was carried out. The study revealed, *inter alia*, that there was a superimposition of the traditional medicinal knowledge (Ayurveda) and modern day contemporary nanomedicine with respect to the use of metals for treatment of several common ailments.

Traditional medicinal knowledge has always remained an easily accessible treasure and thus, susceptible to misappropriation. The traditional knowledge, particularly related to the treatment of various diseases, has provided leads for the development of biologically active molecules by the technology-rich countries. Misappropriation of traditional knowledge has thus become a common practice for economic gains. The situation is alarming in the sphere of traditional medicine.

To prevent misappropriation of its vast traditional knowledge base including traditional medicine knowledge, India developed the Traditional Knowledge Digital Library (TKDL) database. TKDL collates widely scattered references on traditional Ayurveda in a retrievable form. It acts as a link between traditional and modern systems of medicine, thus preventing misinterpretation and misappropriation of knowledge existing in public domain. With the help of TKDL, the need to contest patents can be avoided, which otherwise involves the expenditure of both time and money. The major problem is that patent laws like any other laws remain strictly territorial in nature where the notion of prior art varies from one country to another country. On this basis, traditional knowledge as described in the following sections may or may not be patentable. Therefore, TKDL may have its limitations as it is impossible to document in totality the vast range of traditional methods and know-how associated with traditional medicine system.

In the present study, an effort has also been made to propose an idea to safeguard India's traditional medicinal knowledge from misappropriation. Also, ways by which the traditional medicinal knowledge holders and the pharmaceutical companies can symbiotically exist, mutually benefit and lead to further development of metal-based nanomedicines have been suggested.

Research Methodology

The current study has taken due inputs from Vaidyas (Ayurvedic doctors), apart from the information collected from traditional text books and review articles. Due efforts have been also made to synchronize the data in order to effectively compare it with contemporary nanomedicine. Non-patent literature was employed for retrieval of information pertaining to different types of metals used in Bhasms for treatment of various diseases. This was correlated with patents dealing with modern nanomedicine for the cure of same diseases. This was also used as prior art search. The Bhasms were also examined for their research potential and ability to generate economic gains.

Patent Search

One of the major aims of the study has been to carry out a patent search with regard to various diseases cured with metallic nanomedicines. The patents based on the chosen metals, were first retrieved from the patent database, PatentLens. Claim search was carried out for the entire set of patents across various jurisdictions, using a combination of suitable keywords. The search included patents as well as applications from USPTO, EPO and WIPO/PCT for all the years up to February 2011. The search string employed was [X AND metal AND disease AND treatment AND nanoparticle] where X = zinc, iron, silver, calcium, copper, mercury or gold. The selection of keywords was not comprehensive but only indicative, so as to broadly indicate the territorial contributions in the field. The patents were then analysed and compared with the literature collated on Ayurveda, to infer whether there were any overlaps between the disease treatment using metals in the patents obtained and the literature reviewed on Ayurveda.

Results

Metals such as zinc, iron, silver, calcium, copper, mercury and gold were chosen for study as they were observed to be common to Ayurveda as well as

modern nanomedicine system. A literature survey was conducted for metals used in Ayurvedic Bhasms with the specific ailments they cured, simultaneously with patent search for nanomedicine containing metals. A superimposition between the uses of the same metals for treating the same disorders was scrutinized. Interestingly, it was found that some of the diseases cured with specific metals were common to both Ayurveda and contemporary medicine.

To compare the results, individual Venn diagrams for each metal were constructed with one component of it being the diseases treated by the traditional knowledge constituted by Ayurveda and the other one being modern nanomedicine with the set of diseases it treated. The intersection region depicted the common set of diseases cured by both the medicine systems with the particular metal.

It was found that in case of zinc, the common diseases treated by both the Ayurveda and modern nanomedicine are diabetes, arthritis and tuberculosis. Anaemia, diabetes and rheumatism are commonly treated by iron. Metallic silver cures ailments such as muscle wasting, nerve disorders and brain diseases in both the medicine arena. Whereas, silver nanoparticles are being used in the treatment of meningitis in modern nanomedicine, Rajat Bhasm made from silver metal is employed for treatment of brain diseases in Ayurveda. An overlap of diseases, like acidity, tuberculosis, asthma, impotency and cough are treated using calcium. Disorders, such as acidity, flatulence and tuberculosis are cured using copper in both traditional medicine as well as modern medicine. Similarly, copper Bhasm is shown to be useful in the treatment of cirrhosis, while modern nanomedicine helps treat cancer with copper nanoparticles. Cirrhosis, or scarring, is a chronic liver disease which in most cases leads to liver cancer. Fever, asthma and genital disorders are the common ailments treated by mercury. Gold nanometal has been shown to be used for the treatment of rheumatoid arthritis in both Ayurveda and modern nanomedicine.

Further, an investigation of the current market rates for various Ayurvedic Bhasms, indicate that they are very economical in comparison to the current metal-based nanomedicines, which generally involve huge costs for production.⁹

Discussion

The study conducted in the present context is unique and challenging, as it attempts to draw a

comparison between Ayurvedic Bhasms and the emerging field of contemporary nanomedicine.

The present study serves as an excellent example of commonality between the role of Ayurvedic Bhasms and metal nanoparticles in various disease treatments. Financial investment and skilled resources can thus be employed strategically to amalgamate ethno-nanomedicine with contemporary nanomedicine and avoid any duplication of research. Not only can the combinatorial approach described below, foster and add gravity to R&D in the field of medicine; the traditional medicine system, such as Ayurveda, can also serve as a template to further build a new era of robust, sustainable nanomedicine system.

Traditional Medicine Knowledge as Prior Art

With the proliferation of intellectual property regime, specially patents, there is significant constraint on the freedom of use and freedom to operate in specific research sectors and Ayurvedic Bhasms are no exception. Although the overlap of the use of particular metals for the treatment of specific diseases in ancient Ayurveda and contemporary nanomedicine is corroborated by the patent analysis conducted by the authors, there exists no uniform concept of prior art. National patent laws provide various definitions of what constitutes prior art. For example, not all countries recognize oral disclosures as prior art. In USA, oral disclosures are prior art only if they were made within the country [35 US Code section 102 (a)]. A therapeutic or diagnostic technique/measure passed orally from one generation to another - a common practice in the traditional medicine system - can still be patented in the US, despite it being publicly known in India for many years.

However, in India, Section 3 (p) of the Patents Act, 1970, states that 'an invention which in effect, is traditional knowledge or which is an aggregation or duplication of known properties of traditionally known component or components' is not a patentable subject-matter and such a patent-based on traditional knowledge shall not be granted.

Although, the Indian Ayurvedic system of medicine may serve as a prior art for contemporary nanomedicines, yet due to differing concepts of prior art globally, it is difficult to challenge a patent granted in countries such as the USA, since many traditional

medicinal practices and know-how are passed orally from one generation to another.

A patent claim is said to be anticipated, if the prior art either explicitly or implicitly describes all features of a claim. Further, an invention lacks novelty over prior art if the claim features exact composition as described in the prior art. A claim can thus be novel if the prior art fails to describe one or more features of the claim. Nonetheless, prior art can still be used to investigate the criteria of 'obviousness' for the patent claim. Ayurvedic medicine system can serve as a valuable tool for assessing the novelty and obviousness of the claimed invention by unimaginative person ordinarily skilled in the art (UPOSITA).¹⁰

Traditional Medicine Inventions

The US patent 6939567 titled 'Pharmaceutical ayurvedic preparation' pertains to a process of ayurvedic preparation for the treatment of leukemia without any side effects, using metals, like silver, mercury, sulphur and arsenic trisulphide. The method employed in the stated patent is the same as discussed for the preparation of Bhasms using citrus juices.^{1,2} Under the Indian patent regime, the said patent would have failed to qualify as patentable subject-matter under Section 3(p) of the Patents Act, 1970.

It has also been observed that some patents use the same metals for the treatment of specific diseases as in Ayurveda. However, the claims have been modified such that they meet the patentability criteria of novelty. Since only some features of the claims are identical, such as the use of the metal for treating a particular disease, the patent cannot be said to lack novelty. In other words, one can say that a single prior art requirement is not fulfilled and the patents are easily issued. Illustratively, there were patents that involved treatment of diabetes in humans with the help of zinc metal. In Ayurveda too, Jasada Bhasm (zinc metal with herbal juices) is used to cure diabetes. Evidently, these features are common to both Ayurveda and modern patented nanomedicine. The only difference is that in the latter a chelated form of zinc or zinc in combination with other compounds is used. These observations clearly indicate that more efforts are required to bring the traditional medicinal systems to the main stage so that they are given due significance in building the nanomedicine domain of science.

Misappropriation of Traditional Medicine Knowledge

Apart from evading the rights of stakeholders over their know-how built over years, misappropriation of traditional medicine knowledge can also lead to loss of community identity. Building traditional knowledge databases like TKDL act as a documented inventory of community traditional methods and practices. It can further aid in creation of avenues for socio-economic benefits and recognition of traditional knowledge holders. Yet, these measures may not be adequate to prevent the undesirable exploitation of traditional knowledge. Unauthorized or unregulated access of traditional knowledge by third parties and unintentional passing of traditional knowledge into the public domain, leading to the loss of the rights of the stakeholders, could be some of the possible reasons for this inadequacy. To resolve these problems, effective measures should be taken for the protection of the contents of these databases.

As the misappropriation of traditional knowledge, including traditional alternate medicine system, is rapidly increasing, it is of immense significance to develop stringent regulatory framework for the practice of such knowledge systems, as they are a product of intellectual capacities of the indigenous communities ardently developed over many years. As a matter of fact there are only some international measures available for traditional knowledge protection. For instance, the Convention on Biological Diversity (CBD), discusses traditional knowledge linked to genetic resources. CBD makes it mandatory to disclose the source and method of obtaining the genetic material. However, these provisions are not supported by the TRIPS Agreement. The Article 27.3(b) of TRIPS is already under immense debate as it is silent over the source disclosure of the genetic resources by the patentee as well as the use of any traditional knowledge to develop the invention.¹¹ It is pertinent to note that many a times, traditional knowledge is employed as a base for R&D for novel drug development. However, despite the fact that such traditional knowledge contributes significantly in reducing the costs of preliminary research investigations, the present regulatory and legal frameworks fail to accord due credit and recognition to such knowledge and its holders. Keeping this in view, the source disclosure obligation should not only apply to the disclosure of the geographic origin of a genetic resource, but also to any traditional knowledge-based invention, including where the

traditional knowledge is not directly linked to genetic resources, such as metallic drugs that are used as nanomedicine.

Measures to Prevent Misappropriation

One of the viable mechanisms that can serve the dual purposes of avoiding redundancy of research as well as preventing misappropriation of traditional knowledge is the adoption of 'open source licensing' which has three key objectives: (a) credible commitment, (b) competition, and (c) copyleft (optional). Under the 'credible commitment' component, the follow-on innovator is imparted confidence to invest in the technology development, such as introducing new features in the parent technology by ensuring that his legal rights are protected. The 'competition' objective allows the technology owner to use, improve, sell or distribute the initial innovation or one's own improvements in the technology without entering into any kind of agreement.¹² Further, 'copyleft' licences are instrumental in facilitating follow-on innovators in the extension of these rights beyond the initial technology. A copyleft licensee enjoys the rights as a patent holder does by excluding others from using any intellectual property protected improvements that he might select to distribute, and on the other hand is assured that he will have access to developments in the technology contributed by others.^{12,13}

The authors envisage that open source licensing will emerge as an asset for the Ayurvedic Bhasm industry. For example, new technologies developed with the metals used in the formulations will promote innovation and at the same time, users will have access to modify or incorporate changes to the said technology. The resulting modified formulations or medicaments can then be used or distributed among the users. The cooperation of the traditional medicinal knowledge holders, regarding the free disclosure of their traditional knowledge of Ayurvedic Bhasms, will enhance its value. The reason behind the stated concept is held in the fact that since users can modify the existing technology/traditional knowledge and provide creative inputs through open source, it will lead to better quality of technology and this strategy will, therefore, help these herbo-metallic formulations to survive the rigorous quality testing. Moreover, this approach is economical, user-friendly, affordable and readily available.

However, the obvious question that arises at this point is that when Ayurveda is a living traditional knowledge held by a particular community, how can the improvements through the open source strategy generate profit for the community? Some of the probable income generating means could be:

- Leveraging limited medicinal product value use of Ayurvedic Bhasm to enhance its attractiveness. In other words, free availability of information regarding Ayurvedic metallic medicines would be directly proportional to its overall use.
- Distributing Ayurvedic metallic formulations in the open source arena. This would cause considerable growth in the market for that particular medicament and further revenue could be generated by selling the concerned technology.
- Using open source technology as a market positioner. Ayurvedic Bhasms, initially, would probably generate meager or no revenue as an open source product. However, it is envisaged that in the long run, strategy can play a vital role in its overall brand-building and reputation resulting in an increase in the number of users. Once these Bhasms establish themselves in the market, one could exploit their reputation for brand-licensing and franchising, leading to capital generation.

The misappropriation that has afflicted the rights and identity of the alternate medicine system can be also effectively dealt by the strategy of open sourcing, as it will not only prevent misappropriation, but also bring benefits to the traditional knowledge stakeholders. Additionally, collaborations between ancient and contemporary medicine should be encouraged and more number of conferences, working groups and workshops should be conducted to create awareness.

It is noteworthy that the prices of the various Bhasms are very reasonable compared to the cost of contemporary nanomedicine. The difference may be due to the use of sophisticated contemporary equipments in the production of modern nanomedicine that require a huge investment in terms of capital. Interestingly, the Bhasm preparation in Ayurveda undergoes rigorous processing steps and the ingredients used in Ayurvedic Bhasms are often raw materials that are readily available in nature, resulting in reduced cost of production. Thus, the ancient medicine system has the potential to develop

into an effective nanomedicine system. Moreover, the pool of knowledge associated with Ayurvedic Bhasms is an invaluable intellectual property asset for generating revenue, when strategically leveraged through open sourcing.

Conclusion

Traditional medicine systems such as Ayurveda, can serve as an excellent template for the development of nanomedicine for human theragnostics. The present study shows that traditional medicines such as Ayurvedic Bhasms may hold strong relevance in the emerging era of nanomedicine. There is an urgent need of amalgamation of traditional medicine system involving Ayurvedic Bhasms, with the evolving field of metal-based nanomedicine. Recent reports also support the view that Ayurvedic Bhasms as nanomedicine resemble nanocrystalline materials and are similar in their physico-chemical properties. The studies propose that the Bhasms can be employed for targeted drug delivery as they are biocompatible, non-toxic and non-antigenic in nature.^{5,6}

The global scenario distinctly illustrates both promises and challenges presented by the traditional medicine system, such as Ayurveda. At the same time, a country like India that is well known for its richness in alternate traditional medicine systems, also needs to gauge the ever increasing threat to its traditional medicinal knowledge which can cause permanent damage to the community identity and survival in terms of socio-economic benefits and recognition. Constructive efforts should be made to accelerate modern research in Ayurveda, which would lead to its wider acceptability at the international level that will eventually have a significant impact on the export of Ayurvedic products. The primary objectives should be to create a path for wealth generation, sustenance of the livelihood and recognition of the traditional medicinal knowledge holders.

Further, to prevent misappropriation of Ayurvedic Bhasms, it can be made an open source commodity leading to enhancement of the reputation of these Bhasms in the global market and consequently aid in generating capital for its community stakeholders. Possibilities could also be sought to strategically leverage the information available about these Bhasms to enhance the research activities in the evolving field of nanomedicine, which share a common ground with the Ayurvedic Bhasms in

disease treatment. In this manner, all the goals, such as curbing traditional knowledge misappropriation, strengthening the economics of the country and the combinatorial progress of ethno and modern nanomedicine research for the welfare of mankind, can be achieved.

Acknowledgement

Ms Sanjeeta Paul is thankful to DST-TIFAC for providing her the fellowship to carry out the present work at IIT, Kharagpur. Authors are grateful to Dr Partha Sarathi Guha, Dabur Manufacturing Plant, Narendrapur, for his valuable inputs and recommendations and Vaidya Shekhar Kumar Chandra, Patanjali Yogpeeth, Rourkela for his involvement in providing the textual literature required for the work. Thanks are also due to Dr Punyatma Singh, RGSOIPL, IIT, Kharagpur, for his valuable suggestions.

References

- 1 Kumar A, Nair A G C, Reddy A V R & Garg A N, Availability of essential elements in bhasmas: Analysis of Ayurvedic metallic preparations by INAA, *Journal of Radioanalytical and Nuclear Chemistry*, 270 (1) (2006) 173-180.
- 2 Kumar A, Nair A G C, Reddy A V R & Garg A N, Bhasmas: Unique ayurvedic metallic-herbal preparations, chemical characterization, *Biological Trace Element Research*, 109 (3) (2006) 231-254.
- 3 Wadekar M P, *et al.*, Preparation and characterization of a copper based Indian traditional drug: Tamra bhasma, *Journal of Pharmaceutical and Biomedical Analysis*, 39 (5) (2005) 951-955.
- 4 Jha C B, *Ayurvediya Rasa Shastra* (Chaukhamba Surbharati Prakashana, Varanasi), 1994 (Hindi).
- 5 Chaudhary A K, Ayurvedic bhasma: Nanomedicine of ancient India-Its global contemporary perspective, *Journal of Biomedical Nanotechnology*, 7 (5) (2011) 68-69.
- 6 Sarkar P K & Chaudhary A K, Ayuvedic Bhasma: The most ancient application of nanomedicine, *Journal of Scientific and Industrial Research*, 69 (12) (2010) 901-905.
- 7 Chan K, Some aspects of toxic contaminants in herbal medicines, *Chemosphere*, 52 (2003) 1361-1371.
- 8 Pattnaik N *et al.*, Toxicology and free radicals scavenging property of Tamra Bhasma, *Indian Journal of Clinical Biochemistry*, 18 (2) (2003) 181-189.
- 9 Panda H, *Handbook on Ayurvedic Medicines with Formulae, Processes and their Uses* (National Institute of Industrial Research, India), 2004, p. 1-582.
- 10 Kant A, Section 3 (d): 'New' Indian perspective, *Journal of Intellectual Property Rights*, 14 (5) (2009) 385-396.
- 11 Chugh A, in *Knowledge Sharing and Intellectual Property Management* (Lap Lambert Academic Publishing AG and Co, Germany), 2010, p. 192-199.
- 12 Weber S, *The Success of Open Source* (Harvard University Press, UK), 2004, p. 1-320.
- 13 Gene Patents and Collaborative Licensing Models, edited by van Overwall G (Cambridge University Press, UK), 2009, p. 1-477.