



Construction and Application Discussion of the Knowledge Graph for Tibetan Medicine Calming Prescriptions

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Abstract. This paper explores the application of artificial intelligence technology in the field of Tibetan medicine calming formulae by constructing a knowledge graph, aiming to answer the question of how to efficiently manage and utilize this knowledge with artificial intelligence techniques. Through the study of Tibetan calming formulas, four types of entities and three types of entity relationships have been identified. The research indicates that constructing the Tibetan medicine calming formula knowledge graph not only provides new ideas for the storage of Tibetan medical knowledge but also opens up a new path for the inheritance and development of Tibetan medicine.

Keywords: Knowledge Graph, Tibetan Medical Classics, Calming Medication, Neo4j

1 Introduction

Traditional Tibetan medicine, as an important part of China's traditional medicine, is a valuable experience accumulated by the people living in the Qinghai-Tibet Plateau area in their struggle against various diseases in nature. It has formed a unique medical system and medication theory. Its unique theoretical system and treatment methods still play a significant role today.

In the Tibetan medical theoretical system presented in the "Four Medical Tantras," the methods of treatment are divided into two types: medicinal treatment and surgical treatment. Among them, medicinal treatment is further divided into calming prescriptions and purgative prescriptions. Calming prescriptions play a crucial role in Tibetan medicine, with significant effects on regulating human body functions and treating diseases.

However, with the accumulation of Tibetan medical literature, how to efficiently manage and utilize this knowledge has become an urgent problem. The paper by Tashi

Drolma^[1], "Analysis of the Compatibility Rules and Medication Characteristics of Tibetan Purgative Prescriptions Based on Data Mining," explores the frequency of drug use, common drug pairs, and commonly used drug combinations in purgative prescriptions. The paper by Tsering Namgyal^[2], "Progress in the Application of Data Mining Technology in the Study of Tibetan Medicinal Formulation Compatibility Theory," discusses the current research status of modern information technology in the field of Tibetan medicinal formulations^[3]. Overall, compared to traditional Chinese medicine, there are fewer articles related to the field of Tibetan medicine, and research on the application of artificial intelligence technology in calming prescriptions is almost non-existent. This paper proposes to use knowledge graph technology to systematically study Tibetan calming medicinal formulations, with the aim of promoting the modernization of Tibetan medicine^[4].

2 Related Materials and Technology

2.1 Research Materials

The research foundation of this paper is based on classic Tibetan medical literature, with the "Four Medical Tantras" published by Shanghai Science and Technology Press selected as the primary research material^[5]. This edition was written by Yutok Yonten Gonpo and others, and meticulously translated by a team including Ma Shilin. The "Four Medical Tantras" not only absorbs the essence of numerous works in the field of Tibetan medicine but also summarizes the long-term experience of the Tibetan people in their struggle against diseases. Its content covers the theoretical basis, diagnostic methods, treatment principles, and medication formulas of Tibetan medicine, providing a rich and reliable source of knowledge for this study.

2.2 Knowledge Graph

A knowledge graph is a structured semantic knowledge base that models entities, concepts, and their relationships, organizing and representing knowledge in a graphical manner. It is a graphical data structure used to express world knowledge, containing a large number of nodes and edges, where nodes represent entities and edges represent various relationships between entities. Through knowledge graphs, computers can better understand, process, and reason about knowledge^[6].

2.3 Tibetan Calming Medicinal Formulations

In the theoretical system presented in the "Four Medical Tantras," medicinal treatment is divided into two categories: calming and purgative. Calming medications mainly include five types: decoctions, powders, pills, pastes, and medicated oils. In addition, there are three more types: ash medicine, plasters, and medicinal wine, making a total of eight types. Moreover, valuable agents for eliminating sequelae and medications for treating acute diseases are already included within the five main types of formulations.

2.4 Neo4j

Neo4j is a high-performance NoSQL graph database designed specifically for storing and managing network-structured data. Unlike traditional relational databases, Neo4j uses graph theory as its data model, with data stored in the form of nodes, relationships, and properties. It also provides the Cypher query language, which is concise and intuitive, enabling users to easily construct complex queries for efficient retrieval and analysis of graph data.

3 Construction of the Calming Medicinal Formulations Knowledge Graph

This article adopts a top-down approach to construct the knowledge graph of sedative medications. First, it clarifies the entities and their relationships within the knowledge graph, and then proceeds with the construction of the knowledge graph.

3.1 Entities

This paper defines the entities in the calming medicinal formulations knowledge graph by summarizing and organizing the content of different formulations from the “Four Medical Tantras,” as presented in Table 1.

Table 1. Prescription Examples.

Questions	Columned Table Title
	Examples
Main Form	Chebolic Myrobalan Single Ingredient Decoction, primarily for treating stomach red bile disease.
Name Default	The decoction of Sedum, Licorice, Comfrey, and Large-flowered Rhodiola is taken to treat lung heat and cough with asthma.
Name Duplication	Pomegranate, Cinnamon bark, Lesser Galangal, and Nard are the main ingredients, combined with Dried Ginger, Myristica, Safflower, and Tsaoko to form the Pomegranate Eight-Flavor Formula.
	The main ingredients combined with Halite, Tibetan Red Salt, Pepper, and Dried Ginger are used to treat both new and old food accumulation.
	The main medicine combined with Tibetan Inula, Aromatic Celery, Seabuckthorn, and Tibetan Papaya is known as the Pomegranate Eight-Flavor Formula.

In cases where the “Four Medical Tantras” does not provide specific names for the formulations, we assign names based on the first ingredient and the number of ingredients in the formula. For instance, a formula without a recorded name is named “Four-Ingredient Rhodiola Formula.” To distinguish between the naming conventions in the “Four Medical Tantras” and those used in this paper, we name the formulas with the number first, followed by the first ingredient. For similar formula names, we differentiate them by assigning names such as “Eight-Ingredient Pomegranate Formula.”

To address the issue of repeated names, we introduce an “id” attribute to distinguish between different formulations. Additionally, to standardize Tibetan medicine names, we refer to “Large Red Rhodiola” simply as “Rhodiola” when organizing the drug preparation of the formulations.

The formulations are categorized into eight different types: decoctions, powders, pills, pastes, medicated oils, ash medicine, plasters, and medicinal wine, primarily for distinguishing between different formulations and for the application of additional prescriptions. The examples of entities and the attributes of prescriptions are shown in Table 2 and Table 3 respectively.

Table 2. Entity Examples Translation.

Entity	Columned Table Title
	Examples
Prescription	Four-Ingredient Jing Tian Decoction
Remedy	Sedum, Licorice, Comfrey, Rhodiola
Disease	stomach red bile disease
Symptom	lung heat, cough with asthma

Table 3. Prescription Attribute Examples.

Entity Attributes	Columned Table Title
	Examples
Formula	Four-Ingredient Jing Tian Decoction
ID	11014
Attributes	Decoction
Additional Formula	Boil the herbal mixture to extract the juice, and administer two-thirds of the extracted herbal liquid for consumption.

3.2 Entity Relationships

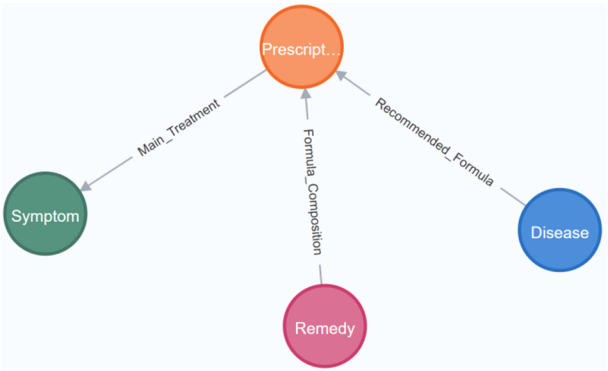


Fig. 1. Schematic Diagram of Entity Relationships.

Based on an in-depth study of Liu He's^[7] research on the extraction of knowledge and the construction of a knowledge graph for traditional Chinese medicine formulas, this paper consulted professionals from the Tibetan Medicine University in Tibet. Focusing on the field of formula research, we explored the intrinsic connections between the entities of formulas, drugs, symptoms, and diseases, and identified the following three types of entity relationships: "Drug-Formula_Composition-Formula," "Disease-Recommended_Formula-Formula," and "Formula-Main_Treatment-Symptom." The specific entity relationships are shown in Figure 1.

In the field of Tibetan medical formulas, the attached formulas for different formulas often vary, making it inconvenient to use the attached formulas as entities to associate with the formulas. Therefore, in this study, we regard the attached formulas as one of the attributes of the formulas to construct a more precise knowledge graph.

3.3 Knowledge Graph Construction

3.3.1 Neo4j Construction Tool and Knowledge Graph Import.

In the data collection phase, this study used Excel spreadsheets as the primary tool for data storage. When entering the knowledge graph construction phase, considering that Python's processing speed and convenience for CSV files are superior to those for Excel files, we chose to use the pandas library in the PyCharm integrated development environment for data conversion. The specific operation involves reading the Excel file with the "read_excel" function of the pandas library and saving it in CSV format using the "to_csv" function.

After the data conversion was complete, we began to read the CSV file line by line. Prior to this, we had already constructed a framework of node and relationship lists. During the reading process, whenever we encountered an element in a line of data, we first determined which node type it belonged to. In particular, each prescription node was treated as an independent list to store its attribute information. Next, we judged whether the element belonged to the node relationship list based on its nature. If the element was a node attribute, it was added to the corresponding prescription's attribute list, thus gradually building multiple lists that contained complete information.

To import the data into the Neo4j database, we used the py2neo library to facilitate the interaction and connection between Python and Neo4j. After successfully establishing the connection, we processed each element in the entity list one by one, filling them into pre-written Cypher statements to construct nodes (using the CREATE statement). Subsequently, we continued to build relationships between entities using the same method described above, ensuring the structural integrity and logical accuracy of the knowledge graph.

3.3.2 Tibetan Calming Medication Knowledge Graph.

The Tibetan medicine calming formula knowledge graph contains a total of four types of entities: formulas, medications, diseases, and symptoms. The entity relationships include three types: "medication-formula-formula", "disease-recommended formula-formula", and "formula-treatment-symptom". Nodes and their relationships can

be queried using the MATCH statement in the Cypher query language. As shown in Figure 2, the query is for "dragon disease-recommended formula-".

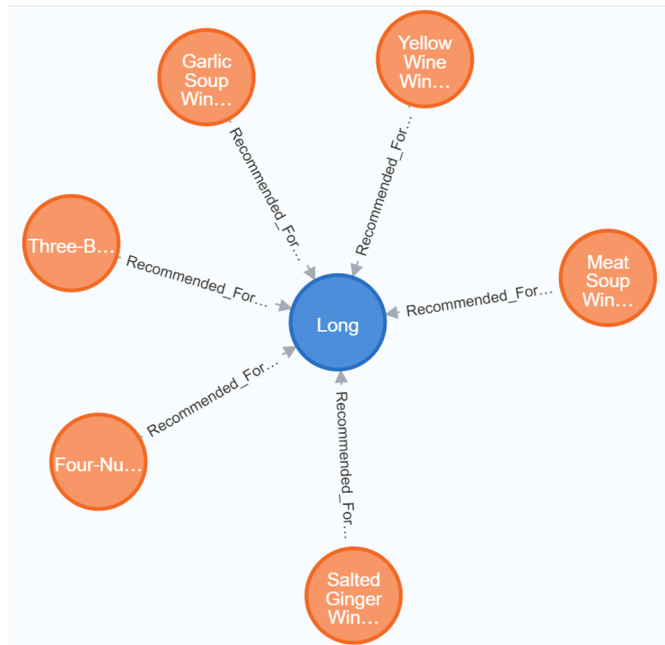


Fig. 2. Partial Schematic Diagram of Recommended Recipes for "Long Disease".

4 Application Discussion

Knowledge graph, as a structured knowledge representation method, can effectively organize and integrate complex information networks. The introduction of knowledge graph in the research and application of Tibetan medicine calming drugs can be mainly reflected in the following aspects:

4.1 Integration of Tibetan Medicine Knowledge

Calming drug formulations involve a large number of medicinal materials, prescriptions, and treatment methods^[8]. The knowledge graph can connect these scattered knowledge points through entities and relationships, forming an organic whole. This helps to understand the theoretical system and application practice of Tibetan medicine calming drugs from a macro perspective.

4.2 Promotion of Knowledge Discovery

Through the construction of the knowledge graph, hidden knowledge such as the interaction between medicinal materials and the association between prescriptions and diseases can be revealed. This associative analysis helps to discover new treatment methods and drug combinations, promoting the innovation and development of Tibetan medicine.

4.3 Auxiliary Education and Inheritance

The knowledge graph can be used as a teaching tool to help students learn about Tibetan medicine calming drugs. Through the visualization interface of the graph, students can more intuitively understand complex pharmacological relationships and prescription composition, improving learning efficiency.

4.4 Intelligent Question-Answering System

In recent years, knowledge graphs have demonstrated exceptional performance in the fields of intelligent question-answering^{[9][10]} and smart recommendations. The intelligent question-answering system based on the knowledge graph is capable of providing users with real-time and accurate information query services in Tibetan medicine. Users can obtain detailed information about the characteristics of medicinal materials, the application of formulas, and the treatment of diseases through simple inquiries. The establishment of this system not only greatly facilitates the acquisition of knowledge for both Tibetan medical professionals and the general public but also further promotes the popularization and intelligent application of Tibetan medical knowledge, laying a technical foundation for the modernization and internationalization of Tibetan medicine.

5 Conclusions

This study constructs a knowledge graph of tranquility formulas in Tibetan medicine and delves into the application of knowledge graphs in the field of tranquil Tibetan medical formulas, offering a novel approach to the organization of Tibetan medical knowledge. However, the study has certain limitations in terms of material selection, as it relies solely on the Tibetan medical classic "Four Medical Tantras" as the source of information, without a comprehensive collection of other ancient texts, which may not fully reflect the rich content of Tibetan medicine. Additionally, when discussing tranquil Tibetan formulas, the study fails to differentiate the pharmacopeia into categories for treating cold, heat, and combined cold-heat diseases, representing another shortcoming.

The application of knowledge graphs has significantly enhanced the efficiency of Tibetan medical research and laid a solid foundation for the modernization and internationalization of Tibetan medicine. Looking ahead, as technology continues to advance and research deepens, the application of knowledge graphs in the field of Tibetan

medicine will become even more widespread. This paper will continue to expand the scope of the knowledge graph, striving to make its content more comprehensive, rigorous, and professional. Subsequent research efforts will be ongoing, with the aim of contributing more wisdom and strength to the development of Tibetan medicine.

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