Connotation and scientific research points of processing of Mongolian medicinal materials

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Abstract
Traditional Mongolian medicine (TMM) is an important part of Chinese traditional culture, which plays an important role within the medical system of China. The processing of Mongolian medicinal materials is a pharmaceutical technology, which is the unique characteristics of Mongolian medicine. In this paper, the basic concepts related to the processing of Mongolian medicinal materials were introduced, and its scientific research points were put forward, in order to deeply excavate the connotation of Mongolian pharmacy and further study the processing mechanism of Mongolian medicinal materials, so as to provide important basis for the development of Chinese traditional medicine. The essence of Mongolian medicinal materials processing is to use drugs safely and dialectically to ensure the quality of Mongolian medicinal materials. The scientific research sites of Mongolian medicinal materials processing have two categories: reducing toxicity (increasing) effect and synergistic effect of excipients and processing factors. Because of the not perfect research platform of Mongolian medicinal materials and the weak processing power, the development of research of Mongolian medicinal materials is relatively slow. Therefore, there are many research breakthroughs in the interdisciplinary research on the processing of Mongolian medicinal materials, and it is expected to become a research hotspot.

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1. Introduction

Traditional Mongolian Medicine (TMM) is an important part of Chinese traditional culture, which plays an important role within the medical system of China. Mongolian medicine is a traditional medicine with regional and national characteristics, which is produced and developed on the basis of Mongolian nomadic economy and nomadic culture (Bilifu, Wu, & Chang, 2007). It has become the characteristics and advantages of medical and health undertakings in Inner Mongolia Autonomous Region, China. In the long development process, taking the original Mongolian medical and health knowledge and technology as the core content and foundation, and through the exchange and integration of multi-ethnic medical culture, the traditional ethnic medicine discipline of studying human physiology and pathology has been preliminarily divided into Mongolian medicine and Mongolian pharmacy. The processing of Mongolian medicinal materials is one of the important characteristics of Mongolian pharmacy. This paper focuses on the connotation of Mongolian medicinal materials processing and puts forward its scientific research points.

2. Related basic concepts

Mongolian pharmacy is a subject that studies the source, collection and processing, nature and taste, drug power, efficacy, efficiency, basic theory and application of medicinal flavor of Mongolian medicinal materials (Luubusang, 2006). Mongolian pharmacy is formed by the knowledge and experience of Mongolian traditional medicine accumulated before the 13th century (“Encyclopedia of Mongolian Studies” Editorial Board, 2002). The formation and development of Mongolian pharmacy is based on the development of Mongolian Materia Medica. In the history of the development of traditional ethnic medicine, the books that record the knowledge of medicine are called “Materia Medica” (the books about the knowledge of medicine in the history of Mongolian medicine are called “Rongbo”). Mongolian Materia Medica has been comprehensively developed and perfected in the historical stage from the end of the 16th century to the middle of the 20th century (Wurentuya, 2021). We summarized the three main Mongolian Materia Medica of Mongolian pharmacy in Table 1. Mongolian Materia Medica records many Mongolian medicinal materials still in use today. Mongolian medicinal materials refer to the raw materials with medical value used by Mongolian doctors to prevent health care and diagnose and treat diseases. Mongolian medicinal materials mainly come from natural substances and processed products, including plants, animals, minerals, fungi and some chemical and biological products, such as artificial musk, artificial bezoar, etc. The processing of Mongolian medicinal materials includes the collection of Mongolian medicinal materials and preparation of medicinal materials. The collection of medicinal materials is a practical activity to obtain Mongolian medicinal materials from the origin, and the preparation of medicinal materials is processing.

Before understanding the processing of Mongolian medicinal materials, it is necessary to understand the basic concepts related to Mongolian medicine. Mongolian medicinal materials take patients as the research center (therapeutic purpose), focusing on how to adjust the imbalance of the “three roots” in the process of birth, growth and aging. Mongolian medicine believes that the world is composed of “mahabod” with five attributes (five sources of astronomy and calendar - earth, fire, water, air and space). “Mahabod” is Hindi word, which means “material”. The human body is composed of the highly concentrated substances of the five substances - three “mahabodes” (or “three roots”, namely “Heyi”, “Xira” and “Badagan” of Mongolian medicine) (Song, 2015). This theory confirms that people in the field of Mongolian medicine are composed of “mahabod” and a part of the material world, thus emphasizing the materiality of life activities. On the premise of this understanding, Mongolian medicine has carried out a series of research on life, health and disease. It holds that on the premise of the dynamic balance of “three roots”, various physiological processes in the body can be carried out normally. At this time, people are in a healthy state. On the contrary, people are in a pathological state when the dynamic balance between the “three roots” is destroyed or there is an abnormal situation in which the nature components of the “three roots” are prosperous and declining (B & J., 2014). The schematic diagram of the “mahabod” and “three roots” theory of Mongolian medicine were shown in Fig. 1. The properties and taste of Mongolian medicine include the properties of Mongolian medicine and the taste of Mongolian medicine. The properties of Mongolian medicinal materials refer to the cold and heat properties of medicinal materials, which can be divided into five kinds such as cold, hot, warm, cool and flat. The medicinal taste of Mongolian medicinal materials is the taste through the tongue, including sweet, salty, sour, bitter, pungent and astringent. The taste of medicinal materials refers to the result of the change of the original taste of medicinal materials after taking, and the newly generated taste also has effect. It is the metabolic hypothesis of Mongolian medicine in vivo. With the development of Mongolian medicine, the theory of six tastes has been promoted to represent the efficacy of medicine. The pharmacological power of Mongolian medicinal materials is the traditional pharmacological content of Mongolian medicine, which classifies the unique power of medicinal materials into cold and heat attributes. The pharmacological power can be divided into thermal medicine and cold medicine. The efficacy of Mongolian medicinal materials refers to the functions related to the therapeutic purpose of medicinal materials, that is, the Mongolian medicinal effect that can treat diseases in various parts of the human body. The efficacy of Mongolian medicinal materials can be divided into two categories: Medicinal taste efficacy and natural efficacy. Medicinal taste efficacy refers to the efficacy of medicinal materials to independently play a therapeutic role through the functions contained in the taste when the natural components of “three roots” (Heyi, Xira and Badagan) are generated or restrained, which can be divided into eight kinds including heavy, greasy, cold, dull, light, rough, hot and sharp. The natural

Table 1
Introduction of three Mongolian materia medica.

| No. | Names | Authors | Writing time | Writing language | Content | Descriptions | References |
|-----|-------|---------|--------------|------------------|---------|--------------|------------|
| 1   | Ren Yao Bai Jing Jian  
      Ren Yao Xue | Yixibaljuur  
      Lubsangquirhem | 18th century  
      18th century | Tibetan  
      Tibetan | 801  
      678 | The first Mongolian materia medica in the history of Mongolian medicine.  
The second Mongolian materia medica in the history of Mongolian medicine. | (Yixibaljuur, 1998)  
(lubsangquirhem, 1998) |
| 2   | Classic Canon of Mongolian Materia Medica | Jambaldorji | 19th century | Tibetan | 879 | The third Mongolian materia medica in the history of Mongolian medicine. The first Mongolian materia medica with plant diagrams in the history of Mongolian medicine. | (Jambaldorji, 1988) |
effect of medicinal materials refers to the therapeutic effect of medicinal materials, which is a unique effect produced by the inherent nature of medicinal materials. The efficiency of Mongolian medicine material refers to the drug function of 20 temperament components that restrain the three roots. It is divided into 17 kinds, such as soft, heavy, warm, greasy, solid, cool, dull, cold, gentle, thin, dry, indifferent, hot, light, sharp, rough and dynamic. The basic theory of Mongolian medicine was summarized in Table 2.

### 3. Connotation of Mongolian medicinal materials processing

The processing of Mongolian medicinal materials refers to the technology of processing medicinal materials under the guidance of Mongolian medical theory and according to the properties of medicinal materials and the clinical needs of preparing patent drugs (Nashengsang, 2012). It is an important content of collecting and preparing Mongolian medicinal materials. The processing of Mongolian medicinal materials is a pharmaceutical technology, which is the unique characteristics of Mongolian medicine.

#### 3.1. Processing purpose of Mongolian medicinal materials

The processing purposes of Mongolian medicinal materials can be summarized as follows: i) Eliminate or reduce the toxicity, intensity and side effects of drugs to ensure the safety of drugs; ii) Change or alleviate drug performance; iii) Improve clinical efficacy; iv) Change the target site of drug action or the trend of efficacy operation; v) Convenient for dispensing and preparation; vi) Purify medicinal materials and facilitate storage; vii) Easy to take. Among them, “eliminating or reducing the toxicity, intensity and side effects of drugs to ensure drug safety” is the main purpose.

### 3.2. Processing methods

The processing method of Mongolian medicinal materials was first published in the Mongolian medicine book *Hundred Prescription*, which records the processing methods of Mongolian medicine conch calcined ash for the first time. Later, the processing methods of many Mongolian medicines were recorded in works such as the collection of the essence of the *The Eight Branches of the Medical Classics, Collection of Eight Branches of Medical Classics*, and *Moonlight*. There are many processing methods of Mongolian medicinal materials, including modification method, liquid process method, fire process method, water fire CO system process method and other process methods. The modification methods are mainly purification, crushing, and cutting. The liquid process method includes washing, soaking, bleaching, elutriation, etc. The common methods of fire system include frying, baking, calcining, simmering, melting, etc. Cooking and steaming are commonly used in the water fire co production method. Other methods commonly used are frost making, stirring, salt making, etc (Luobusang, 1989). We summarized the commonly used processing methods of Mongolian medicine in Table 3.

### 3.3. Processing of Mongolian medicinal materials is a pharmaceutical technology

The most of Mongolian medicinal materials come from plant, mineral, fungi and animal products. The Mongolian medicinal

| No. | Concepts                        | Meaning                                                                 | Number of classifications | Content                                      |
|-----|---------------------------------|------------------------------------------------------------------------|---------------------------|----------------------------------------------|
| 1   | Medicinal properties            | The cold and heat properties of medicinal materials                    | 5                         | Cold, hot, warm, cool and flat                |
| 2   | Medicinal taste                 | The taste through the tongue                                           | 6                         | Sweet, salty, sour, bitter, pungent and astringent |
| 3   | Pharmacological power           | Classifies the unique power of medicinal materials into cold and heat attributes | 2                         | Cold and heat                                |
| 4   | Medicinal taste efficacy of Mongolian medicine material | The functions related to the therapeutic purpose of medicinal materials | 8                         | Heavy, greasy, cold, dull, light, rough, hot and sharp |
| 5   | The efficiency of Mongolian medicine material | the drug function of 20 temperament components that restrain the three roots | 17                        | Soft, heavy, warm, greasy, solid, cool, dull, cold, gentle, thin, dry, indifferent, hot, light, sharp, rough and dynamic |
materials just collected from the origin are mixed with soil, nonmedicinal parts and pollutants, so they cannot be directly used in clinic. It is only a raw material that can be used in clinic and has not yet become a drug. It must be processed into processed Mongolian medicinal materials (Mongolian medicine decoction pieces) before it can be used to prepare Mongolian medicine or add flavor when taking Mongolian medicine. The processing technology of Mongolian medicinal materials is a key point between the drugs used in Mongolian medicine clinic and the raw materials that can be used in Mongolian medicine clinic. After processing, the properties of raw medicinal materials are changed into drugs. Therefore, the processing of Mongolian medicinal materials is a pharmaceutical technology, not a simple pretreatment process. For example, the copper ash of Mongolian medicine was just a piece of metal copper before processing. It needs to be processed before medication. The metal copper is calcined red, smashed into very thin slices or file scraps, boiled in Seabuckthorn soup, dried, and then studied with sulfur, borax and sesame, stewed and calcined for application. The Mongolian name is Jisinwunes, which has the effects of drying pus, clearing lung and liver heat. It is clin-ically used to treat lung heat, liver abscesses, pulmonary tuberculosis, expectoration of pus and hemoptysis (Cui & Bai, 1991).

3.4. Processing of Mongolian medicinal materials is not only the characteristics of Mongolian medical use, but also the characteristics of Mongolian medicine itself

The guiding ideology of clinical medication of Mongolian medicine is based on the macro holistic view of cold and heat (yin and yang) theory (Bagena, 2007). According to the complex etiology and pathogenesis, different Mongolian patent medicines are selected at different times in the morning, noon and evening. The specific form of clinical medication in Mongolian medicine is the use of Mongolian patent medicine (compound). Mongolian patent medicine is composed of many processed Mongolian medicine products (Mongolian medicine decoction pieces). When preparing Mongolian patent medicine, we should fully consider the organic unity of the nature, taste and efficacy of the processed products of single Mongolian medicine, and gather many therapeutic effects or potential effects that may play a role into the final overall efficacy of the prepared Mongolian patent medicine, so as to meet the requirements of syndrome differentiation and treatment. Mongolian patent medicine is mainly prepared according to three factors: the medicinal flavor effect, natural effect and medicinal flavor effect of the processed products of single Mongolian medicine. In clinical practice, the essence of one-day Mongolian medicine compound taken by patients is a “big compound” composed of more drug flavors formed through two or more prescriptions. The effective way to organically unify the drug flavor efficacy, natural efficacy and medicinal chemical flavor efficacy of many Mongolian medicine processed products that make up one-day Mongolian medicine compound is the processing technology. Therefore, the processing of Mongolian medicine is a drug feature. For example, the processing of Mongolian medicine Calcite has six methods: cold processing, hot processing, strong processing, warm processing, ash processing and bubble processing. Different processing methods are adopted according to clinical needs, e.g., the cold processing is adopted for treating fever, and the heat processing is used for treating cold disease. For nourishing and strengthening, the Calcite is processing by milk. The effect of promoting digestion and detoxification will be better after ash preparation (Bater & Menggenbagen, 2010; Zhao, Lv, & Zhang, 2016).

There is a “separation and integration” relationship between single Mongolian medicine processed products (Mongolian medicine decoction pieces) and Mongolian patent medicines. Mongolian patent medicine is composed of many processed products of Mongolian medicine. Processed products of Mongolian medicine are the material basis of Mongolian patent medicine. Mongolian patent medicine is the practical application form of processed products of Mongolian medicine. From this point of view, there is a “fit” relationship between processed products of Mongolian medicine and Mongolian patent medicine. However, the effect of each processed Mongolian medicine cannot be reflected in the effect of Mongolian patent medicine synthesized by these processed Mongolian medicine products, but exists in the form of invisible effect. From this perspective, there is a “separation” relationship between Mongolian medicine processed products and Mongolian patent medicine. To deal with the dialectical and unified relationship between processed Mongolian medicine and Mongolian patent medicine, the processing method of Mongolian medicinal materials plays a unique role. The processing method is used to deal with the relationship between processed Mongolian medicine and Mongolian patent medicine, so as to ensure the safety of dialectical drug use. To sum up, the processing of Mongolian medicinal materials is not only the characteristics of Mongolian medical use, but also the characteristics of Mongolian medicine itself.

4. Scientific research points of Mongolian medicinal materials processing

Whether from the perspective of connotation or purpose, further excavating the scientific research points of Mongolian medicinal materials processing can be summarized into two points: revealing the mechanism of reducing toxicity and increasing effect and the synergistic effect of excipients and processing factors.

4.1. Mechanisms of reducing toxicity and increasing effect

The research on the mechanisms of reducing toxicity and increasing effect can be started from two aspects: one is for the medicinal materials with the same effective components and toxic components, and the other is the medicinal materials with antagonistic components. When processing medicinal materials with the same active ingredients and toxic ingredients, we should consider reducing the content of toxic (active) ingredients to a level acceptable to the human body, rather than completely eliminating toxic (active) ingredients. For example, processing Chinese Blistering Beetle, Nux-vomica, etc (Nashengsang, 2017; Baolechaolu & Wulantuuya, 2021).
The preparation and processing of medicinal materials with antagonistic components should consider the clinical purpose. The time before and after the antagonistic components playing their role should be adjusted according to the different tolerance of antagonistic components to heat treatment. For example, Rhubarb, Panax notoginseng, etc (Gao, Zou, & Wang, 2022; Subuda & Nashengsan, 2017).

4.2. Synergistic mechanisms of auxiliary materials and processing factors

Liquid excipients such as liquid medicine, distilled spirit, vinegar, milk, and yogurt, as well as solid excipients such as sand, mung bean, highland barley and t alc powder are often used in the processing of Mongolian medicinal materials. The purpose of selecting solid excipients is to consider the uniformity of heat transfer and flexible mixing. Most of the excipients used in the processing of Mongolian medicine are food products such as wine, milk, beef and mutton, which are closely related to the Mongolian living customs. The processing methods and techniques of Mongolian medicine vary from region to region, such as the processing methods of medicinal materials in the eastern and western regions of Inner Mongolia.

The synergy of liquid excipients is obvious, especially the synergy of liquid medicine. For example, soaking in Chebula Decoction when processing Aconitum is a typical example. The essence of selecting liquid excipients such as Chinese distilled spirits and vinegar is to select cosolvent according to the acid-base properties of the effective ingredients of medicinal materials. The processing of Aconiti Kusnezoffii Radix with Terminalia chebula Retz. decoction can appropriately reduce the diester aconitine in vitro, slow down the absorption rate of aconitine and adjust the distribution of aconitine in vivo, and T. chebula can prevent the cardiotoxicity induced by Aconiti Kusnezoffii Radix. The main active components of Stellera chamaejasme L. include flavonoids, diterpenes, coumarins and lignans (Han & Nashengsan, 2008). The total flavone extract of S. chamaejasme has strong anti-tumor effects in vivo and in vitro. At the same time, it is also the main toxic component of S. chamaejasme. Therefore, in the process of traditional processing, in order to reduce the loss of effective components and reduce toxicity, traditional Chinese medicine processes it with vinegar, while Mongolian medicine has always processed S. chamaejasme with milk, Chinese distilled spirits and Chebula Decoction to achieved remarkable results (Wu, Wang, Liu, & Dai, 2013). The heat treatment factors in the processing can purify the medicinal materials, make the medicinal materials brittle, inhibit their own consumable enzyme activity, oxidize (except stewing), remove the peculiar smell and so on.

5. Conclusion and outlook

As a pharmaceutical technology, the processing of Mongolian medicinal materials is the unique characteristics of Mongolian medicine. Therefore, the research on the processing of Mongolian medicine should fully inherit the theory and characteristics of Mongolian medicine, and take in-depth investigation, collection, excavation and sorting as an integral part of Mongolian medicine processing, such as to further collect and excavate the characteristic processing methods of Mongolian medicine by famous and old Mongolian doctors in many years of clinical practice.

Revealing the synergistic mechanism between reducing toxicity and increasing effect, excipients and processing factors are always the connotation and ultimate goal of Mongolian medicinal materials processing. However, from the current research situation, in the processing of Mongolian medicinal materials, the research on the synergistic mechanism between reducing toxicity and increasing effect, excipients and processing factors is still in the primary stage, and some key scientific problems have not been effectively solved. For example, the processing of Mongolian medicinal materials is an extremely complex process of chemical changes. What exactly is this chemical? How to identify this chemical change? What analytical techniques should be used to comprehensively identify? What processing principle should be used to correctly distinguish? Are key scientific issues that need to be further revealed? Based on the basic theory of Mongolian medicine and many methods for the study of the material basis of Mongolian medicine in recent years, we can use modern combined analysis technologies such as UPLC-Q-TOF-MS and GC–MS/MS to study the processing mechanism of Mongolian medicine by referring to metabolomics, serum pharmacology, serum pharmacochimistry (in vitro transformation and in vivo absorption, transport and metabolism), chemometrics, spectrum – effect of learning and other methods (Long & Yuan, 2004) (Kui et al., 2022; Yin et al., 2021; He & Zhou, 2021). The research on the processing mechanism of Mongolian medicine is the key and core foundation to improve the processing technology of Mongolian medicine, reveal the material basis of Mongolian medicine efficacy, formulate the quality standard of Mongolian medicine, improve the clinical efficacy of Mongolian medicine, enrich the processing theory of Mongolian medicine and promote the development of Mongolian medicine processing discipline. In short, the research on the processing of Mongolian medicine should not only fully inherit the theory and characteristics of Mongolian medicine, but also discover new theories, new technologies and new processes as much as possible. Only in this way can the process, quality and clinical efficacy be rapidly improved, the processing of Mongolian medicine can be further developed, the characteristics and advantages of Mongolian medicine in China can be brought into full play, and the continuous progress in the field of medicine in China can be promoted, so as to provide more patients with better services.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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