

Annual advances of Chinese minority traditional medicine in 2020

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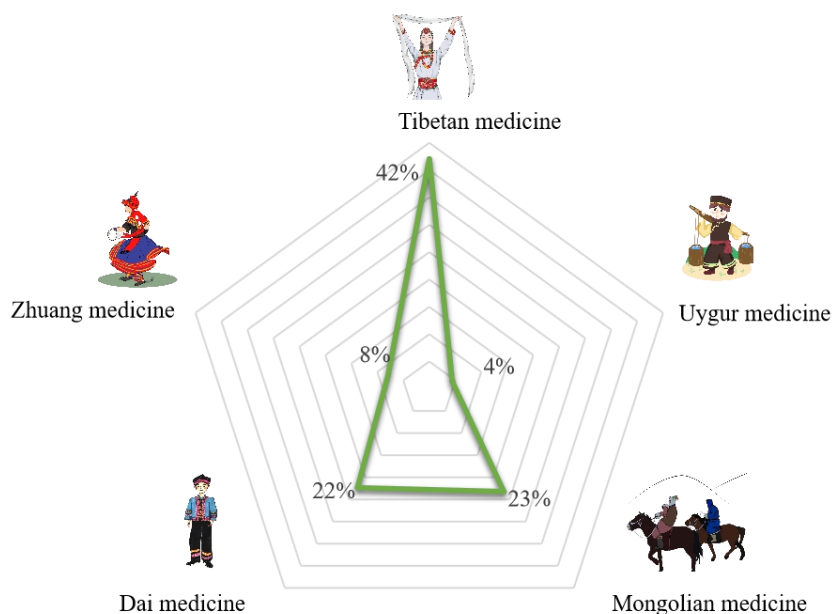
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Highlights

This review covered the academic papers related to Chinese minority traditional medicine published in 2020. The main focus is on the traditional application, chemical composition, pharmacological effects, and mechanisms. Moreover, the Chinese minority traditional medicine application under the background of the coronavirus disease 2019 epidemic situation has also attracted the widespread attention of some scholars.

Tradition

The annual review summarized the research progress of the traditional application, chemical composition, pharmacological effects, and mechanisms among different ethnic groups in 2020.



Abstract

Chinese minority traditional medicine is a traditional medicine formed during the long-term medical practice of various ethnic groups and is the crystallization of the wisdom of the people in all ethnic groups in China. The unique meaning carried by Chinese minority traditional medicine makes it an inseparable and important part of traditional Chinese medicine. The rich clinical experience and theoretical studies with different Chinese minority traditional medicine provide new ideas and new methods for Chinese medicine development. The pieces of literature published in 2020 on the traditional application analyzed the phytochemical composition, pharmacological effects, and mechanisms of the different ethnic groups including Tibetan, Mongolian, Zhuang, Dai, and Uyghur medicines, among others. This study found that some projects were stalled or delayed due to the coronavirus disease 2019 outbreak in 2020 compared with 2019, resulting in a decrease in the number of articles in certain fields. However, studies on Chinese minority traditional medicine have shown an overall upward trend this year with the Tibetan, Mongolian, and Dai medicines as the top three. In addition, the Chinese minority traditional medicine application under the coronavirus disease 2019 epidemic situation background was also summarized. Consequently, this study found that among the Chinese minority traditional medicine-related publications in 2020, publications using Chinese minority traditional medicine to treat coronavirus disease 2019 account for a certain percentage. Thus, this article systematically reviews and summarizes the related research of Chinese minority traditional medicine published in 2020 and provides references for future Chinese minority traditional medicine development.

Keywords: Chinese minority traditional medicine, Tibetan medicine, Mongolian medicine, Uyghur medicine, Zhuang medicine, Dai medicine, COVID-19

Author contributions:

Shao-Hui Wang and Wei Liu, investigation, writing original manuscript; Jing-Jing Zhang, making figures and tables; Shao-Hui Wang and Yi Zhang, supervision, project administration, review and editing.

Acknowledgments:

The work was supported by the National Key R&D Program of China (No. 2017YFC1703900), the introduction and cultivation plan of young innovative talents in Colleges and Universities of Shandong Province in 2019 (No. 2019-81), the Social Science Popularization and Application Project of Shandong Province (No. 2020-SKZZ-43), the Program of Scientific Research Project of Qingdao Binhai University (No. 2020KZ01, 2019KY13), and Qingdao Science and Technology Demonstration and Guidance Project (No. 20-3-4-52-nsh).

Abbreviations:

CMTM, Chinese minority traditional medicine; COVID-19, coronavirus disease 2019; TCM, traditional Chinese medicine; CFDA, China Food and Drug Administration; iNOS, inducible nitric oxide synthase; UC, ulcerative colitis; DP, dermal papilla.

Competing interests:

The authors declare that there is no conflict of interest.

Citation:

Wang SH, Liu W, Zhang JJ, Zhang Y. Annual advances of Chinese minority traditional medicine in 2020. *Tradit Med Res.* 2021;6(3):28. doi: 10.12032/TMR20210316224.

Executive editor: Jing-Na Zhou.

Submitted: 25 January 2021, **Accepted:** 12 March 2021, **Online:** 04 April 2021

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Background

Chinese minority traditional medicine (CMTM) is an important part of traditional Chinese medicine (TCM), which is the product of China’s vast geographical area and long history. CMTM provides a wealth of references for TCM development. For example, the Xiangfei cardi tonic (an empirical formula) and Yimusake tablets (Chinese patent drug; China Food and Drug Administration (CFDA) number, Z65020144) in Uyghur medicine have formed mature dosage forms and are exported overseas [1]. Books, such as the classical Tibetan medical book *The Four Medical Tantras* (Yutuo Yundangongbu, the end of the eighth century) and *Anthology of Tibetan Medicine* (Luosangquepei, 1982), have influenced the development of traditional medicine in many countries [2]. In addition, Zhenggu Shui (Chinese patent drug; CFDA number, Z45021659), Yunxiang Jing (Chinese patent drug; CFDA number, Z45021658), Dieda pills (Chinese patent drug; CFDA number, Z45020316), Huatuo Fengtongbao tablets (Chinese patent drug; CFDA number, Z20083088), and so on are mostly developed based on the secret recipes of Zhuang and Yao medicines [3].

The coronavirus disease 2019 (COVID-19) has rapidly developed and spread to many regions around the world in a short period, causing widespread concern at home and abroad, since the outbreak in Wuhan in December 2019 [4]. The domestic epidemic in China has been effectively controlled currently due to the combined administration of conventional therapy plus active TCM intervention. In particular, TCM has shown its unique advantages in the treatment

of severe and critically ill patients [5–7]. Medical doctors of all ethnic groups offered advice and suggestions on the understanding, prevention, and treatment of COVID-19 based on their medical theories, which has made great contributions to the protection of people’s health in ethnic areas.

By searching the academic research results related to CMTM in major databases (such as CNKI, PubMed, WOS, and so on), academic papers in 2020 were found to show an overall upward trend, especially those derived from the WOS database, and the results are mainly concentrated in Tibetan, Mongolian, Zhuang, Dai, and Uyghur medicines (Figure 1). The annual review focuses on the traditional application, chemical composition, pharmacological effects, and mechanisms of different minority medicines, especially Zhuang, Tibetan, Mongolian, Dai, and Uyghur medicines. Moreover, CMTM application under the background of the COVID-19 epidemic situation was discussed. Thus, this annual review provides a reference for further research and development of ethnic medicine.

Description of different CMTM

Tibetan, Mongolian, Zhuang, Dai, and Uyghur medicines are the most representative among the CMTM. The long history and large population base of the aforementioned nationalities ensure the relative integrity of their cultural heritage. Therefore, the research achievements of traditional medicine in these nationalities accounted for a large proportion this year. In addition, traditional ethnic medicines of the Sui, Yao, Tujia, and Yi minorities also account for a certain proportion.

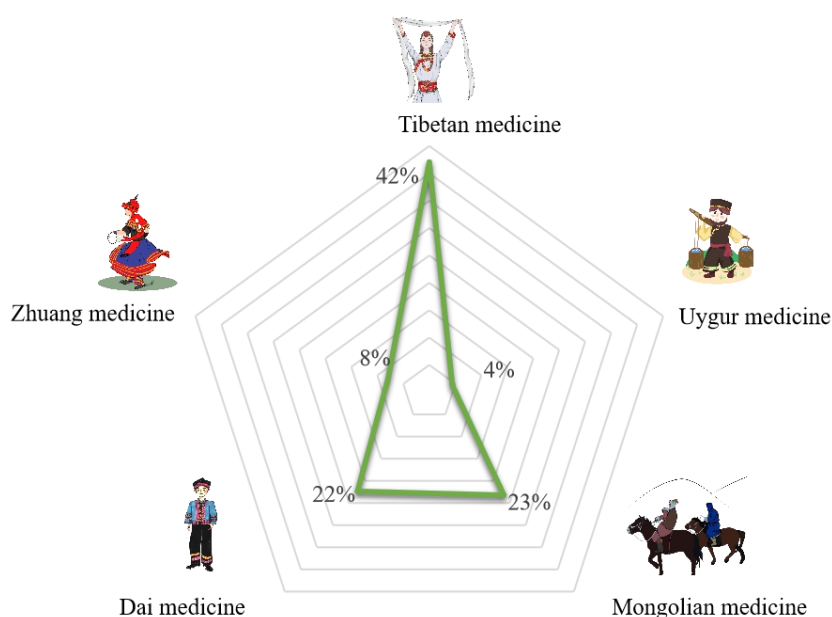


Figure 1 Statistical analysis of Chinese minorities with the most academic research results in 2020

Tibetan medicine

As an important part of TCM, Tibetan medicine has its national characteristics. On the one hand, the alpine geographical environment of the Qinghai-Tibet Plateau determines its regional characteristics. Thus, it remains stable for a long time. On the other hand, Tibetans are deeply influenced by Buddhism. Thus, Tibetan medicine has a strong Tibetan Buddhism color as its foundation [8]. In the past century, the world's research on Tibetan medicine has entered a new stage. Central Asian countries, especially India, have shown unprecedented enthusiasm for Tibetan medicine. Some universities in the USA, Britain, Australia, and other countries also have plans to study Tibetan medicine.

Through statistical analysis of the publications of Tibetan medicine in different countries, research fields, and institutions in 2020, this study found that the research fields of Tibetan medicine are mainly concentrated in pharmacology and pharmacy, biochemistry and molecular biology, plant sciences, and integrated complementary medicine. The top three most studied countries were China, the USA, and Australia. Similarly, the top three institutions with the most research were the Chinese Academy of Sciences, Chengdu University of Traditional Chinese Medicine, and Sichuan University (Figure 2). Some scholars have studied the classical books related to Tibetan medicine and the traditional applications of some of its famous prescriptions. Furthermore, Cairang et al. made a preliminary study on the academic value of the

classical book of herbal medicine *Sea of Medicine Names* (Gama Rangqiongduoji, mid-eighth century C.E.) and put forward its historical status and role as a blueprint for later generations of classic Tibetan medicine [9]. Sonam et al. took the plants and mineral drugs in *Jingzhu Materia Medica* (Timaer tanzengpengcu, 1745) as the research objects; sorted out the related literature on detoxification; and summarized the specific content, mechanism, and clinical application value of the detoxification thought contained therein [10]. Liu et al. found that the combination of Tibetan medicine prescriptions, i.e., Qiwei Tiexie pills (Chinese patent drug; CFDA number, Z54020026), Qingnai wine (empirical formula), Jiuwei Niu Huang pills (Chinese patent drug; CFDA number, Z54020054), and Shiwei Heibingpian powder (Chinese patent drug; CFDA number, Z63020171), can be used in patients with liver cirrhosis and jaundice, with obvious clinical curative effect and small side effects [11]. Some scholars have conducted preliminary studies on the pharmacological effects and mechanisms of commonly used Tibetan ethnomedicines and prescriptions (e.g., Tibetan ethnomedicine *Swertia punicea*, *Pterocephalus hookeri*, *Prunus mira Koehne*, *Chebulae Fructus*, and so on) and Tibetan prescriptions (Ruyi Zhenbao pills, Duoxuekang capsules, Ershiwuwei Songshi pills, Ershiwei Chenxiang pills, Triphala, Tsantan Sumtang, and so on) [12–22]. Furthermore, the pharmacological actions and mechanisms of the above ethnomedicines and prescriptions are shown in Table 1.

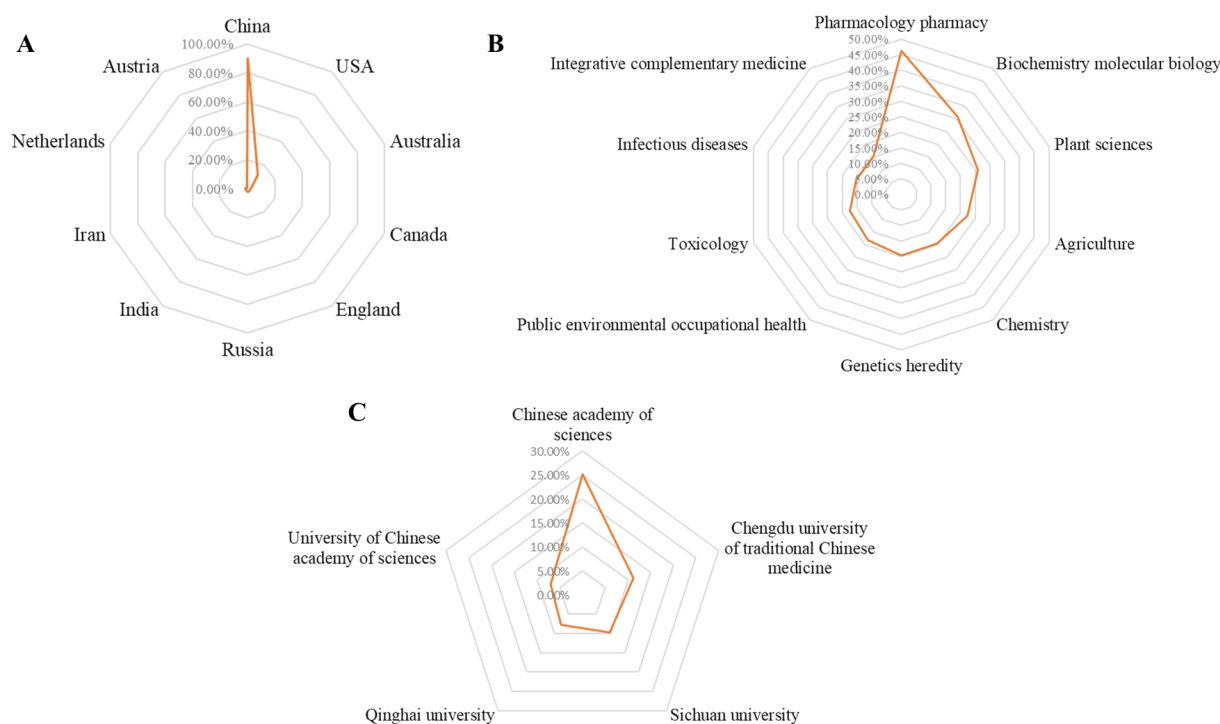


Figure 2 The percentage of Tibetan medicine-related research results in different countries (A), research fields (B), and institutions (C) in 2020.

Table 1 Pharmacological action and mechanisms of Tibetan ethnomedicines and prescriptions

Ethnodrugs/ prescriptions	Traditional application	Compounds	Cells/animal models	Dose	Pharmacological action	Mechanisms	Reference
<i>Swertia punicea</i>	With the treatment of acute bilious hepatitis, cholecystitis and jaundice.	8-O-β-D-Glucopyranosyl-2-methylchromone; 8-hydroxy-2-methylchromone; 1,3,5-trihydroxyxanthone; 1,7-dihydroxy-2,3-dimethoxyxanthone; decentapicrin C; sweroside; Epivogeloside; luteoloside and Arctigenin.	Mouse macrophage cells-RAW 264.7 and three human cancer cell lines (HeLa, MDA-MB-231 and A375).	40, 8, 1.6, 0.32, and 0.064 μM.	All compounds exhibited significant to moderate anti-inflammatory activity; 8-hydroxy-2-methylchromone displayed much better cytotoxic activity against A375.	/	[12]
<i>Pterocephalus hookeri</i>	For treating common diseases such as flu, cold, enteritis, and rheumatoid arthritis.	Pterocephanoside A	Mouse macrophage cells-RAW 264.7.	With serial dilutions of the compounds with a maximum concentration of 100 μM.	Anti-inflammatory activity.	/	[13]
<i>Prunus mira Koehne</i>	Used to cure loss of hair, eyebrows, beards, etc.	α-tocopherol; Vitamin E; linoleic acid.	β-sitosterol; oleic acid and C57BL/6 mice.	KM mice and C57BL/6 mice.	Promoting hair growth.	May be related to Wnt/β-catenin signaling pathway.	[14]
<i>Chebulae Fructus</i>	Widely used for fevers, diarrhea, asthma, rheumatism, and dysentery.	Phenolic acids from <i>Chebulae Fructus</i> immaturus.	CCl ₄ -induced acute liver injury in mice.	225, 1125 and 2250 mg/kg.	Have convincing protective effects.	By enhancing the anti-oxidative defense system, ameliorating inflammation and inhibiting the hepatocyte apoptosis.	[15]
		Chebulanin	CIA mouse model and LPS stimulated RAW 264.7 cell inflammation model.	In vitro: 25, 50, and 100 μM; in vivo: 80 mg/kg.	Anti-inflammatory and anti-arthritis effects.	By inhibiting NF-κB and MAPK pathways.	[16]
Ruyi Zhenbao pills (Chinese patent drug, CFDA number: Z63020064)	Most commonly used clinical drugs to cure white vein disease and angiemphtaxis.	/	Nitroglycerin-induced migraine model rats.	1.00, 0.5 and 0.25g/kg.	Anti-migraine effect.	By suppressing the EEG pain-wave, increasing PENK, SP, DORR levels and reducing CCK and CGRP expression, mediating PAG anti-nociceptive channel and inhibiting central sensitization.	[17]
Duoxuekang capsules (classic ancient prescription of Tibetan medicine)	Used to treat high altitude polycythemia.	/	HH-induced brain injury model in mice.	0.9, 1.8 and 3.6 g/kg.	Ameliorate hypobaric hypoxia-induced brain injury.	The underlying mechanism may be related to maintaining the integrity of cerebral vascular endothelial cells and vascular function.	[18]

Table 1 Pharmacological action and mechanisms of Tibetan ethnomedicines and prescriptions (*Continued*)

Ethnodrugs/ prescriptions	Traditional application	Compounds	Cells/animal models	Dose	Pharmacological action	Mechanisms	Reference
Ershiwuwei Songshi (Chinese patent drug, CFDA number: Z54020082)	Commonly used in the folk to treat indigestion, gall bladder disease, liver bar disease, fever, jaundice infectious hepatitis, etc.	/	ANIT-induced cholestatic injury in rats.	0.09, 0.18 and 0.36 g/kg.	Have an obvious protective effect.	May be related to the bile acid metabolism mediated by the FXR signaling pathway.	[19]
Ershiwei Chenxiang (Chinese patent drug, CFDA number: Z54020065)	Mainly used for Longzhibu disease (cerebral ischemia sequelae).	/	A model of cerebral ischemia reperfusion injury by blocking the middle cerebral artery of rats.	1.33 and 2.00 g/kg.	Protective effect on ischemic brain.	Through regulating CaMKII, ATF4, c-Jun protein expression and inhibiting the mitochondrial apoptosis pathway.	[20]
Triphala (also known as Zhe Busong decoction, classic ancient prescription of Tibetan medicine)	Anti-fatigue, antioxidation, prevention and treatment of polycythemia at high altitude.	It's composed of three Tibetan medicines: <i>Phyllanthus emblica</i> L. (Barura), <i>Terminalia chebula</i> Retz. (Ju Rula) and <i>Terminalia</i> <i>billerica</i> (Gaertn.) Roxb. (Alura).	Diabetic Wistar rat model.	0.43, 0.86 and 1.72 g/kg.	Anti-diabetes.	May enhance the activity of incretin-cAMP signal pathway and affect the proliferation and apoptosis of islet β cells.	[21]
Tsantan Sumtang (classic ancient prescription of Tibetan medicine)	Used to treat cardiomyretic disease.	Consists of <i>Choerospondias</i> <i>axillaris</i> , <i>Myristica fragrans</i> and <i>Santalum album</i> .	Rat exposed to chronic hypoxia.	1.0, 1.25, 1.5 g/kg.	Attenuate remodeling fibrosis.	By equilibrating RV local and ACE-AngII-AT1R/ ACE2-Ang1-7-Mas axis.	[22]

CFDA, China Food and Drug Administration; ACE, angiotension converting enzyme; AT1R, angiotensin II type 1 receptor; Ang1-7, angiotensin 1-7; FXR, farnesoid X receptor; ATF4, activating transcription factor 4; CCl₄, carbon tetrachloride; CIA, collagen-induced arthritis; HeLa, cervical epithelial adenocarcinoma cells; MDA-MB-231, human breast cancer cells; A375, human malignant melanoma cells; PENK, proenkephalin; SP, substance P; DORR, opioid peptide receptor; CCK, cholecystokinin; CGRP, calcitonin gene-related peptide; PAG, periaqueductal gray; ANIT, α -naphthalene isothiocyanate; LPS, lipopolysaccharide; cAMP, cyclic adenosine monophosphate; RV, right ventricular; /, not mentioned.

In addition, some scholars have conducted studies on their chemical components [23–26]. Zhan et al. isolated 13 compounds from the ethyl acetate part of *Dracocephalum tanguticum* identified as oleanolic acid, ursolic acid, betulinic acid, betulin, β -sitosterol, β -carotin, geraniol, thothaxanthin, dibutyl phthalate, di-n-pentyl phthalate, bis(2-ethylhexyl) phthalate, phthalic acid-bis(2-ethylheptyl) ester, and N-decanethiol [23]. Moreover, Liu et al. isolated six compounds (tricosanoic acid, mirabijalone A, boeravinone C, mirabijalone H, mirabijalone I, and abronione) from the methanol extract of *Mirabilis himalaica* roots. Among them, mirabijalone H and mirabijalone I are new compounds [24]. Some scholars have researched on the traditional and characteristic treatment methods of Tibetan medicine, such as Tibetan-medicated bathing therapy, brain-heart interactions underlying traditional Tibetan Buddhist meditation, and so on [27, 28].

Mongolian medicine

Mongolian medicine is a brilliant treasure in Mongolian culture. In the historical development of the nation, it has gradually formed distinctive national, regional, and clinical characteristics and a unique medical theory system. Moreover, it has a prominent position in the history of ethnic minority medicine development in China [29]. This study found that the research fields of Mongolian medicine are mainly concentrated in pharmacology and pharmacy, genetics and heredity, and biochemistry and molecular biology. The most studied countries were China and Mongolia, and the top three institutions with the most research were Inner Mongolia Medical University, Mongolian National University of Medical Sciences, and Inner Mongolia University for Nationalities (Figure 3). Some scholars have studied the cultural heritage, traditional characteristic therapies, and prescriptions of Mongolian medicine. In addition, Liu et al. discussed the origin, the history of the development, and the

characteristics and position of Mongolian medicine in traditional medicine based on the historical research of Mongolian medicine [30]. Liu et al. summarized the prescriptions (i.e., Eligen decoction, Niu Huang Jiuwei powder, Naren Mandula compound, and so on) used in Mongolian medicine to treat liver cancer and its symptoms. Among them, the Naren Mandula compound is often used to treat liver cancer in Mongolian medicine [11]. Furthermore, Ma et al. found that the use of Mongolian medicine characteristic therapies, such as Suanma'nai therapy, Mongolian medicine Niruha therapy (enema therapy), and internal treatment, can effectively improve the main symptoms of ulcerative colitis with mild or moderate abdominal pain and diarrhea [31]. Mongolian warm acupuncture could alleviate exercise-induced fatigue [32]. Moreover, Shui et al. found that warm acupuncture could reduce fatigue caused by chronic exhaustive swimming and improve learning and memory ability. Consequently, the effects may be related to the decrease of the inflammatory response and inducible nitric oxide synthase expression [33]. Some scholars have studied the chemical components and pharmacological actions of Mongolian ethnomedicines. In addition, Niwa et al. isolated four previously undescribed acylated iridoid glucosides (linaburiosides A–D), one undescribed iridoid (7-deoxyiridolactonic acid), and one known acylated iridoid glucoside (iridolinarin C) from the aerial parts of ethnomedicine *Linaria buriatica* [34]. Tong et al. isolated two new compounds (ordos acid A–B) along with four known compounds (3,4-dihydroxybenzaldehyde, p-hydroxybenzoic acid, p-hydroxycinnamic acid, and o-hydroxycinnamic acid)

from the ethyl acetate extract of *Artemisia ordosica* [35]. Moreover, DaHuang pills is a traditional herbal medicine used by Mongolians to treat liver cancer for many years. Consequently, Ha et al. found that DaHuang pills targets epidermal growth factor signaling to inhibit the proliferation of hepatoma cells and could be a supplementary medicine to tyrosine kinase inhibitors in cancer therapy [36]. Kim et al. found that *Ribes diacanthum* mediated anti-inflammatory effects in lipopolysaccharide-stimulated mouse RAW 264.7 macrophages and 12-O-tetradecanoylphorbol-13-acetate-induced dermatitis animal models by regulating the Nrf2/HO-1 and NF-κB signaling pathways [37].

Zhuang medicine

Chinese Zhuang medicine began to sprout during the pre-Qin period. “Qu Xifan’s Five viscera map” in the Northern Song Dynasty (960–1127 C.E.) is the first real-life anatomy of the human body in the medical history of China. It laid the foundation for the development of anatomy, physiology, and pathology in Zhuang medicine and also promoted the improvement of the clinical level of Zhuang medicine [38]. Zhuang medicine was approved on May 23, 2011, by the State Council to be included in the third batch of national intangible cultural heritage lists, which promoted the faster development of Zhuang medicine. This study found that the research fields of Zhuang medicine are mainly concentrated in biochemistry and molecular biology, pharmacology and pharmacy, experimental medicine, and genetics and heredity. The most studied countries were China, followed by the USA. Moreover,

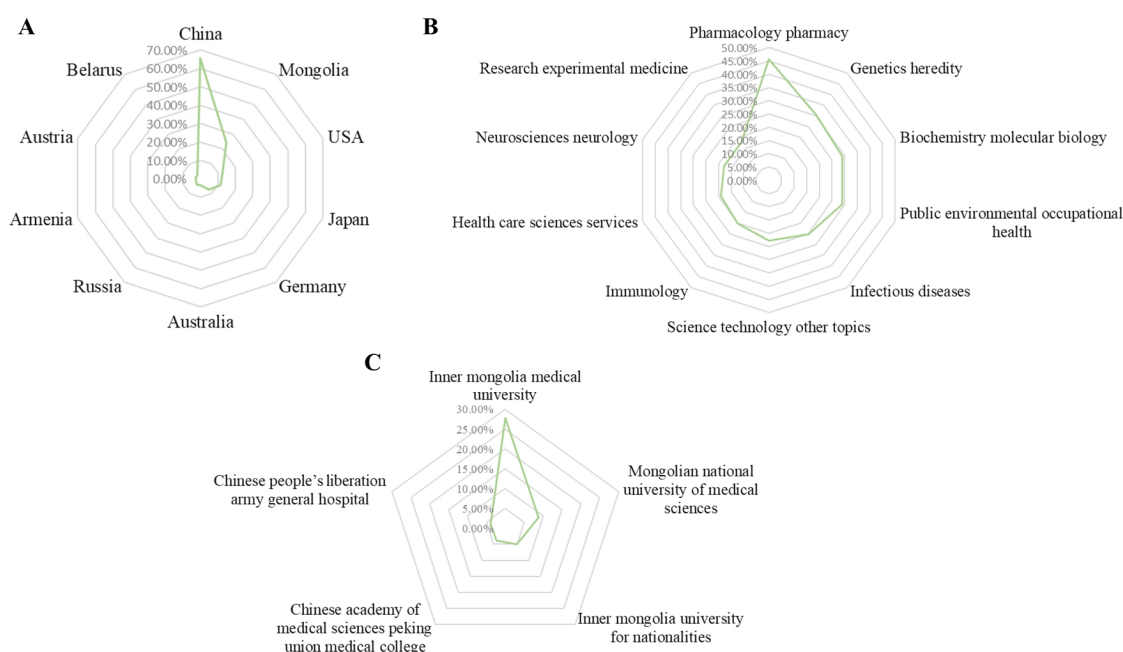


Figure 3 The percentage of Mongolian medicine-related research results in different countries (A), research fields (B), and institutions (C) in 2020.

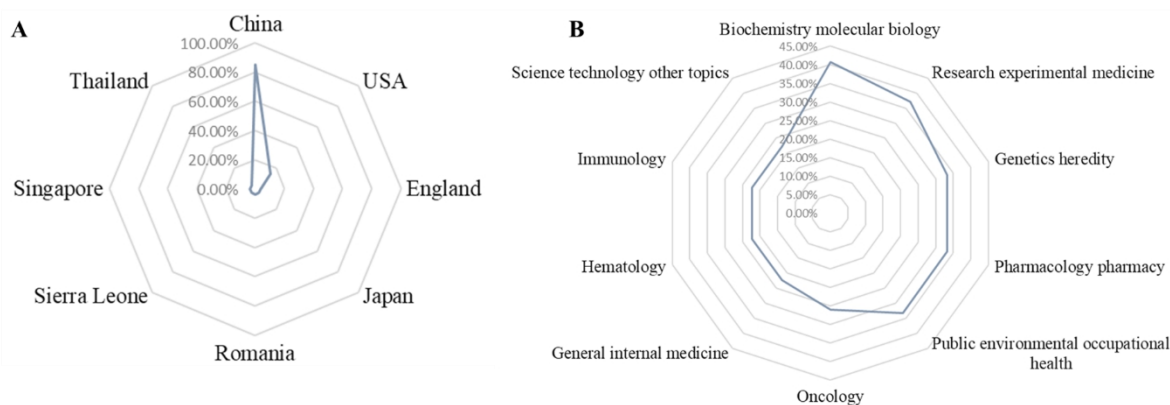


Figure 4 The percentage of Zhuang medicine-related research results in different countries (A) and research fields (B) in 2020.

the top three institutions with the most research were Guangxi Medical University, Guangxi University of Chinese Medicine, and Guilin Medical University (Figure 4). Various Zhuang medicine therapies currently exist, which mainly contain Zhuang medicine hot-sensitive point-probing acupuncture therapy, Zhuang medicine thread moxibustion, Zhuang medicine fire needle, Zhuang medicine bamboo cupping therapy, Zhuang medicine needle pricking therapy, and so on [39]. Furthermore, Zhang et al. observed the curative effect of thread moxibustion on Tianshu (ST25) and Qihai (RN6) points in ulcerative colitis (UC) rat model and found that Zhuang medicine thread moxibustion has the effect of treating UC, which may reduce Th17 cell production and IL-17F secretion and ROR γ t expression inhibition in colon tissue, thereby reducing the inflammatory damage to the colon tissue in the UC rat model [40]. In addition, scholars have researched on the chemical composition and pharmacological effects of Zhuang ethnomedicines [41–46]. Teng et al. isolated two novel cyclohexanone-monocyclic polyprenylated acylphloroglucinol derivatives (named norgarmultinones A–B) from the fruits of *Garcinia multiflora* [42]. Lu et al. isolated 12 compounds from *Scutellaria sibiricum*, which were identified as β -sitosterol, lupeol, octacosanol, betulinic acid, thioflavin, 7,4'-dihydroxyflavone, formononetin, apigenin-5-O- β -D-glucopyranoside, β -carotin, (2S)-1-O-heptatriacontanoyl glycerol, stigmaterol, and formononetin [44]. *Viburnum taitoense* has been used as folk medicine, especially in Guangxi Zhuang Autonomous Region. Furthermore, Wu et al. found that the ethyl acetate extract of *Viburnum taitoense* showed significant anti-inflammatory activity [41].

Dai medicine

Dai medicine is a traditional medicine system formed through long-term practice and continuous accumulation based on the special resource endowments of the Dai area and the local knowledge of the Dai people. Dai medicine, as the treasure of the

ancient wisdom of the Dai people, is a splendid cultural heritage and living fossil [47]. This study found that the research fields of Dai medicine are mainly concentrated in pharmacology and pharmacy, gastroenterology and hepatology, integrative complementary medicine, and immunology. Consequently, the most studied country was China (Figure 5). Lei et al. isolated eight compounds from the 95% ethanol extract of *Aspidopterys obcordate*, which were identified as 3,4-dihydroxybenzoic acid-3-O- α -L-rhamnoside (new compound), 3,4-dihydroxyphenol acetate, 3,4-dihydroxybenzoic acid, catechin, β -sitosterol, daucosterol, cinnacasilide C, and alantan [48]. Furthermore, *Marsdenia tenacissima* is a traditional Dai medicine antitumor drug. Thus, many scholars have studied its antitumor effects in depth [49–52]. Hu Y et al. found that the extract of Dai ethnomedicine *Marsdenia tenacissima* could promote lung cancer apoptosis by regulating the Ca²⁺/CaM/CaMK signaling pathway [49]. In addition, some scholars have found that Shuangjiang Weitong pills (Chinese patent drug; CFDA number, Z20026657) have obvious analgesic effects. Moreover, its analgesic mechanism is related to reducing the release of local inflammatory factors and pain mediators [53].

Uyghur medicine

Uyghur medicine is an important part of China's medical treasure house, the crystallization of the wisdom of the Uyghur people, and a very characteristic traditional medical science. A set of medical theories, case studies, and pharmacology and medical methods through long-term life practice, which not only forms a unique Uyghur medical experience but also achieves remarkable curative effects in the treatment of endemic diseases, acute difficult diseases, diabetes, cancer, skin diseases, and so on, have been summarized in terms of the content and nature of Uyghur medicine [54]. This study found that the research fields of Uyghur medicine are mainly concentrated in biochemistry and molecular biology, gastroenterology and hepatology, pharmacology and

pharmacy, and cardiology. The most studied country was China, and the top four institutions with the most research were Xinjiang Medical University, Hanshan Normal University, Shanghai Jiao Tong University, and Shihezi University (Figure 6). The most popular among the studies on Uyghur medicine is the study on the pharmacological effects and mechanisms of Uyghur drugs [55–59]. Gong et al. proved that the anti-inflammatory function of *Saussureae involucratae* (snow lotus) is through the NF-κB/PI3K/MAPK signaling pathway, and it could also protect melanoma cells from UV damages via PI3K/Akt signaling activation [57, 59]. Thus, the in-depth research on Uyghur ethnomedicines plays an important role in Uyghur medicine development.

Other minority medicine

The long-term historical development of Yao medicine concluded that the internal organs of the human body, between the internal organs of the human body, and the external environment are both opposed and unified. Diseases will occur in the human body when this balance is disrupted and cannot be fully self-regulated and restored. Some scholars have studied and summarized the common liver-protecting drugs in Yao medicine (e.g., *Plumbago zeylanica*, *Ventilago leiocarpa*, *Phylloidium pulchellum*, *Kadsura coccinea*,

Polygala fallax, and so on) and explained their pharmacological effects [60–71]. In addition, some scholars researched on other ethnic drugs or compounds of Yi medicine (e.g., Sui ethnomedicine *Desmodium gyrans*, Tujia ethnomedicine *Panax japonicus* var. major, *Kadsura heteroclite*, and Jinweitai capsules (Chinese patent drug; CFDA number, Z20026039)) [72–78]. Moreover, the pharmacological effects and mechanisms of ethnomedicines commonly used by other ethnic groups are shown in Table 2.

CMTM application under the background of COVID-19 epidemic situation

In the course of historical development, the fight against infectious diseases has always been one of the huge survival problems facing mankind. Ethnic minorities have also participated in the fight against the COVID-19 epidemic in various forms since the COVID-19 epidemic outbreak at the end of 2019 [79, 80]. COVID-19 prescriptions and prevention methods recommended by ethnic minority regions or ethnic medical institutions this time are all classic prescriptions or treatments that are effective in similar diseases in the local area. This reflects the CMTM wisdom in preventing and curing diseases.

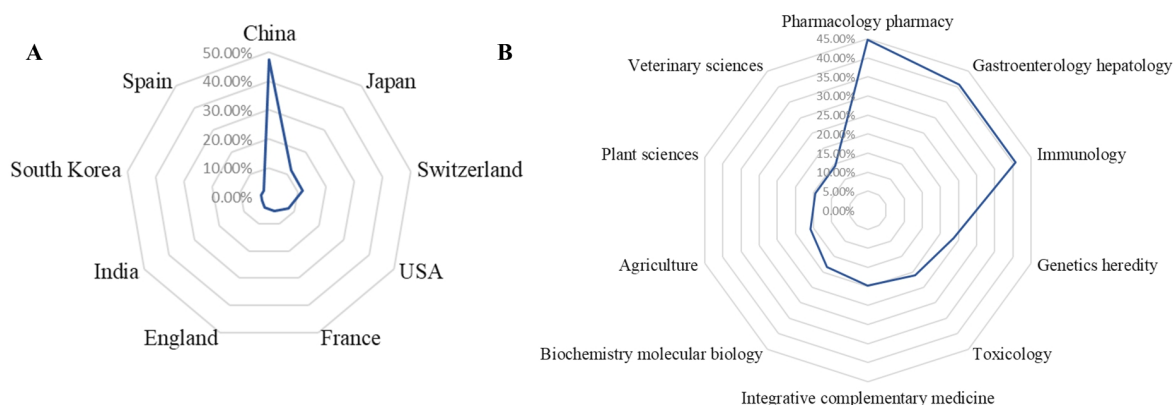


Figure 5 The percentage of Dai medicine-related research results in different countries (A) and research fields (B) in 2020.

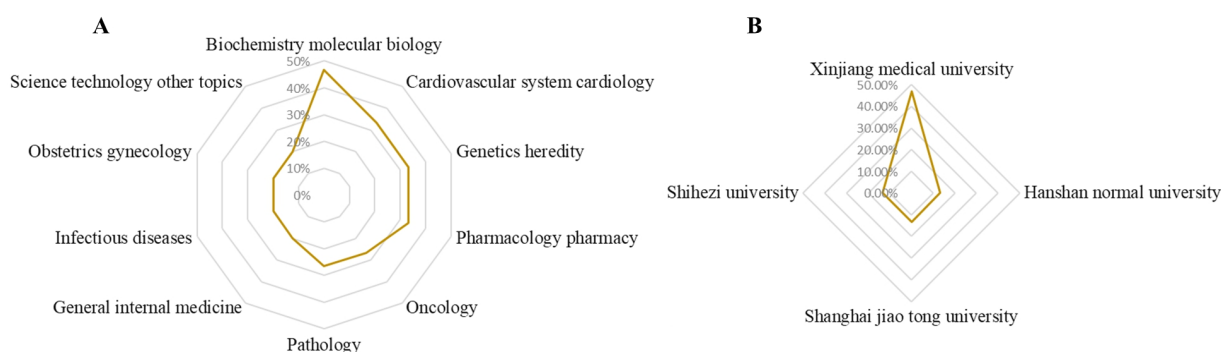


Figure 6 The percentage of Uyghur medicine-related research results in different countries (A) and institutions (B) in 2020.

Table 2 Pharmacological effects and mechanisms of ethnic ethnomedicines commonly used in other ethnic minority areas

Ethnic drug name/ Compound	Minorities	Traditional application	Ingredient/a ctive site	Cells/animal models	Pharmacological effect	Mechanism	Reference
<i>Polygala fallax</i>	Yao medicine	Treat various acute and chronic hepatitis.	Ethyl acetate fraction	Human hepatocellular cell line HepG2 cells.	Inhibit proliferation of HepG2 cells.	Promote the expression of Bax, inhibit the expression of Bcl-2, and down-regulate the expression of AKT and ERK.	[71]
			/	LPS-induced rat cardiomyocyte injury.	Protect rats of LPS-induced cardiomyocyte injury.	Down-regulate miR-369 and target AKT1.	[69]
<i>Plumbago zeylanica</i>	Yao medicine	For the treatment of rheumatic arthralgia; hepatosplenomegaly, etc.	Ethanol extract	Hair follicle dermal papilla (DP) cells.	Suppress DP cells development.	By enhancing the growth of DP cells and down-regulating the expression of SRD5A2 in DP cells.	[60]
<i>Desmodium gyrans</i>	Sui medicine	Mainly used to treat rheumatic bone pain, fractures, etc.	Total alcohol extract	D-galactose induced osseous changes of rat.	Improve D-galactose induced osseous changes.	/	[72]
<i>Panax japonicus</i> var. major	Tujia medicine	Clinically used to treat traumatic injuries, vomiting blood, strains and waist injuries, etc.	Triterpenoid saponins	Human gastric cancer cell line BGC-823, human colorectal adenocarcinoma cell line HCT-116, human cervical cancer cell line HeLa and human hepatocellular cell line HepG-2 cells.	Antitumor activity.	/	[73]
<i>Kadsura heteroclite</i>	Tujia medicine	Used to treat rheumatic arthralgia, bone pain, rheumatoid arthritis, etc.	Xuetongsu A/B/F	LPS-induced macrophages, human cervical cancer cell line HeLa, human gastric cancer cell line BGC 823.	Xuetongsu A/B exhibit inhibition of iNOS activity in LPS-induced macrophages, xuetongsu F has anti-tumor activity.	/	[75]
Jinweитай capsules	Yi medicine	Promotes Qi and blood circulation, relieves stomach pain.	/	/	Xuetongsu A/B exhibit inhibition of iNOS activity in LPS-induced macrophages, xuetongsu F has anti-tumor activity. Treatment of acute and chronic gastritis, gastric and duodenal ulcers and chronic colitis.	Act on AKT1, EGFR and PTPN11.	[78]

DP, dermal papilla; LPS, lipopolysaccharide; iNOS, inducible nitric oxide synthase; SRD5A2, Steroid 5 α -reductase type-2; PTPN11, protein tyrosine phosphatase non-receptor type 11; HeLa, cervical epithelial adenocarcinoma cells; /, not mentioned.

Tibetan medicine

Qinghai Province, based on the masterpieces of Tibetan medicine “*The Four Medical Tantras*” (Yutuo Yundangongbu, the end of the eighth century), “*Lan Liuli*” (Disi Sangjijiacuo, 1688), and “*Nectar Aquarius*” (Duoshirenboqie, 2011) and the characteristics of dampness, heat, poison, and blood stasis in the epidemic, proposed the Tibetan medicine prevention and treatment plan for COVID-19. In *The Four Medical Tantras*, COVID-19 belongs to the

category of Tibetan medicine Nianren and is an epidemic virus. In long-term clinical practice, Tibetan medicine mainly treats Nianren based on the symptoms of *Nison* (three causes) disorder after the epidemic gas enters the human body. Prevention and treatment emphasize the combination of heat syndrome ripening and eliminating pathogenic factors. The treatment is divided into three steps (immature distemper, increased distemper, and distemper recession), and different drug treatments are carried out in stages. The main prescriptions and usage of

Tibetan medicine in COVID-19 treatment are shown in [Table S1](#). Gyang et al. summarized and explored the commonalities of the prescriptions of Tibetan medicine for COVID-19 prevention and treatment [81]. Zhao et al. explored the active compounds of Tibetan prescription Sanwei Longdanhua tablets for COVID-19 treatment. Thus, Sanwei Longdanhua tablets were found to exert curative effects through the synergy of multiple components, multiple targets, and multiple pathways, thereby playing a role in anti-COVID-19 [82].

Mongolian medicine

COVID-19 belongs to the category of sticky disease in Mongolian medicine according to its infectiousness. In Mongolian medicine, it can be called pulmonary sticky disease, which is caused by sticky worms, because it is mainly located in the lungs. Moreover, Mongolian medicine is divided into two types according to the severity of the symptoms and uses drugs separately ([Table S2](#)). Qingwen Shierwei pills (empirical formula of Mongolian medicine), Huhe-9 pills (Chinese patent drug, CFDA number: Z15020456), Garidi-5 pills (Chinese patent drug, CFDA number: Z15021604), Qingfei Shibawei pills (Chinese patent drug, CFDA number: Z15020400), Chagan decoction, Qingre Bawei San, Daogule-Ebosi-7 decoction, and so on were used as the total prescriptions [83].

Uyghur medicine

The Xinjiang Uyghur Autonomous Region launched the Expert Consensus on TCM (Uyghur Medicine) Treatment of COVID-19 on January 30, 2020, which mainly recommends local medicines in Xinjiang. According to the susceptible population in Xinjiang, following the treatment principles of regulating blood quality, cooling blood and reducing fever, detoxification, enhancing the function of the main organs, and restoring the natural power of the body, combined with the clinical characteristics of COVID-19, the prevention and treatment measures of TCM (Uyghur medicine) and medication according to symptoms were initially formulated. Jimilian et al. studied the components, targets, pathways, and biological functions of Zukamu particles through network pharmacology. The results showed that Zukamu particles have a significant COVID-19 regulatory effect on virus replication and cytokine storm (<http://wjw.xinjiang.gov.cn/hfpc/zyfw/202001/a1aa59b207ee4687af9b65385c5a1e3b.shtml>) [84].

Zhuang medicine

Zhuang medicine believes that the main COVID-19 symptom belongs to the category of Miasma disease. Therefore, the internal cause of this disease is the deficiency of righteous Qi, the external cause is mainly miasma, and the pathogenesis is characterized by deficiency and toxicity. Therefore, Guangxi

International Zhuang Medical Hospital drafted the “Zhuang and Yao Medical Prevention and Treatment Plan” based on the characteristics of Zhuang and Yao medicines. The prevention methods are mainly to aromatize turbidity, eliminate dirt and detoxify, and take into account the Qi and promote Yang. The treatment principles are mainly to regulate Qi and detoxify. The prevention and treatment methods include oral treatment, external treatment, and rehabilitation therapy, which specifically include eight prevention and treatment methods (antimiasma prescription (divided into prescriptions 1 and 2), Zhuang medicine-wearing therapy (including fragrant and dampness removing sachet and airway sachet), Zhuang medicine biyin therapy (Shanxiang Qudu prescription), Zhuang medicine application therapy, Zhuang medicine fragrant moxibustion therapy, Zhuang medicine embroidering ball exercise, three-Qi health exercises) and eight other prevention methods (<https://www.gxtcmu.edu.cn/Item/27534.aspx>) [5].

Yi medicine

The Yi medicine proposed two plans according to its development characteristics: the prevention plan (for the general population) and the treatment plan (for the patient). In the prevention plan, Fanggan prescription, solid surface tea, and turbidity-reducing medicine packets are recommended. Moreover, the addition and subtraction of the prescription are mainly based on the patient’s physical condition. Furthermore, moxibustion, acupoint application, external application of Yingxiang acupoint (LI20), and fumigation of Yi drugs based on Yi medicine are attached to purify the environment and strengthen the preventive effect. The treatment plan is mainly based on clearing heat and detoxification of Qingwenfang [79]. In addition, the main prescriptions of Uyghur medicine for COVID-19 treatment and its composition and efficacy are shown in [Table S3](#).

Conclusion and perspective

CMTM is a medical system with rich clinical experience and ethnic characteristics formed by people of all ethnic groups in the long-term struggle against diseases. CMTM has given full play to its unique advantages and has been actively integrated into the modern medical system in recent years with the strong encouragement and support of national policies. It has now become one of the important sources for the establishment of TCM theory and clinical practice research. According to the 2020 annual review, the total number of publications in the first quarter has decreased compared with 2019 due to the COVID-19 impact. However, this trend has picked up in the second quarter of this year which may be closely related to the phased victory of China’s epidemic prevention work. In addition, this study found that

publications using CMTM to treat COVID-19 account for a certain percentage among the CMTM-related publications this year. This fully reflects the great role of CMTM in public health emergencies and the social responsibility of researchers.

Many scholars have conducted research on the traditional application, pharmacological effects, and mechanism of different ethnic medicines. However, these studies are not in-depth and mostly concentrated on the collation of traditional and special usages of ethnic medicine, lack of systematic analysis, and in-depth mechanism discussion on the effective ingredients of ethnic drugs/ethnic prescription. In addition, the excavation, sorting, and protection of ethnic minority medical culture are not deep enough. Thus, the international perspective of ethnic medicine research has been strengthened. Countries such as India and Japan have gradually increased CMTM research, which is conducive to broadening the research thinking of traditional medicine and speeding up its rapid development. It is worth noting that articles related to the Internet and CMTM exist, which is an attempt to develop CMTM under the background of the Internet.

In future research, in-depth CMTM study, including its effective ingredients, pharmacological effects, mechanism, clinical applications, and so on, should be focused on to also pay attention to the excavation, collation, and protection of minority medical culture, including diagnosis and treatment technology, development and protection of medical resources, literature collation, standard formulation, academic experience inheritance, and so on. At the same time, new ideas should be opened and interdisciplinary integration developed to provide a solid foundation for CMTM development.

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