



Analysis of medication rules and application characteristics of Chinese patent medicine containing borneol based on data mining

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ARTICLE INFO

Keywords:

Borneol
Internal prescriptions
External prescriptions
Primary diseases
Proprietary Chinese medicines
Medication rules

ABSTRACT

Background: In this study, the regularity of drug containing borneol proprietary Chinese medicine was mined, to provide reference for the clinical application and new drug research and development of borneol.

Methods: The database of proprietary Chinese medicines on Pharmaceutical Intelligence Network was searched for internal and external prescriptions that contained borneols and the diseases they treat. Microsoft Office Excel 2019 and SPSS Modeler 18.0 were used to analyze the properties, flavors, meridians tropisms and association rule analysis of the medicines, and Origin 21.0 software was used to draw the association rules diagram.

Results: Among them, 528 prescriptions of internal Chinese patent medicine containing borneol and 387 prescriptions of external Chinese patent medicine were included. The diseases treated by internal prescription were mainly neurological diseases and heart diseases, among which Chinese medicines with higher frequency of compatibility with borneol were bezoar, licorice, cinnabar, musk and scutellaria. The diseases treated by external prescription were mainly physical disabilities, paralysis diseases, sore and ulcer diseases and so on. Among them, menthol, camphor, frankincense, angelica, and carthami flos and so on are the most frequently combined with borneol.

Conclusion: The prescription of Chinese patent medicine containing borneol is composed of cold or warm, pungent or bitter Chinese medicine. Internal prescription primarily targets the meridians of the heart, liver, and lungs, and is often combined with sedative, antipyretic and detoxicating drugs to treat stroke, infantile convulsion and angina pectoris. External prescription mainly acts on liver, heart and spleen meridian, and is often combined with drugs for clearing heat, promoting blood circulation and removing blood stasis to treat rheumatic arthralgia syndrome and sore and ulcer diseases.

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1. Introduction

Borneol is made from borneol resin of borneol fragrance families plant; it is pungent, bitter, cold, and it acts on the heart, spleen, lung meridians [1]. Initially it is described in the *Tang Materia Medica*, in this book, it was thought to remove evil energy in the heart and abdomen, the accumulation of wind and damp, and to treat deafness and eye diseases. In addition, according to the record in *Compendium of Materia Medica*, borneol was used to treat throat paralysis, headache, toothaches, childhood pox, etc. Modern pharmacological studies have demonstrated that borneol has the functions of bacteriostasis, sterilization, analgesia, central nervous system protection, and promoting drug penetration through the blood-brain barrier [2]. Furthermore, borneol has the effect of inducing medicine to go up and restoring consciousness, and it is often used as "Inducing medicine" in Chinese patent medicines such as Liushen Pill, Niu Huang Shangqing Pill, quick-acting jiuxin pill, Bingpeng powder and so on. The medicinal application of borneol is evidently extensive, but the summary study of borneol using rule has not been reported. Pharmaceutical Intelligence Network (<https://db.yaozh.com/>) contains drug prescriptions from sources like *the Compilation of National Standards for Proprietary Chinese Medicines*, *the Chinese Pharmacopoeia*, *the New Compilation of National Proprietary Chinese Medicines*, *the National Drug Standards*, and *Ministry of Health Drug Standards for Prescriptions of Chinese Medicines*. These prescriptions and data of Pharmaceutical Intelligence Network is comprehensive and reliable. The purpose of this study is to collect the prescription of Chinese patent medicine containing borneol in the database of Pharmaceutical Intelligence Network, and analyze the rule of borneol using rule by data mining, so as to provide reference for its clinical application and research and development.

2. Information and approach

2.1. Sources of data

The keywords "borneol" was used to retrieve the pertinent prescriptions of proprietary Chinese medicines from Pharmaceutical Intelligence Network Database (<https://db.yaozh.com/>), in order to gather crucial details regarding the name, composition, function and other important information of prescription.

2.2. Inclusion and exclusion criteria

Inclusion criteria: The included prescriptions must have borneol in its compositional medicine, and the composition of the prescription was complete, the function and dosage were clear.

Excluding criteria: The prescriptions for injection or including western medications were excluded, and the prescriptions with same traditional Chinese medicine but various dosage forms were counted only once.

2.3. Processing of data

According to the difference of oral and external use, the prescriptions that meet inclusion criteria were entered separately into Microsoft Office Excel 2019 to establish database. In accordance with the 2020 *edition of the Chinese Pharmacopoeia* and *Traditional Chinese Medicine*, the names, nature, flavor and meridian tropism of traditional Chinese medicines were standardized; for example, "Shudi" should be standardized for "Shudihuang", "somewhat cold" should be standardized for "cold", if the efficacy or meridian tropism

Table 1
High frequency Chinese medicine in prescription containing borneol.

Chinese medicine of internal prescription	Frequency/times	Chinese medicine of internal prescription	Frequency/times	Chinese medicine of external prescription	Frequency/times	Chinese medicine of external prescription	Frequency/times
Borneol	528	Buffalo Horn	78	Borneol	387	Phellodendri chinensis cortex	51
Bezoar	220	Bile South Star	75	Menthol	119	Sophora flavescens	49
Licorice	168	Saffron	74	Camphor	116	Blood exhaustion	45
Cinnabar	167	Eustoma	73	Frankincense	89	Lilac	42
Musk	163	Frankincense	73	Angelica	84	Borax	42
Scutellaria baicalensis	121	Windproof	70	Carthami flos	84	Pearls	41
Realgar	109	Gardenia	70	Angelica alba	82	Qiang Zhi	39
Rhubarb	106	Mint	69	Myrrh	80	Panax notoginseng	38
Brassica juncea	99	Peppermint Brain	69	Musk	76	Windproof	35
Pearls	97	Amber	69	Chuan Wu	63	Licorice	34
Panax notoginseng	89	Whole Scorpion	69	Grass Crow	62	Brassica juncea	34
Stiffworms	86	Geranium Yellow	69	Cinnamon	58	Hearthstone	34
Asparagus	80	Gypsum	68	Chuanxiong rhizoma	57	Serpentine	34
Chuanxiong rhizoma	78	Angelica	66	Rhubarb	57	Fenugreek	34

of traditional Chinese medicine changes before and after processing, it should be counted separately. Then, the diseases treated by the prescription of Chinese patent medicines containing borneol were classified and standardized with the reference to *Chinese Medicine Clinical Treatment Terminology - Disease Part* (GB/T1675.1–1997).

2.4. Analytical statistics

The efficacy and main treatment of the prescriptions containing borneol were counted by Microsoft Office Excel 2019, as well as the nature, flavor, meridian tropism, frequency of the Chinese medicines involved. The Apriori algorithm of IBM SPSS Modeler 18.0 software was carried out to analyze the association rules of traditional Chinese medicine in the prescriptions. The specific process were as follows: First, select the automatic mode, set the confidence level $\geq 80\%$, the maximum number of the preceding items is 2, the promotion level ≥ 1 , then check the box "Only with the flag variable true value", and finally click the run button. At the same time, Origin 21.0 software was used to demonstrate the association rules of Chinese herbal medicines.

3. Results

3.1. Frequency and effectiveness analysis

A total of 915 prescriptions containing borneol were screened, among them, there were 528 internal prescriptions involving 498 kinds of Chinese medicine and 7163 cumulative uses, and 387 external prescriptions involving 476 kinds of Chinese medicine and 4137 cumulative uses. The standardized traditional Chinese medicines were carried out frequency analysis and categorized according to their therapeutic effects, as shown in Table 1 and Table 2.

Based on the table, The traditional Chinese medicines in internal prescriptions with high frequency of compatibility with borneol are bezoar (220 times), licorice (168 times), cinnabar (167 times), musk (163 times), and scutellaria (121 times), They are mostly heat-clearing drug, resuscitation drug, liver-calming and wind-extinguishing medicine. In external prescriptions, the Chinese herbs most frequently combined with borneol are L-menthol (119 times), camphor (116 times), frankincense (89 times), angelica (84 times), and carthami flos (84 times), They are mostly blood-activating and stasis-resolving herbs, heat-clearing herbs, and resuscitation drug.

3.2. Analysis of nature, flavor and meridian tropism

The radar chart of the nature, flavor and meridian tropism of all the Chinese herbal medicines in the prescription is shown in Fig. 1A, B. The composition of Chinese patent medicines containing borneol for internal and external use is basically the same in nature and flavor, they are cold or warm, pungent or bitter. Furthermore, the internal prescriptions predominantly act on the heart, liver and lung meridians, while the external prescriptions mainly act on the liver, heart, and spleen meridians. This result is related to inherent cold nature, pungent, bitter flavor of borneol and its effect on heart, spleen and lung meridian.

3.3. Classification of primary treatment diseases

The main diseases treated by prescription of Chinese patent medicine containing borneol were classified respectively, as shown in Fig. 2. It can be observed that internal prescriptions are mainly used for the treatment of neurological diseases (epilepsy, convulsions, stroke, phlegm-induced convulsions, migraine, etc.), pediatric idiopathic diseases (high fever convulsions, etc.), heart diseases (coronary heart disease, angina, etc.), while external prescriptions are mainly used for the treatment of physical disabilities, paralysis and other diseases (rheumatic disease, numbness of limbs, bruises and sprains, etc.), and ulcerative diseases (burns, abscesses, ulcers, etc.). Therefore, they will be used as representatives to analyze the medication rules of borneol in the proprietary Chinese medicine. Since pediatric diseases mainly refer to pediatric convulsions, characterized by high fever seizures and delirium, which belong to

Table 2
Efficacy categories of traditional Chinese medicine.

Chinese medicine of internal prescription	Frequency/times	Chinese medicine of external prescription	Frequency/times
antipyretic medicine	1298	invigorate blood circulation and remove blood stasis herbs	713
resuscitation medicine	806	antipyretic medicine	709
liver-calming and wind-extinguishing medicine	706	resuscitation medicine	485
blood-activating and stasis-resolving herbs	679	dispelling wind and removing dampness herbs	428
tonic herbs	659	herbs for Eliminating the Exterior	287
herbs for Eliminating the Exterior	569	toxin-attacking, insecticidal and antipruritic herbs	246
resolving phlegm and relieving cough and asthma	450	interior-warming drug	239
qi-regulating drugs	345	tonic herbs	200
tranquillizer	277	removing toxicity and promoting tissue regeneration herbs	118
toxin-attacking, insecticidal and antipruritic herbs	225	hemostatic drug	110
interior-warming drug	202	liver-calming and wind-extinguishing medicine	96
hemostatic drug	172	resolving phlegm and relieving cough and asthma	82
purgative herbs	149	purgative herbs	78
diuretic and drainage medicines	119	qi-regulating drugs	77

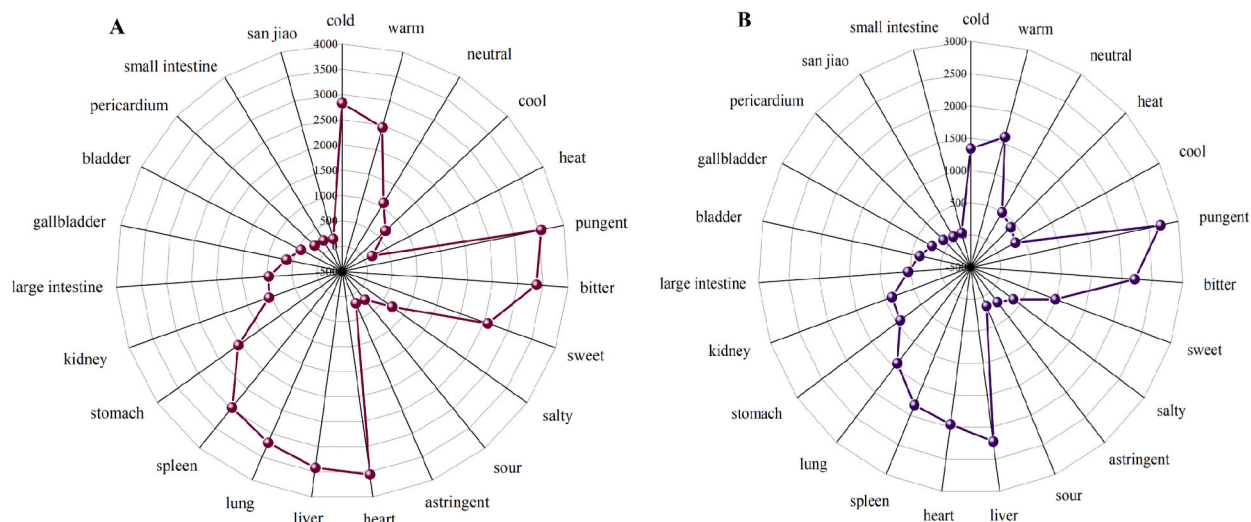


Fig. 1. Radar chart of nature, flavor and meridian tropism (A: Internal prescriptions, B: External prescriptions).

Disease Classification

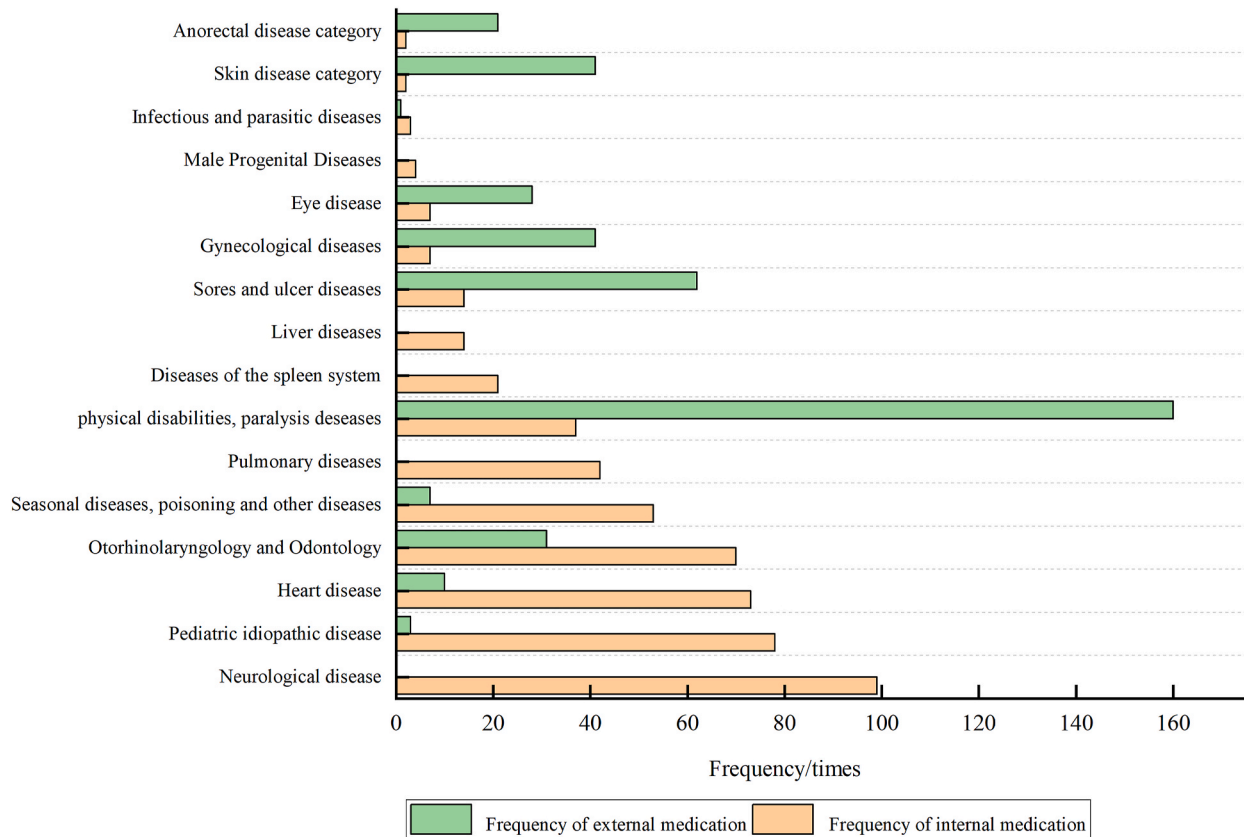


Fig. 2. Classification of primary treatment diseases of proprietary Chinese medicines containing borneol.

neurological diseases, there is no need for further elaboration.

3.4. Analysis of the medication rules of internal prescriptions for treating diseases

3.4.1. Medication rules of neurological diseases

The results revealed that there are a total of 99 traditional Chinese medicine prescriptions containing borneol, which is commonly used in the treatment of neurological diseases. These prescriptions involve 233 different traditional Chinese medicine, with a cumulative usage of 1903 times. By employing the Apriori algorithm to analyze association rules among these prescriptions, a total of 239 medication combinations were identified, with a support degree of $\geq 20\%$ in the treatment of neurological diseases. The top 10 combinations are displayed in [Table 3](#), the core combination for the treatment of neurological diseases are Borneol-Bezoar, Borneol-Cinnabar, Borneol-Chuanxiong rhizoma, Bezoar-Scutellaria, Borneol-Scutellaria, and Borneol-Buffalo horn, the associated network show in [Fig. 3](#).

3.4.2. Medication rules for heart diseases

There are a total of 73 internal prescriptions containing borneol for treating heart diseases, involving 133 different traditional Chinese medicine, with a cumulative usage of 653 times. Through association rules analysis, ten key Chinese medicine combinations with a support degree of $\geq 20\%$ were identified, as shown in [Table 4](#). These combinations include Borneol-Panax notoginseng, Borneol-Salvia miltiorrhiza, Borneol-Ginseng, Borneol-Musk, and Borneol-Toadstool and so on. The associated network is show in [Fig. 4](#).

3.5. Analysis of the medication rules of external prescriptions for treating diseases

3.5.1. Medication rules of physical disabilities, paralysis and other diseases

The results revealed that there are a total of 160 external prescriptions containing borneol, which is commonly used in the treatment of physical disabilities, paralysis disease. These prescriptions including 304 different traditional Chinese medicine, with a cumulative usage of 2352 times. Through association analysis, sixty-eight traditional Chinese medicine combinations were identified with a support degree of $\geq 20\%$. The top 10 combinations with higher support degree are presented in [Table 5](#). It can be seen that borneol-camphor, borneol-menthol, borneol-carthami flos and so on are the core combination of physical disabilities, paralysis and other diseases. The visual association rules is shown in [Fig. 5](#).

3.5.2. Medication rules of sore and ulcer diseases

There are 62 prescriptions of Chinese patent medicine containing borneol for treating ulcerative diseases, they contain 212 different traditional Chinese medicines, with a cumulative usage of 612 times. Through association rules analysis, 29 combinations with a support degree $\geq 10\%$ were identified. The top 10 combinations with higher support degree are shown in [Table 6](#), the combinations of Borneol-arnebiae radix and Borneol-Rhubarb have the highest support degree. The visual association rules is shown in [Fig. 6](#).

4. Discussion

Borneol is one of the most widely used traditional Chinese medicine. It has the effects of resuscitation, tranquilizer, antipyretic and relieving pain. It is mainly used for the treatment of febrile delirium, convulsion, phlegmatic syncope of stroke, convulsion due to Qi stagnation, coma and so on [3]. The result of this study indicates that borneol is widely used for both internal and external use. Chinese medicine of both internal and external use mainly are cold or warm nature, pungent or bitter flavor. One of the principles of traditional Chinese medicine prescription is "warming the cold and cooling the heat". Cold nature traditional Chinese medicine have the function of antipyretic, purgative, calming liver and extinguishing wind, resuscitation, and their fundamental medicine flavor is bitterness. They exhibit therapeutic effects on dizziness and stroke caused by upper hyperactivity of liver yang, as well as like blurred vision arising from ascending liver fire [4]. Warm nature traditional Chinese medicine is renowned for its ability to dispel cold, tonify

Table 3

Association rules of Chinese medicine in internal prescriptions containing borneol for treating neurological diseases.

post-item	previous item	support degree/%
Borneol	Bezoar	55.56
Borneol	Cinnabar	50.51
Borneol	Chuanxiong rhizoma	41.41
Bezoar	Scutellaria	39.39
Borneol	Scutellaria	39.39
Bezoar	Scutellaria, Borneol	39.39
Borneol	Cinnabar, Bezoar	38.38
Borneol	Buffalo horn	37.37
Borneol	Licorice	37.37
Bezoar	Buffalo horn, borneol	37.37

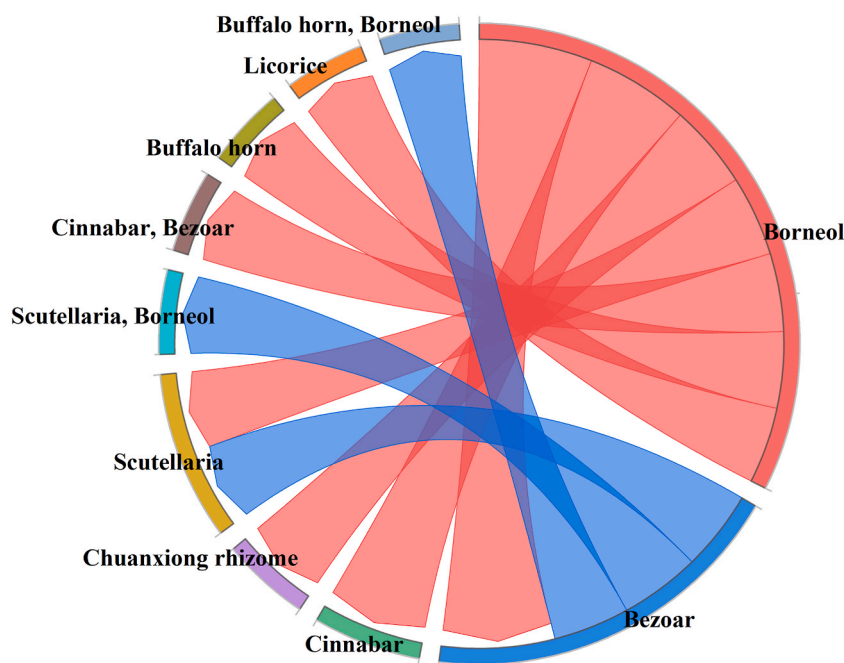


Fig. 3. Association network diagram of Chinese medicine in internal prescriptions containing borneol for treating neurological diseases.

Table 4

Association rules of Chinese medicine in internal prescriptions containing borneol for treating heart diseases.

post-item	previous item	Support degree/%
Borneol	Panax notoginseng	54.79
Borneol	Salvia miltiorrhiza	52.05
Borneol	Ginseng	41.10
Borneol	Musk	38.36
Borneol	Salvia, Panax Notoginseng	34.25
Borneol	Toadstool	32.88
Toadstool	Bezoar	28.77
Musk	Bezoar	28.77
Borneol	Bezoar	28.77
Toadstool	Bezoar, Borneol	28.77

deficiencies, invigorate the spleen and stimulate the appetite, the basic flavor of the medicine is pungent, which has the characteristics of being able to circulate and disperse. In addition to the functions of dispersing, replenish qi and activating blood, There is the role of eliminating dampness by aromatics and resuscitating by warm nature drug. It is suitable for cold constitution or cold and deficiency syndrome patients [5]. Modern studies of traditional Chinese medicine show that warm and pungent medicines mostly act on spleen meridians, cold and pungent medicines enter the lung meridian, cold and bitter medicines tend to enter liver meridian and heart meridian [6]. This study shows that Chinese medicine prescribed for oral use mostly belongs to heart, liver and lung meridians, and is mainly used to treat neurological diseases and heart diseases, in traditional Chinese medicine, dizziness and stroke of neurological diseases are mostly caused by hyperactivity of yang-qi of liver meridian, and heart diseases such as coronary heart disease is mostly caused by stagnation of heart vessels. Chinese medicine of external prescription mostly belongs to liver, heart and spleen meridian, which is mainly used to treat physical disabilities, paralysis diseases, sore and ulcer diseases, etc. The pathogenesis of 19 articles in "Plain Questions: A General Comment on Zhi Zhen" suggests that All kinds of pain, sores and ulcers are attributed to Pathological changes of the heart meridian, and Chinese medicines for treating sores and ulcers mainly act on the heart meridian [7]. Thus it can be seen that the nature, taste, meridian tropism of Chinese medicine and its mainly treating diseases are corresponding to each other.

Borneol belongs to the category of resuscitation medicine, When taken internally, it primarily exerts effects such as clearing heat, promoting blood circulation, and resuscitation wake-up and so on. The core compatibility medicines of internal prescription are calculus bovis, licorice, cinnabar, musk, scutellaria and so on. Bezoar is a calming liver and quenching wind medicine, which is a commonly used and valuable medicinal material, it can be used together with borneol to exert the effect of resolving phlegm and resuscitating, quenching wind and stopping spasms [8]. Musk and borneol are aromatic resuscitation medicines, and the two drugs are often combined to treat the symptoms of evil-deceived heart orifices and consciousness coma, which can enhance the effect

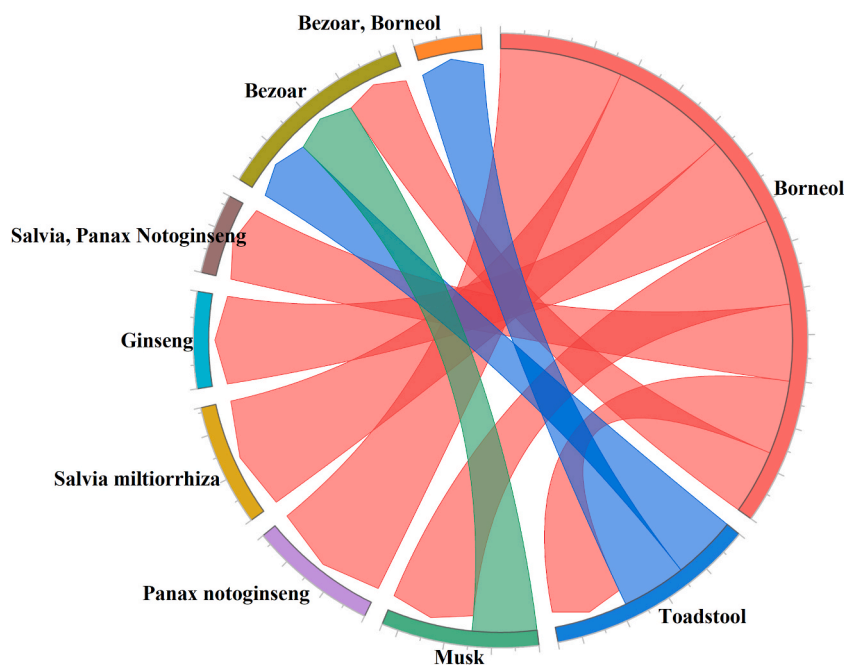


Fig. 4. Association network diagram of Chinese medicine in internal prescriptions containing borneol for treating heart diseases.

Table 5

Association rules of Chinese medicine in external prescriptions containing borneol for treating physical disabilities, paralysis disease.

Post-item	Previous item	support degree/%
Borneol	Camphor	60.00
Borneol	Menthol	55.63
Borneol	Carthami flos	44.38
Borneol	Menthol, Camphor	42.50
Borneol	Angelica	41.25
Myrrh	Frankincense	40.63
Myrrh	Frankincense, Borneol	40.00
Borneol	Sichuan codonopsis	38.13
Frankincense	Myrrh	36.25
Sichuan codonopsis	Kusnezoff monkshood root	35.63

synergistically. It has been demonstrated that the combination of the musk and borneol has a cerebroprotective effect by inhibiting the expression of AQP-4 mRNA in the brain tissue after ischaemia-reperfusion to reduce BBB permeability and attenuate cerebral oedema [9]. When borneol is used for external use, it mainly plays the role of eliminating wind and dampness, removing putrid flesh, promoting wound healing and other effects. The core compatibility medicines of the external prescription are menthol, camphor, frankincense, angelica, carthami flos. Among them, camphor is pungent, hot and slightly toxic. It is one of the raw materials of the synthetic borneol, and has the effect of dehumidifying and relieving itching [10]. *The Pin Hui Jing Yao* said that camphor is mainly used to kill insects, remove scabies, treat fire sores, remove foul gas. camphor and borneol are often used in combination preparations to treat non-convergent sore and ulcer. Menthol is an dispelling wind medicine, it is pungent and cool, can be used in the skin or mucosa to produce a cool feeling to reduce discomfort and pain, the combination of borneol and menthol has the effect of removing wind and dampness, promoting blood circulation and dredging meridians, detumescence and relieving pain, it mainly treats arthritis, gout and so on [11].

528 internal prescriptions containing borneol are mainly used to treat 16 categories of diseases such as neurological diseases and heart diseases. The *Certificate of Treatment - Headache* states that “The brain is the sea of marrow, where the true qi is gathered, It can not be attacked by evil spirits, and if it is affected by evil, the people will die”. The common pathogenesis of neurological diseases is phlegm blocking collaterals orifices, timely opening of blocked brain orifices can prevent the further development of neurological disease [12]. The action of borneol with eliminating phlegm and resuscitating can directly remove the cause of disease, and its ascending effect of drug introduction can obviously increase the concentration of therapeutic drugs in the brain [13]. The results of association rules showed that borneol-bezoar, borneol-cinnabar, borneol-ligusticum, borneol-scutellaria, and borneol-buffalo horn, etc. were the most supportive combinations of neurological diseases. These combinations have the effects of clearing heat and

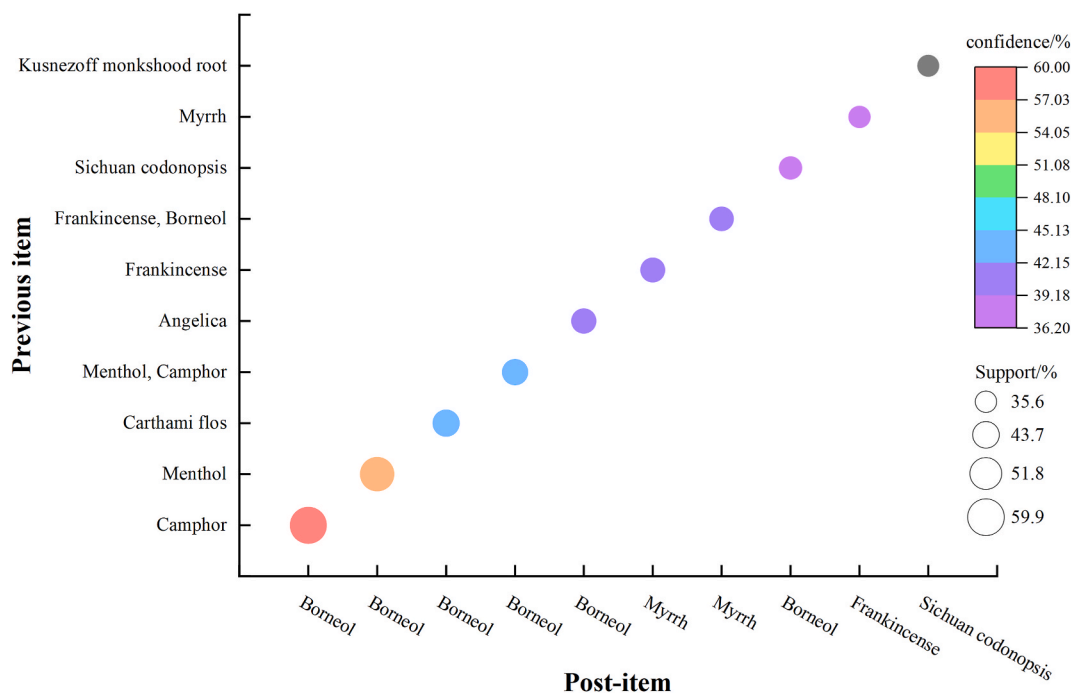


Fig. 5. Bubble diagram of Chinese medicine in external prescriptions containing borneol for treating physical disabilities, paralysis disease.

Table 6

Association rules of Chinese medicine in external prescriptions containing borneol for treating sore and ulcer diseases.

post-item	previous item	support degree/%
Borneol	Arnebiae radix	22.58
Borneol	Rhubarb	22.58
Borneol	Musk	20.97
Borneol	Cinnabar	19.35
Myrrh	Frankincense	19.35
Borneol	Angelica	19.35
Borneol	Frankincense	19.35
Myrrh	Frankincense, Borneol	19.35
Borneol	Coptis chinensis	17.74
Borneol	Cortex Phellodendri	17.74

resuscitating, calming the mind, removing toxin and eliminating phlegm, and they are the main components of Angong Niu Huang Pill. Cardiovascular diseases mainly include chest obstruction and palpitation. The main cause of which is qi stagnation and blood stasis. As stated in the *Internal Medicine of Traditional Chinese Medicine*, “Chest obstruction is the syndrome of qi and blood blocking in the chest, which leads to cardiac dysfunction” [14]. The treatment of chest obstruction and heartache is still mainly based on promoting blood circulation and removing blood stasis, resolving phlegm and dredging collaterals by modern doctors. The association combinations with high support were borneol-panax notoginseng, borneol-salvia miltiorrhiza, borneol-ginseng, borneol-musk, and borneol-toadstool. These combinations are the main components of Shexiang baixin pill, which is derived from Suhexiang Pill, a famous prescription in Song dynasty. It has a strong function of resuscitating and relieving pain, and is supplemented with the function of promoting blood circulation and removing blood stasis. It is mainly used to treat chest obstruction caused by qi stagnation and blood stasis. The most supportive three medicines combination is salvia miltiorrhiza-panax notoginseng-borneol, which is the main component of compound Salvia miltiorrhiza dropping pills, in which salvia miltiorrhiza has the function of activating blood circulation and resolving blood stasis, Panax notoginseng has the function of relieving pain, stopping bleeding and activating blood stasis, and borneols can clear heat and relieve pain, resuscitate and restore consciousness. This combination can promote blood circulation, remove blood stasis and relieve pain. Therefore, it can be seen that borneol plays an important role in calming and inducing resuscitation in the treating these two diseases. However, the emphasis on the Chinese medicine combination is different. For neurological diseases, the emphasis is on clearing heat and cooling blood, while for cardiovascular diseases, the emphasis is on promoting blood circulation and resolving stasis.

387 external prescriptions containing borneol were mainly used to treat 11 kinds of diseases such as physical disabilities, paralysis

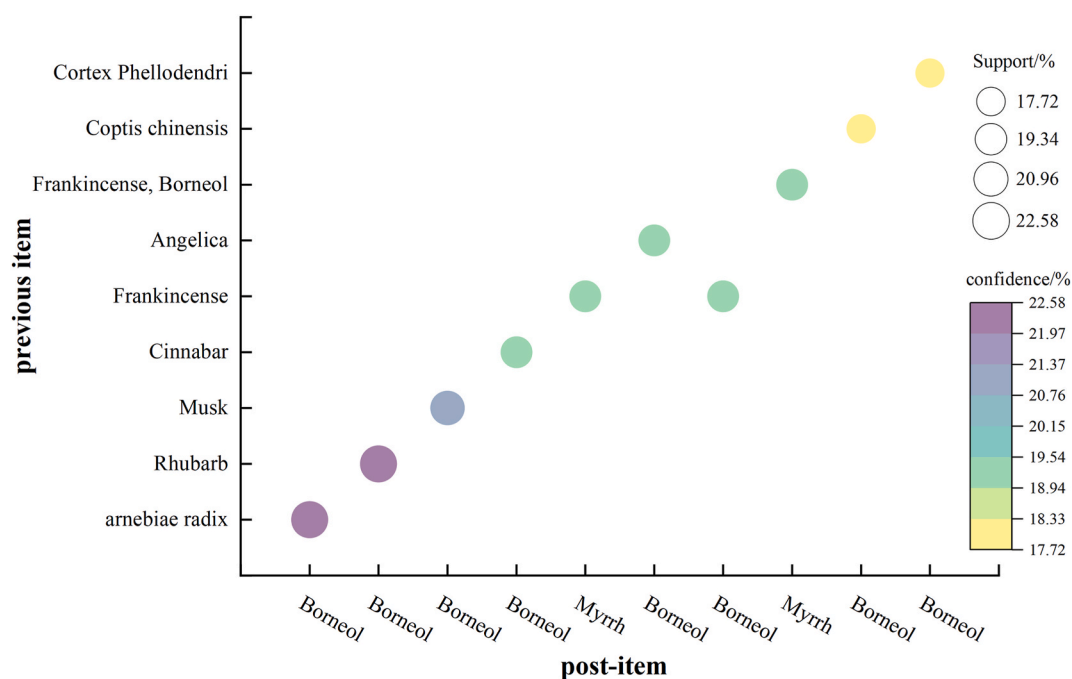


Fig. 6. Bubble diagram of Chinese medicine in external prescriptions containing borneol for treating sore and ulcer diseases.

diseases, sore and ulcer diseases and so on. The most common of these diseases are rheumatism and bruising. Traditional Chinese medicine believes that wind, cold and damp evil are the main external factors of the occurrence of rheumatism in the body [15], while bruises and injuries are more likely to cause muscle and bone injury, blood stasis, swelling pain, Qi and blood disharmony and meridian obstruction [16]. The results showed that among the prescriptions for treating rheumatism and bruising, the Chinese herbal combinations with high support were borneol-camphor, borneol-menthol, borneol-carthami flos, etc. among which borneol, menthol and camphor can clear heat, relieve pain and dispel wind and dampness, and carthami flos can activate blood circulation and resolve blood stasis, and their combination can enhance the therapeutic effect and reduce pain, as the main composition of rheumatism-relieving plaster. The diseases of sore and ulcer mainly include burn and scald, carbuncle and furuncle, sore and ulcer, etc. It is found that the diseases of sore and ulcer are most closely related to heat toxin and fire toxin [17], and are mostly caused by exogenous damp-heat toxin, the two evils feed on each other and the muscles begin to rot. Therefore, heat-clearing and detoxification is its basic treatment. The results showed that the combinations of borneol-arnebiae radix and borneol-rhubarb have the highest support degree, and rhubarb is the antipyretic and antitoxic drug, borneol can lead the medicine to striae from muscle surface, and promote wound healing [18]. Arnebiae radix is sweet, salty, cold, while borneol is bitter, cold, they together play the role of cooling blood and promoting blood circulation, clearing heat and relieving pain, removing saprophytic muscle. Modern pharmacological studies have proved that shikonin, the main component of arnebiae radix, has an astringent effect on some skin lesions with excessive secretion, and it is often used in combination with borneol for trauma and burn wounds [19]. It can be seen that borneol plays an important role in clearing heat and relieving pain in the treatment of these two kinds of diseases, for body paralysis, atrophy, bruises and injuries, borneol is usually combined with these traditional Chinese medicine for removing wind and dampness, promoting blood circulation and removing blood stasis, while for sore and ulcer, it is usually combined with these traditional Chinese medicine for clearing away heat and toxin.

5. Conclusions

In summary, this study systematically analyzed the characteristics of internal and external prescriptions of Chinese patent medicines containing borneol and their main therapeutic diseases based on data mining method, the association rules of the four most representative diseases, such as neurological diseases, heart diseases, physical disabilities or paralysis diseases, and sore and ulcer diseases were analyzed, it fully reflects the unique efficacy and advantages of borneol in specific diseases, and provides certain reference value for clinical application and product development of borneol.

Data availability statement

The original contributions presented in the study are publicly available.

Author contributions

Conceived and designed: Ye Zhong, Yue Qi, Zhilan Jiang, Bolong Wang and Zetian Wang; (2) Analyzed and interpreted the data: Ye Zhong, Yongsheng Hu, Xiao Zhang and Chunxing Wu; (3) Wrote the paper: Ye Zhong; (4) final approval of the version submitted: Bolong Wang and Zetian Wang.

Funding sources

This research was supported by the Science and Technology Project of Jiangxi Provincial Education Department, China (GJJ211617).

Consent for publication

Not applicable.

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.

Acknowledgments

Not applicable.

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