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Research on the Efficacy and Prescription Rules of Health Foods Containing *Schisandra chinensis* Based on Data Mining

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Abstract: Objective: To explore and analyze the formulation patterns of health products containing *Schisandra chinensis* based on data mining. Methods A search was conducted for health products containing *Schisandra chinensis* from the National Market Supervision Administration. After selection and data organisation, SPSS was used to analyze the raw materials and high-frequency health functions of all health products containing *Schisandra chinensis*. The analysis involved methods such as dosage form, health function, pharmacological properties, taste and meridian affiliation, efficacy The analysis involved methods such as dosage form, health function, pharmacological properties, taste and meridian affiliation, efficacy, frequency statistics, association rules, and cluster analysis to investigate formulation patterns. The top five high-frequency ingredients were *Schisandra chinensis*, Ziziphus jujuba, Pueraria lobata, Ganoderma lucidum and Ziziphus jujuba. The top five high-frequency ingredients were *Schisandra chinensis*, Ziziphus jujuba, Pueraria lobata, Ganoderma lucidum, and Lycium barbarum. The prevalent health functions included: assisting in sleep improvement, providing auxiliary protection against chemical liver damage, and enhancing immunity. A total of 70 traditional Chinese medicinal ingredients were involved, primarily aimed at tonifying deficiency, with a predominant neutral temperature and sweet flavour, primarily associated with the liver, spleen, and kidney meridians. Common combinations included: Ziziphus jujuba-*Schisandra chinensis*, Pueraria lobata-*Schisandra chinensis*, Lycium barbarum- *Schisandra chinensis*, and Ganoderma lucidum- *Schisandra chinensis*. Conclusion: Health products containing *Schisandra chinensis* primarily focus on improving sleep, providing auxiliary protection against the effects of the disease and enhancing immunity. Common combinations include Ziziphus jujuba-*Schisandra chinensis*, Pueraria lobata-*Schisandra chinensis*, and Lycium barbarum-*Schisandra chinensis*. This analysis may provide references for the development of food-medicine.

Keywords: Data Mining; *Schisandra chinensis*; Food-medicine Homology; Health Products; Health Functions.

1. Introduction

Schisandra chinensis is the dried mature fruit of the genus *Schisandra* of the Magnoliaceae family, which is mainly distributed in northern and northeastern China as well as Henan and other places in China, and has been used in health food(Zhang et al., 2020). *Schisandra chinensis* is sour, sweet and warm in nature; it belongs to the lung, heart and kidney meridians. The herb has the effects of astringing lung qi, tonifying the kidney and generating fluids, and is specifically used clinically for the treatment of palpitations and insomnia, spontaneous sweating and night sweating, prolonged coughing and wheezing, dreaming and spermatorrhea, and prolonged diarrhoea. In modern pharmacological research, it is found that *Schisandra chinensis* mainly affects the central nervous system, the digestive system, and the cardiovascular system, and can be clinically used to regulate gastrointestinal peristalsis, treat neurodegenerative diseases, coronary artery disease, and so on(Lin et al., 2024).

In recent years, the state has introduced a number of policies to promote the high-end and differentiated development of the health products industry. The Outline of the Healthy China 2030 Plan proposes to integrate the health industry and traditional Chinese medicine (TCM), focus on the aging society, and develop TCM health product lines for the elderly group, such as health food, through modern technology(China, 2016-10-25). As a famous medicinal material, the application of *Schisandra chinensis* is in growing demand in the health care market, so this study takes health food containing *Schisandra chinensis* as the research object, and uses data mining to investigate the formulation law of health food containing *Schisandra chinensis* and the mechanism of its health care function, so as to provide theoretical basis and relevant references for the development and application of *Schisandra chinensis* related medicinal and food health food.

2. Information and Methodology

2.1. Data Sources and Search Methods

In this study, "*Schisandra chinensis*" was used as the search term, and a search was conducted on the Special Food Information Query Platform (http://ypzsx.gsxt. gov. cn/ special food) of the State Administration of Market Supervision and Administration of the People's Republic of China (SAMSA) on 30 August 2024, and the search was completed in the same year.

2.2. Inclusion and Exclusion Criteria

Inclusion criteria: 1) health food must have a clear health function; 2) inclusion of health food containing *Schisandra*

chinensis must have a clear composition of raw materials; 3) for the same composition of raw materials and different dosage forms of health food, retaining the difference in dosage forms, only a single inclusion; 4)for the same composition of raw materials and different concentrations of drugs in the health food, a single inclusion of only a single.

Exclusion criteria: 1) no clear health function of health food; 2) not clear the appropriate population of health food; 3) repeated registration of health food.

2.3. Data Normalisation

1) When counting the main raw materials, only the part of traditional Chinese medicine is retained, and auxiliary materials and chemical components, such as "*xylitol*" and "*microcrystalline cellulose*", are excluded. 2) The names of Chinese herbal medicines were standardised with reference to the 2020 edition of the Chinese Pharmacopoeia(Commission, 2020), and Chinese medicines not entered into the Pharmacopoeia were supplemented with reference to Pope's Standard (https://db.ouryao.com/dfbz/), and priority was given to the Pharmacopoeia. Among them, the drugs with different names caused by the difference of origin and preparation method are unified according to the same drug, such as "*Southern* Schisandra" and "*Northern Schisandra*" are unified as "*Schisandra*". 3) In order to reflect the characteristics of the data, the modifiers were excluded from the statistical flavour, such as slightly sweet and slightly cold, which were unified as sweet and cold. 4) Health functions are standardised with reference to "Catalogue of health functions allowed to be claimed by health food products Non-nutrient supplements (2023 edition)"(Regulation, 2023-8-31), e.g. "improve sleep" is standardised as "help to improve sleep".

2.4. Data Entry and Analysis

The standardised data were entered into EXCEL 2019, and the process was first entered and then compared and tested to ensure the accuracy and completeness of the entered data. EXCEL was used to carry out descriptive statistics on health product dosage forms, health functions, frequency of traditional Chinese medicines, efficacy and sexual flavour attribution; SPSS Statistics 29.0 and SPSS Modeler 18.0 were used to carry out systematic clustering as well as association rule analysis on the main raw material matrix, respectively.

3. Analysis of Statistical Results

Collected by the Special Food Information Query Platform of the State Administration of Market Supervision and Administration, a total of 96 *Schisandra chinensis* related health products were obtained, and after the standardisation, a total of 80 were included in the statistical analysis.

3.1. Health Functions, Nutraceutical Dosage Forms, Inappropriate Population Groups

The health functions involved in the 80 health products included were mainly to help improve sleep, to have an adjunctive protective effect against chemical liver injury, and to help enhance immunity, in a total of 92 instances. See Figure 1 for details.

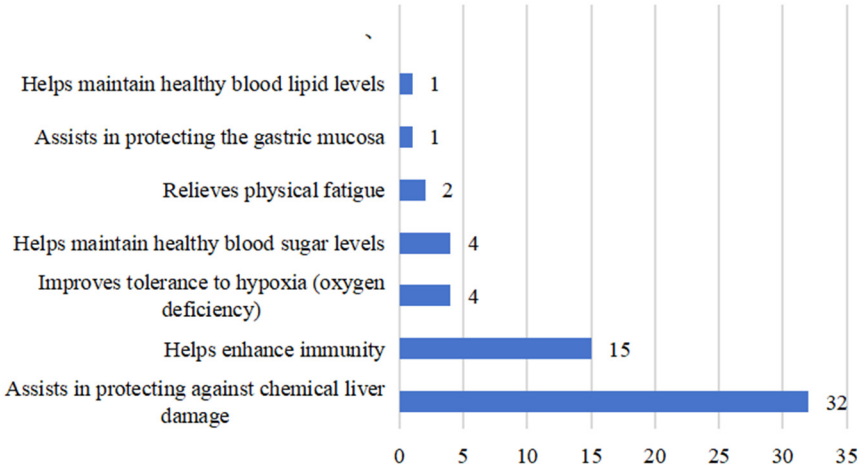

Figure 1. Frequency statistics of health functions of health food products containing *Schisandra chinensis*

Dosage forms >15% of the 80 health food products were classified as high-frequency dosage forms, including oral capsules (55%), oral solutions (16.25%), and tablets (16.25%). The unsuitable population consisted mainly of children and adolescents, pregnant women, lactating mothers (universal in nature) and contraindicators of individual ingredients (with single health food targeting).

3.2. Frequency of Administration, Efficacy of Drugs

The 80 health products included covered 70 herbal medicines, and the statistics yielded a total frequency of 314 times, setting the frequency of use >5 as a high-frequency ingredient, totalling 12 flavours. The specific frequency statistics are shown in Table 1.

Classification analysis of each raw material Chinese medicine according to the fifth edition of "Traditional Chinese Medicine"(Guo, 2021-4), the results showed that the herbal efficacy of health care product raw materials containing *Schisandra chinensis* included deficiency tonic, astringent, tranquiliser, etc., with a total of 12 categories, and the specific frequency and frequency statistics are shown in Table 2.

3.3. Drug Properties and Flavours

Among the TCM drugs included in the statistical analysis, the primary medicinal flavors were sweet, bitter, pungent, and sour; the medicinal properties were predominantly neutral, warm, cold, and cool; and the main meridian tropisms were the liver, lung, spleen, and kidney meridians. Specific details are shown in Figure 2.

Table 1. Frequency statistics of ingredients in health food formulations containing *Schisandra chinensis*

serial number	veterinary drug	Frequency (times)	Percentage (%)	serial number	veterinary drug	Frequency (times)	Percentage (%)
1	*Schisandra chinensis*	80	100.00	7	*Eleutherococcus senticosus*	9	11.25
2	*Ziziphi Spinosae Semen*	22	27.50	8	*Poria cocos*	8	10.00
3	*Pueraria lobata*	20	25.00	9	*Lilium brownii*	8	10.00
4	*Ganoderma lucidum*	15	18.75	10	*Polygala tenuifolia*	6	7.50
5	*Lycium barbarum*	15	18.75	11	*Panax quinquefolius*	6	7.50
6	*Panax ginseng*	10	12.50	12	*Curcuma longa*	6	7.50

Table 2. Efficacy statistics of ingredients in health food formulations containing *Schisandra chinensis*

serial number	categorisation	Frequency (times)	Frequency (%)	serial number	categorisation	Frequency (times)	Frequency (%)
1	medicine for treating weakness	102	32.69	7	medicine clearing heat (e.g. Chinese medicine)	8	2.56
2	astringent	86	27.56	8	medicine that calms the liver and restores wind	8	2.56
3	tranquilliser	47	15.06	9	tonic	7	2.24
4	antipyretic (antibiotic)	24	7.69	10	antipyretic (drug)	5	1.60
5	removing blood stasis (medicine)	12	3.85.	11	medicine for resolving phlegm, cough and asthma	2	0.64
6	medicine that induces diuresis and seeps dampness	12	3.85	12	hemostatic drug	1	0.32

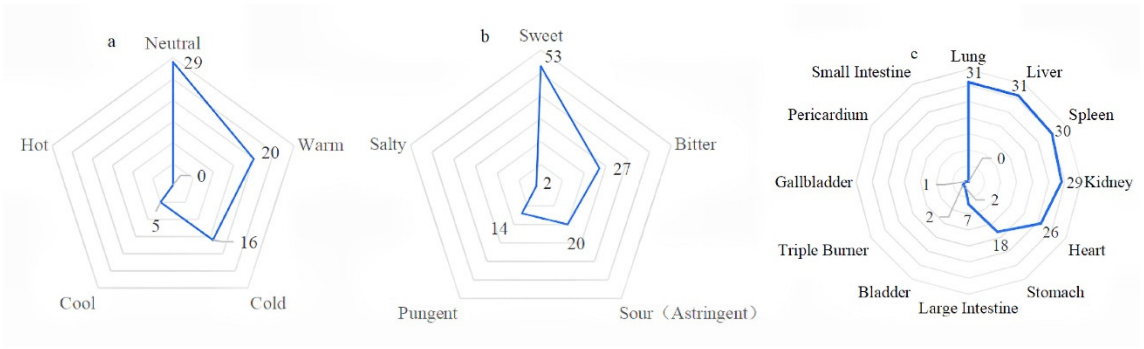

Figure 2. Radar diagram of the four qi and five flavours of raw materials and medicines

a - the four qi's of Chinese medicine; b - the five flavours of Chinese medicine; c - the meridians of Chinese medicine

3.4. Complex Networks

All raw materials of health products were imported into SPSS Modeler 18.0 for complex network visualization, and association rule analysis was performed on all traditional Chinese medicines. Subsequently, correlation analysis was conducted for the top three health functions (helping to improve sleep, providing auxiliary protection against chemical liver injury, and aiding in enhancing immunity), and a complex network diagram was generated. See Figure 3 for details.

a-all all-raw medicinal materials; b-helps improve sleep; c-adjuvant protection against chemical liver injury; d-helps boost immunity

3.5. Cluster Analysis

The top three health functions by frequency were identified as core functions. Using the hierarchical clustering analysis in SPSS Statistics 29.0, the raw materials associated with these core functions were analyzed. The clustering method selected was between-groups linkage, with variables used for clustering the raw materials of each function. The clustering members were set to a single solution (with the number of clusters set to 3). The clustering method employed was within-groups linkage, with interval measurement, the Euclidean distance as the measurement formula, and standardization based on Z-scores. The results are shown in Figure 4.

a- Helps improve sleep; b- Adjuvant protective effect against chemical liver injury; c- Helps strengthen immunity

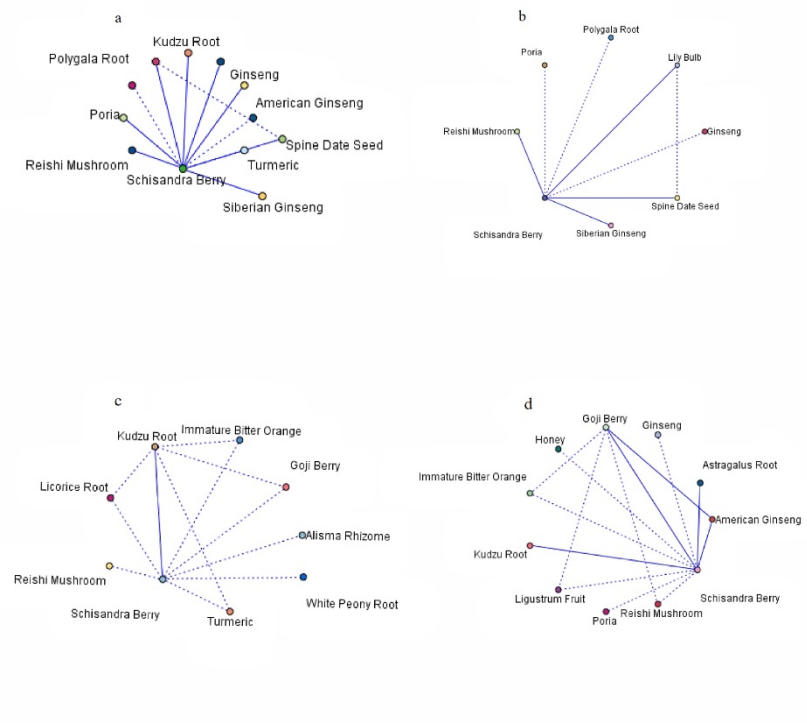

Figure 3. Complex network

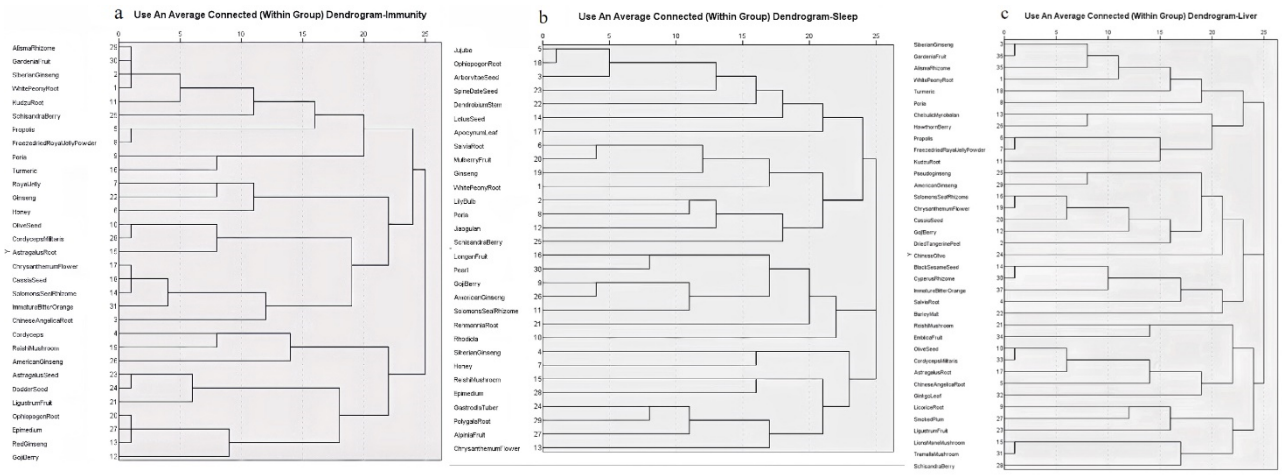

Figure 4. Spectrum of high-frequency health function cluster analysis

4. Discussion

The concept of "medicine and food having the same origin" refers to the fact that certain foods have the same origin and efficacy as medicines, a concept that originated in traditional Chinese medicine. It emphasises the close relationship between diet and health, and believes that many ingredients can not only be used as part of the daily diet, but also have certain health and therapeutic effects(Sun et al., 2025). Its value and role in the treatment of untreated diseases, subhealth conditioning, and health and wellness have been continuously explored and applied in the health care market, and medicinal food and foodstuffs are in an important position in the current health care market. Therefore, the research on the formulation law of health food containing *Schisandra chinensis* was carried out to provide reference for the development and application of *Schisandra chinensis* related medicinal food health food.

More than half of the 80 health food products in this study were in the form of capsules, followed by solutions and tablets. The main active ingredients in *Schisandra chinensis*, such as lignans and volatile oils, usually have high lipid solubility and low water solubility, resulting in insufficient effective concentration in aqueous solutions and affecting their bioavailability(Li et al., 2025) , so capsules were mostly used to reduce the loss of potency.

In the statistics of flavour and meridian, sweetness is the main flavour of the medicine, which is warm and flat in nature, and mainly enters the liver meridian, the lung meridian and the kidney meridian. Sweet medicines can nourish, harmonise and slow down, with the effect of nourishing and tonifying, mainly entering the liver, lung and spleen meridians, improving the function of internal organs by promoting the operation of qi and blood; they are mainly distributed in the medicines for tonifying the deficiency, tranquillising the spirit, and inducing drainage and seepage of dampness, and their effects can lie in tranquillising the heart and tranquilising the spirit, strengthening the organism, regulating the body immune function, and enhancing the ability of resistance to diseases, etc(Yu et al., 2023) . If the nature of the medicine is

calm, then the warmth and coolness deviation is small, the effect is mild, and it has the characteristics of nourishing, harmonising and regulating, and the calm nature of the medicine can usually be used to tonify qi and blood, harmonise with the middle and relieve pain, and tranquillise the spirit and tranquillise the mind. In the frequency of drug use, the highest frequency of the introduction of drugs to supplement the deficiency, and to tonify qi as the main, supplementing yin, yang, and blood, so there is no weakness in the performance of the person, should not be abused; coupled with the *Schisandra chinensis* in the lignan chemical components such as *Schisandra chinensis A*, *Schisandra chinensis B*, etc., will have an impact on the endocrine system, affecting the level of hormones(Chen et al., 2025) , which for the children and adolescents in the process of growth and development, foetus, will interfere with the normal physiological development, and the children and adolescents in the normal physiological development. This will interfere with the normal physiological development of children, adolescents and foetuses, and the immature liver of children and adolescents and the lower metabolic capacity of the liver of pregnant women, the metabolism and excretion of drugs in these groups is low, which can easily lead to the accumulation of drugs in the body, and increase the risk of toxicity, so children and adolescents, pregnant women and breastfeeding mothers should be avoided.

The health food containing *Schisandra chinensis* has the most common health function of helping to improve sleep, and the most frequently occurring health food formulas with this function are *Schisandra chinensis*, jujube seed, *Serratula officinalis*, and *Ganoderma lucidum*. The above medicines can enter the liver, kidney, heart and spleen meridians, and "*Suwen - Anger and Tongtian Theory*" points out that "the disease of insomnia" is "yin and yang secret, the spirit is cured", and the imbalance of yin and yang in the body, the insufficiency of qi and blood, and the disorders of the internal organs will lead to poor sleep or insomnia. The body's yin and yang are out of balance, qi and blood are insufficient, and the disorder of the internal organs will lead to poor sleep or insomnia. People lie in the blood to the liver, liver blood, the heart line, the liver is the main drainage, like the organ, the kidney is the main water, the heart is the main fire, the spleen is the main transport. If the liver qi is blocked, the heart and kidney do not communicate, heart and spleen deficiency, it is easy to cause palpitations, insomnia(Tu et al., 2021). Although *Schisandra chinensis* is an astringent, it also tonifies the heart and kidneys, treating deficiency of yin and blood, loss of nourishment of the heart and spirit, and palpitation and insomnia; *Ziziphi Spinosae Semen* has the effects of nourishing the heart and tonifying the liver, calming the heart and tranquilising the spirit, restraining sweating, and generating fluids, which is categorised as a medicine to nourish the heart and tranquillise the spirit; *Prickly Wujia* has a sweet and slightly bitter flavour, and is warm in nature. In the "help improve sleep" Chinese medicine pair, the most frequently used is *Schisandra chinensis - Ziziphi Spinosae Semen*, the two must be used together, *Schisandra chinensis* is acidic and warm, and acid can astringent; sour jujube seed is sweet and nourishes the heart and liver, and the combination of the two can effectively regulate the heart and spirit and enhance the effect of tranquillising the mind; sour jujube seed nourishes the yin and nourishes heart and blood, and *Schisandra chinensis* is mildly astringent and promotes the operation of qi and blood; the dual regulation of the liver and kidney; and the dual regulation of the liver and kidney. In addition, sour jujube seed nourishes yin and tonifies the heart and blood, while *Schizandra* is mild and astringent, which promotes the operation of qi and blood(Gao et al., 2013).The combination of sour jujube seed and *Schizandra* fully reflects the therapeutic concepts of Chinese medicine of "regulating yin and yang" and "tonifying qi and blood", and is an ideal combination for calming the mind and tonifying qi for restful sleep.

Polysaccharides, schisandrin A, ethanol extracts, and lignans derived from *Schisandra chinensis* have been shown to modulate nervous system excitability. These compounds increase the concentration of the inhibitory neurotransmitter *γ-aminobutyric* acid while reducing levels of glutamate, thereby exerting calming and tranquilizing effects, which contribute to their sedative-hypnotic properties(Rybnikar et al., 2019). Similarly, extracts from *Ziziphi Spinosae Semen* contain saponins, volatile oils, flavonoids, and alkaloids, which demonstrate sedative-hypnotic, anticonvulsant, antidepressant, and anxiolytic effects on the central nervous system. Studies have revealed that *Ziziphi Spinosae Semen* extracts can reduce the levels of *dopamine* (DA) and *norepinephrine* in the body(Wang et al., 2022), The primary active component, *jujuboside*, plays a critical role in these effects. Importantly, *Ziziphi Spinosae Semen* is often used in combination with *Schisandra chinensis* to regulate neurotransmitters such as *Serotonin* , DA, and *Brain-derived neurotrophic factor* , as well as related signaling pathways, to address insomnia. This combination is a widely utilized therapeutic pair in clinical settings for treating insomnia, anxiety, and neurasthenia. It is also a key component in many compound formulations designed to promote tranquility and sleep(Zheng et al., 2022).

In the health function of "auxiliary protective effect on chemical liver injury," the most frequent pairing is *Schisandra chinensis* and *Pueraria lobata*, with a co-occurrence frequency of 18 times. Chemical liver injury is typically categorized into drug-induced liver injury and alcoholic liver injury. According to TCM theory, these conditions are often accompanied by symptoms of dampness, heat, and stagnation in the liver, which impede blood flow and hinder metabolic processes. *Pueraria lobata*, known for its detoxifying properties, can disperse heat, relieve superficial pathogens, and counteract alcohol toxicity, making it particularly effective in treating alcoholic liver injury(Zhang et al., 2006). When combined with *Schisandra chinensis*, which tonifies qi, promotes fluid production, nourishes the kidneys, and calms the mind, the two herbs exhibit synergistic effects, enhancing overall therapeutic efficacy.

Liver injury, if left untreated, can progress to liver fibrosis and even hepatocellular carcinoma (HCC). *Schisandra chinensis* has been shown to promote hepatic enzyme synthesis, reduce transaminase levels (e.g., alanine aminotransferase and aspartate aminotransferase), and protect liver function by enhancing lymphocyte activity, improving detoxification capacity, and mitigating hepatic pathology (Zhang et al., 2020). Additionally, lignans from *Schisandra chinensis*, such as those in its ethyl acetate extract, demonstrate significant protective effects against drug-induced liver injury. These effects are primarily mediated through the activation of the NRF2/ARE pathway, where NRF2 (nuclear factor E2-related factor 2) and ARE (antioxidant response elements) play critical roles in reducing oxidative stress and inflammation(Zhang et al., 2024).On the

other hand, the active components of *Pueraria lobata*, particularly *puerarin*, have been found to inhibit HCC progression through dual pathways involving PI3K/Akt and MAPK signaling. *Puerarin* significantly suppresses the proliferation of human HCC cells, highlighting its potential as a therapeutic agent for liver cancer(Li et al., 2024).

For the health function "helps to enhance immunity", its high-frequency pairing is *wolfberry - schisandra*. Studies have shown that *schisandra polysaccharide* can enhance the number of white blood cells, increase the phagocytosis of macrophages, and promote the transformation of lymphocytes (Li et al., 2018) , and improve the immune ability of the body. *Lycium barbarum* is sweet and flat, and enters the liver and kidney meridians. The main active ingredient is *Lycium barbarum polysaccharide*, which acts in the same way as *Schisandra chinensis polysaccharide* and improves the vitality of macrophages.

5. Conclusion

In this study, data mining techniques were applied to explore health food containing *Schisandra chinensis* in depth with remarkable results. In terms of efficacy, it was clarified that it has multiple fields of utility such as regulating immunity, anti-fatigue, improving sleep, etc., which can effectively help optimise the state of the organism. In terms of formulation, *Schisandra chinensis* is often paired with *Wolfberry, Astragalus* and *Ginseng*, following the principles of strengthening the body and regulating qi and blood to synergistically enhance healthcare efficacy.

In summary, based on the data mining technology, we have analysed the formulation pattern of health food containing *Schisandra chinensis*, the core drug combinations of high-frequency health functions and their mechanisms of action, and made it clear that they can help to improve sleep, have auxiliary protective effects on chemical liver injury, and help to enhance immunity and other health functions, which can help to optimize the state of the body, and that they can synergistically enhance the health effects by following the principle of supporting the right and strengthening the root and the regulation of qi and blood in the formulation pattern. The formula follows the principles of strengthening the body and regulating qi and blood to synergistically enhance the health care functions, which can provide reference for the development and application of *Schisandra chinensis* related health food products.

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