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China, Cultivation

China: Industrialization development of forsythia cultivation

--Take the production base of Shijiazhuang Yiling Pharmaceutical in She County, Handan City as an example

Contents

I. Background Information

1.1 Introduction of forsythia

1.1.1 Pharmacological effect

1.1.2 The role forsythia has played in the battle against COVID-19

1.2 “Demonstration and Application of Standardized Production Technology of Genuine Medicinal Material in Taihang Mountain of She County” Project

1.2.1 Purpose and Significance of the project

II. Advantages of She County as a production base for forsythia

2.1 Growing environment and advantages of forsythia

2.2 The geographical environment of She County

2.3 Policy and Platform

2.3.1 Policy

2.3.2 Organization

2.3.3 Market

III. Scale and Technical Achievement of Planting and Production of Forsythia

3.1 Construction on production base

3.1.1 Construction of core demonstration bases

3.1.2 Construction of wild forsythia cultivation base

3.2 Production technology

3.2.1 Technical system of forsythia ecological cultivation

3.2.2 Pollination technology of forsythia

IV. Problems and solutions

4.1 Problems

4.1.1 The herb farmers lack autonomy when cultivating

4.1.2 The utilization of resources and the added value of products need to be improved

4.1.3 The key technologies are still immature

4.2 Solutions

V. Further thought

5.1 Domestic revolution

5.2 Global efforts

VI. Summary

Abstract

Taking Yiling Yanzhao Chinese Herbal Medicine Co., Ltd. 's production base of Forsythia in Shexian

County, Handan City, Hebei Province as an example, this paper introduces the industrialization development of forsythia and the positive effect of production scale and technology on the quality improvement of forsythia. Besides, I will analyze current problems and try to give suggestions.

Key words

Forsythia Chinese medicinal crop Yiling pharmaceutical Plant science and technology

I. Background Information

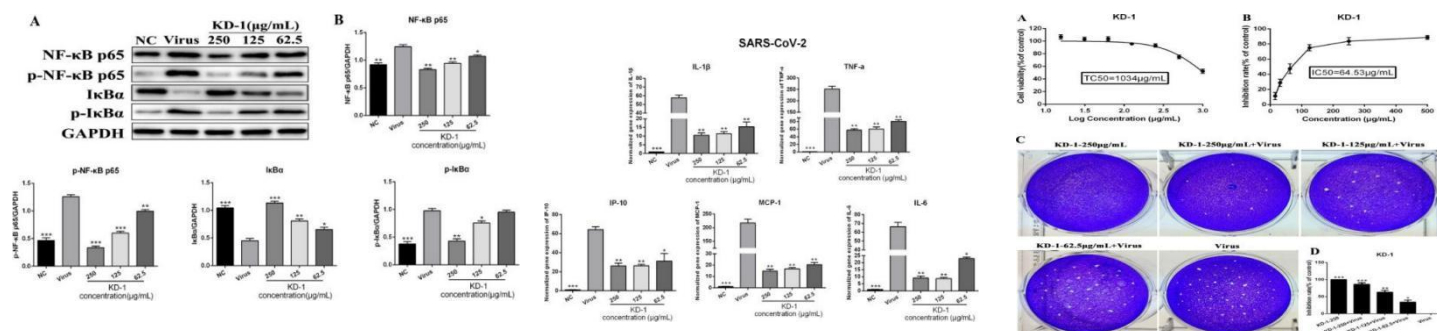
1.1 Introduction of forsythia

1.1.1 Pharmacological effect

Forsythia is a traditional woody Chinese medicine crop with a long history of application. Commonly found in Hebei Province, forsythia is a well-known and genuine medicinal material from which dozens of medicines are made. Besides being a potent detoxification medicine, the forsythia has strong anti-inflammatory effects such as clearing away heat and reducing swelling. Therefore, it has been widely used in the prescription for treating fever. In recent years, several outbreaks of public health crisis have become global challenges that attract all countries' attention, and Chinese patent drugs have played an active role in such pandemics. Forsythia has an outstanding effect on the prevention and treatment of respiratory diseases including SARS, H1NI, H7N9 and COVID-19.

1.1.2 The role of forsythia in the battle against COVID-19

Lignans are the main chemical constituents of forsythia, and Phillyrin (KD-1) is the lignans compound found in higher content. The 2010 edition of Chinese Pharmacopoeia takes KD-1 as an important index for quality control of forsythia. Authored by Yang's team and the Fuli team, an article published in *Phytomedicine* highlighted the anti-coronavirus effect of forsythia, "Phillyrin (KD-1) exerts anti-viral and anti-inflammatory activities against novel coronavirus (SARS-CoV-2) and human coronavirus 229E (HCoV-229E) by suppressing the nuclear factor kappa B (NF-κB) signaling pathway" "KD-1 could significantly inhibit SARS-CoV-2 and HCoV-229E replication in vitro. KD-1 could also markedly reduce the production of proinflammatory cytokines (TNF-α, IL-6, IL-1β, MCP-1, and IP-10) at the mRNA levels. Moreover, KD-1 could significantly reduce the protein expression of p-NF-κB p65, NF-κB p65, and p-IκBα, while increasing the expression of IκBα in Huh-7 cells. KD-1 could significantly inhibit virus proliferation in vitro, the up-regulated expression of proinflammatory cytokines induced by SARS-CoV-2 and HCoV-229E by regulating the activity of the NF-κB signaling pathway. Our findings indicated that KD-1 protected against virus attack and can thus be used as a novel strategy for controlling the coronavirus disease 2019." It has shown the efficacy of forsythia.^[1]



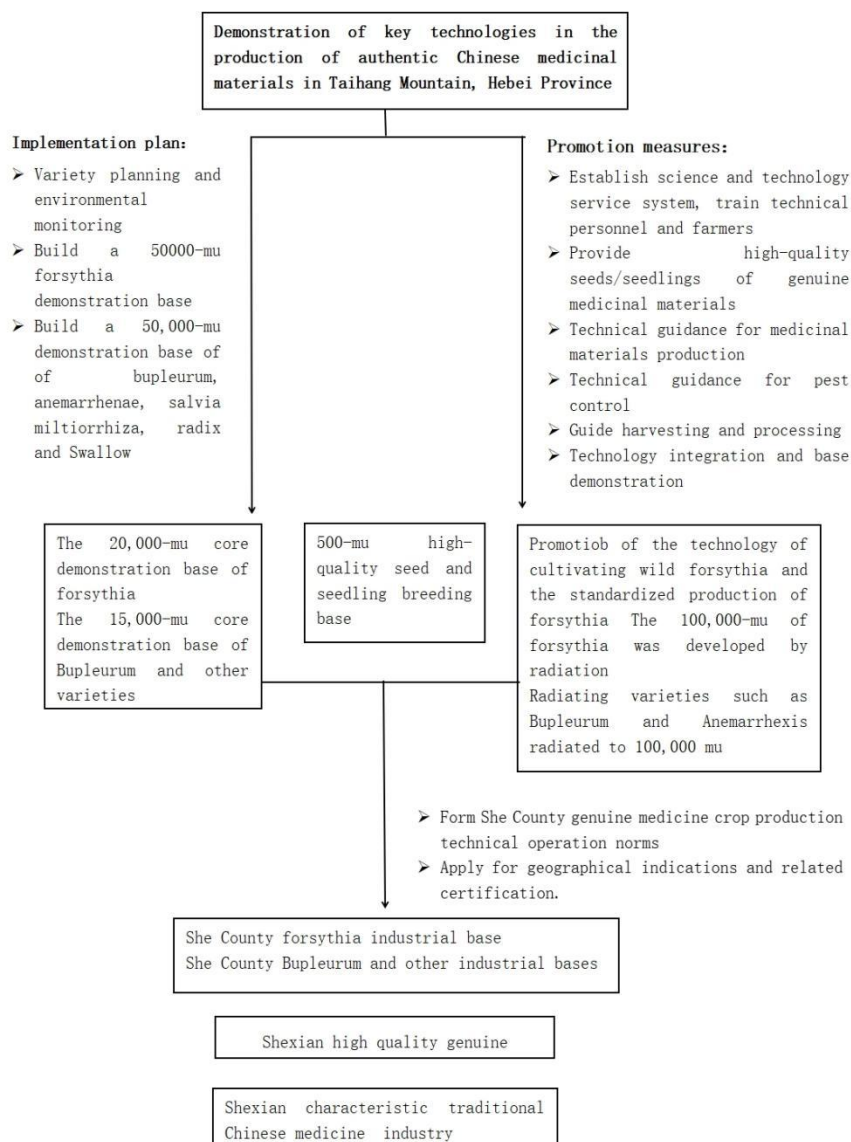
1.2 “Demonstration and Application of Standardized Production Technology of Genuine Medicinal Material in Taihang Mountain of She County” Project

1.2.1 Purpose and Significance of the project

This project aims to solve the prominent problems in planting such as the variety is disorder, lacking seedlings and the production has no standard. The project intensively demonstrates a number of key technological achievements in the production of genuine medicinal materials in Taihang Mountain, promoting a standardized, large-scale and ecologically friendly construction of Chinese medicinal materials cultivation in She County. The project also explores effective operational mechanisms and models, and promotes them in similar areas.^[2]

1.2.2 Practice process of the project^[3]

II. Advantages of She County as a production base for forsythia



2.1 Growing environment and advantages of forsythia

“Forsythia is a hardy, sun-loving and shade-tolerant plant. It likes warm and humid climate. Forsythia doesn't choose the soil so it can grow normally in neutral, slightly acid or alkaline soil. It has the property of drought-resistance but can't stand waterlogging. Forsythia has strong vitality, developed root system and strong ability of soil fixation and water retention. It is a characteristic and excellent variety for soil fixation and slope protection, water conservation and ecological cultivation in mountainous areas.”^[4]

2.2 The geographical environment of She County

She County is located in a deep mountainous area. It is subject to a temperate continental monsoon climate in the north temperate zone. The average annual temperature of the county ranges from 10.7°C to 14.2°C, with an average annual difference of 27.4°C to 29.6°C. There are great seasonal and inter-annual variabilities in precipitation.^[5] Taihang Mountain stretches throughout the territory, the terrain slowly tilts from northwest to southeast. She County is a high radiation area with abundant light energy resources.^[6] Generally, the natural environment in She County can provide enough heat for forsythia and there is a large scale of land available for plantation. Besides, the deep and expanding roots of forsythia can play an active role in slope stability in the steep environment of Taihang Mountain.

2.3 Policy and Platform

2.3.1 Policy

In June 2019, the People's Government of She County issued the “Opinions on Accelerating the Development of Chinese Medicinal Crop Industry in She County”(<2019>-65), which pushed forward the goal of 2019 to 2022 to further promote the development of Chinese medicinal crop industry in She County.

2.3.2 Organization

A technical team with experts from Hebei Academy of Agricultural Sciences will be responsible for the research and technical training, problem solving and hence ensuring a smooth-flowing project. The company will set up a project implementation team in the base so as to facilitate the implementation process.

2.3.3 Market

As a wholly-owned subsidiary of Shijiazhuang Yiling Pharmaceutical, She County Yiling Yanzhao Chinese Herbal Medicine Co., Ltd. carries out the duty of supplying Chinese patent medicine raw materials to Shijiazhuang Yiling Pharmaceutical. More than 90% of the processed forsythia is used for the production of Lianhua Qingwen Capsules (Granules) of Yiling Pharmaceutical.

III. Scale and Technical Achievement of Planting and Production of Forsythia

3.1 Construction of production base

3.1.1 Construction of core demonstration bases^[7]

In the urban planting demonstration areas, Yiling Pharmaceutical will provide support in building the core forsythia demonstration planting base. The intensive production mode of centralized construction, unified management and protection, unified harvest and processing will be adopted. The base will be built in the gentle slope terraced mountainous areas of 500-1000 meters above sea level. Approximately 100 plants of forsythia seedlings will be planted per mu with 2 3076 mus in total.

Table 1. Construction of Forsythia Core Demonstration Base

Date	District (Forsythia Core Demonstration Base)	Area (Mu)
2013-2014	Sangzhai Village	6200
2015	Nanaipu 800,Xiaojiao 3700,Ximiao Bay 2000, Shifeng 3520,Siziyan 980mu	10376
2016-2017	Sang Zhai,Nanaipu	6500
Amount		2 3076

3.1.2 Construction of wild forsythia cultivation base^[8]

In Piancheng town, Qingta wild forsythia demonstration area has been constructed relying on

the Yiling pharmaceutical. At an altitude of 800-1300 meters, the base is located in an area densely covered with wild forsythia. They carry out wild cultivation and artificial management to form the artificial cultivation base of wild forsythia. In recent years, a total of 30,500 mu of raising demonstration base have been built.

Table 2. Implementation of wild forsythia cultivation base

Date	Content	District	Area (mu)
2013-2014	Wild cultivation	Sangzhannanaipu, Yaomenkou	12500
2015	Wild cultivation	Galapu	8000
2016-2017	Wild cultivation	Nanaipu, Heilongdong	10000
Amount			30500

3.2 Production technology

3.2.1 Technical system of forsythia ecological cultivation

The ecological cultivation technology pattern of forsythia is to implement the management of “three no and one cut”. First, instead of watering, rain-collecting fish scale pits will utilize natural precipitation to meet the requirements for growth. Second, instead of applying chemical fertilizer, leaves or weeds will be buried in the fish scale pit annually to increase organic matter and enrich the soil. Third, chemical pesticides will also be further avoided. Proper retention of associated plants will allow to maintain plant diversity, and various insects interacting with each other will avoid the formation of large-scale pure forest which may result in frequent occurrence of diseases and insect pests. “One cut” refers to the plastic pruning of forsythia. By pruning, it can control the growth of branches of forsythia and update the bearing branches and thus improving the yield and quality of the forsythia. So far, “the ecological cultivation technology pattern of forsythia” has constructed 150,000 mu of forsythia ecological cultivation area in She County and formed the forsythia resource-based industry in Taihang Mountain.

3.2.2 Pollination technology of forsythia^[9]

In order to solve the problems of the same self-sterility, the low setting percentage and low yield existing in the current production methods, the approaches of mixed planting of the two species or artificial cross pollination was adopted in the planting process of forsythia to increase the setting rate. In late February, disease-free scions are collected and grafted plants are selected. The grafting was carried out in mid-March.

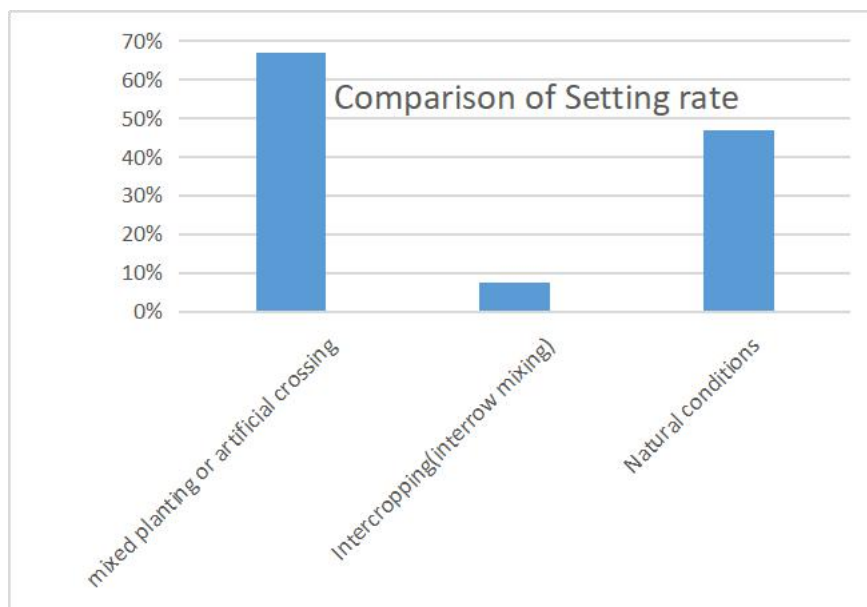


Figure 5 Comparison of setting rate

(1) Scion collection. In late February, the strong forsythia plants with long or short flowers were selected, then the strong branches without diseases and pests were cut from the selected forsythia plants. Next is to cut off the scion from the cut branch. After that, the scion is sealed with paraffin wax and wrapped with plastic wrap. At last, the type and date will be indicated and the scion stored in the condition of 0 ~ 5 °C.

(2) Selection of grafted plant. In the dense area of forsythia, a grafted plant was selected and marked at intervals of 4 to 5 plants.

(3) Perform grafting. In the middle of March, 4 to 6 branches in step(3) were selected as rootstocks and cut off 20 to 40 cm from the branches. Then the grafting knife was used to cut vertically from the pith center in the middle of the section with a depth of 3 to 5 cm. The lower end of the scion obtained in Step(2) was cut into wedges and the length of the slanted plane was 3-5 cm. Next the wedge of the scion were quickly inserted into the cut of the stock with two sides aligned. And then the grafted part was tightly secured with plastic rope while exposed part of the scion wrapped with plastic rope.

(4) Investigation of grafting survival rate. 10 ~ 20 days after grafting to check the survival situation, if the bud sprouts on the scion or grows new leaves then the graft survives. At this time, the bud on the stock and the plastic rope wrapped on the scion would be removed,

revealing bud on the scion. When the new bud tip of the scion grows to 5 ~ 10 cm or longer and the grafting site has healed completely, then it is time to untie the plastic band wrapped at the grafting site. According to the statistics, the fruit fresh weight and dry weight have increased by 177.05 % and 170.3 % respectively.

IV. Problems and solutions

4.1 Problems

4.1.1 The herb farmers lack autonomy when cultivating

Local people have a long history of picking forsythia but not the planting. And they have just started the planting industry for a short time. Therefore, they may lack experience and technical guidance when planting in different seasons, utilizing various technologies and making independent choices and so on. In addition, there may be a lack of understanding of Chinese medicine crop in general.

4.1.2 The utilization of resources and the added value of products need to be improved

The cultivated area of forsythia is large and the yield is high, but the product type formed after processing is relatively limited, the market is narrow and the limitations are significant. The value created by the production link and the circulation link still have room for improvement. There is also a need to develop new approaches to guarantee the sustainable development of the industry.

4.1.3 The key technologies are still immature

Although the pollination technology of forsythia can effectively improve the setting rate, the current operation process is cumbersome, time-consuming and environment-demanding. The effect of processing technology on increasing fruit dry weight and effective ingredient of forsythia was not obvious. The phenomenon of stem, not full, impurity and mildew can't be completely avoided.

4.1.4 Forsythia has not been promoted effectively

COVID-19 is obviously a global challenge and forsythia is an effective treatment for this type of pneumonia. However, forsythia is almost only available in China. Promoting such an effective Chinese medicine to the world is emergent. Only when the efficacy of forsythia is recognized or awarded by authorities can it be convinced and applied by all countries in the world.

4.2 Solutions

4.2.1 The mountainous areas with thick soil layer, good drainage and leeward to the sun or

gentle slope land serve as better choices to cultivate. The wasteland, roadside, field edge, corner, front and back of the house, courtyard space could be planted sporadically. For continuous large-scale cultivation, the sandy loam soil should be selected to make the roots of the seedlings stretch and stratify steadily. The soil covering the planting point should be higher than the cave surface so as to avoid the cave soil sinking after raining. Enough farm manure needs to be applied before planting.

4.2.2 A relatively complete scientific and technological service system for Chinese medicinal crops should be formed and a normal mechanism of scientific and technological service should be established. The compilation of textbooks, the use of new Internet media, the opening of hotlines and other carriers could all help to spread the knowledge of Chinese medicinal crop industry. Educational training and discussion, field service and combined guidance and consultation are enriching, too. Ultimately, we could cultivate new professional farmers through the construction of Chinese medicine crop herbarium and farmer technology training center.

4.2.3 Explore the value of forsythia fruit products, improve and expand the quality and popularity of forsythia leaf products and extend the research on forsythia flower products. Besides, we could explore additional economic values of forsythia and make full use of forsythia resources. Additionally, we could carry out intensive processing research on Forsythia, continue product development and produce export-grade fine decoction slices of forsythia to expand international market and develop functional homologous to forsythia medicine and food to improve resource utilization rate and product added value.

4.2.4 Firm operation pattern and secure benefits of farmers. Explore and promote the “leading enterprises + cooperatives(base) + farmers” pattern. Take “leading enterprise is responsible for the demonstration of adjacent area” as the principle, land within villages and leading enterprises sign a contract(or cooperative), provide seeds(seedlings), guide and purchase uniformly. Implement order production and establish the lowest protection price mechanism. Through the establishment of supply and demand relations with pharmaceutical factories and merchants, we can develop base planting, implement order planting and contract planting, product the goods whatever the market need and establish a solid mechanism of benefit sharing and risk sharing.

4.2.5 Combined with the development trend of ecological tourism in Taihang Mountain, the construction of traditional Chinese medicine cultural scenic spots in the base should be promoted, landscape facilities are supposed to be built, and the traditional Chinese medicine industry can be fully combined with tourism resources so that tourists can enjoy the beautiful scenery of forsythia flowers. It will expand the spreading channels of traditional Chinese medicine culture and the brand of forsythia in She County can be publicized. It's beneficial to develop new forms of tourism with the theme of providing traditional Chinese medicine culture dissemination, health care, ecological tourism and other services to promote the sustainable development of forsythia industry.

4.2.6 It's significant to strengthen scientific and technological development and cooperation, carry out systematic research by relying on the technology of scientific research institutions, cultivate high-quality varieties by taking advantage of resources such as laboratories and carry out research on the integrated processing technology of forsythia. Using scientific research achievements to promote industrial upgrading. Last but not least, publish papers, apply for patents, breeding and popularize fine varieties of forsythia.

4.2.7 County-level governments are expected to provide policy support and guarantee for forsythia base construction. At the same time, other corresponding preferential policies should be formulated according to the needs of industrial development. After finishing the project, questionnaire survey and specific evaluation on the implementation effect of the project will be conducted and the experience will be summarized for promotion and application.

4.2.8 It's suggested that the Chinese medicine crop industry in each region be positioned as different leading varieties. Take the way of differentiation and misplacing development. Scientific planning should be utilized to guide the development of Chinese medicinal crop industry, avoid the vicious circle of chaos and disorder and ensure the interests of farmers from the source.

4.2.9 It is quite vital to strengthen supervision over the whole process of forsythia planting. In terms of fertilizer and water management, it can effectively prevent waterlogging. Of the same importance is to apply fertilizer reasonably according to the growth trend and use phosphoric acid and ammonium fertilizer in the growth process of forsythia. In order to improve the fruiting rate of forsythia, boron spraying method should be adopted at the flowering stage and the dosage of various drugs should be well controlled to effectively prevent pesticide residues. It is also necessary to reinforce plastic pruning job in flowering period as well as prune young and adult trees. Renewing aging plant to shorten planting period is available as well.

4.2.10 To enhance international recognition of forsythia, education is particularly important. Many international friends see Chinese medicine as part of Chinese culture and some of them will come to China or study in overseas colleges. In addition to providing new employment possibilities and spreading culture, the biggest role of education is to enable new development of Chinese medicine in other parts of the world and strengthen international cooperation. If people from all over the world learn to find and identify herbs in mountains and rivers, there will be more cooperation and more application space for Chinese medicine.

4.2.11 The cooperation between countries cannot be separated from the assistance and support of some international organizations and non-governmental organizations. In order to promote and apply traditional Chinese medicine like forsythia on a global scale, a unified mechanism should be established to standardize the application of traditional Chinese medicine.

4.2.12 The international standards for traditional Chinese medicine are very strict, so scientific research comes first. Only when Chinese medicinal products are developed that are

consistent with Chinese medicinal theory and exact mechanism of action can Chinese medicine be applied widely.

V. Further thought

Forsythia is only a part of the treasure house of Chinese medicine, through the investigation of forsythia planting, we have got some conclusions and experience, and it can be promoted to other traditional Chinese medicine, so as to commit to promoting Chinese traditional medicine to the world.

5.1 Domestic revolution

5.1.1 It's initial for Chinese to discard the cultural inferiority complex and recognize TCM as a science. The main viewpoint of TCM is to carry out human science and medical research with systematic viewpoint and systematic method. To promote TCM, the cultural identity and cultural confidence of Chinese people are needed first.

5.1.2 In terms of the means of using the political power, an independent administrative body of TCM should be established, it's supposed to be managed by excellent TCM personnel, and relevant laws should be introduced.

5.1.3 Take the advantage of the geographical knowledge to select the suitable growth area of traditional Chinese medicine for the construction of demonstration base. Additionally, use modern management models to explore the optimal scale of growing Chinese herbal medicine.

5.1.4 Cultural creativity can not only meet People's Daily needs for TCM culture, but also improve the quality of life and bring TCM culture into People's Daily life. Through "culture + creativity" to dig deep the cultural connotation of TCM and combine it with new media technology and popular elements in modern life can promote the inheritance and innovation of TCM culture. Introducing creative ideas to enrich the expression of traditional Chinese medicine culture is essential. On the other hand, the change of dissemination mode also puts forward higher requirements for the diversity and complexity of TCM cultural content. So the supervision and prevention of communication should be strengthened.

5.1.5 It is necessary to strengthen the training of TCM cultural communication talents, optimize the structure of talent team, and let comprehensive talents continue to learn and practice the dissemination of TCM culture with the help of exchanges on various platforms.

5.1.6 Put scientific research first. Universities, laboratories and enterprises should cooperate with pharmacological research and new drug research and development. They are supposed to make full use of high-tech equipment, introduce high-quality talents so that the Chinese herbal medicine can meet the needs of modernization and cope with the current global challenges such as COVID-19

5.2 Global efforts

5.2.1 China's outbound and inbound tourism is an effective way to spread TCM culture. It is necessary to give full play to the role of TCM talents in foreign exchanges and publicize TCM culture well.

5.2.2 Let more countries and regions have a better understanding of Chinese herbal medicine, Chinese medicine health preservation methods and traditional Chinese medicine health concept and core values. Except for that, give full play to the international image of TCM culture, which is friendly and kindhearted.

5.2.3 The government should continue to sign TCM cooperation agreements with relevant countries and international organizations, support the establishment of TCM centers overseas, issue international standards for TCM, register TCM products and build demonstration bases for TCM exchange and cooperation with other countries. To sum up, strengthening China's economic and trade cooperation in health with other countries, regions and organizations is expected.

VI. Summary

Improving the quality of Chinese medicine crops can promote the development of the pharmaceutical industry by improving production efficiency, meeting market demand and improving drug efficacy. Forsythia is one of the important medicinal materials to fight against respiratory diseases, the expansion of its planting scale and the development of technology are of great significance. At present, the development pattern of production base represented by She County and Yiling Pharmaceutical has achieved initial results and has broad development prospects and room for improvement, which is bound to become the general trend of sustainable development of Chinese medicine crop industry. I hope that enterprises and planting areas will continue to cooperate sincerely to upgrade the forsythia industry and maximize its medicinal value for the benefit of mankind.

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Acknowledgement

First of all, I would like to extend my gratitude to Shijiazhuang Foreign Language School for giving me this precious opportunity to broaden my horizons and connect with the world. Secondly, I would like to thank my tutors : Li Bo and Yuan Jianhong and all my classmates. Without their help, I could not have finished the paper successfully. Finally, I want to thank Shijiazhuang Yiling Pharmaceutical and She County Taihang Mountain Medicinal Materials Industrial Co., Ltd. for their theoretical and technical support.