

Analysis on Protection of GI Product Liupao Tea and Suggestions of its Industrial Supervision

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Abstract From humanistic characteristics, historical origin, fame, quality, and the correlation between quality and production region, we analyze key factors of protection for Geographic Indication product Liupao Tea. We also analyze industrial development of Liupao Tea from processing threshold, scale of processing enterprises, standard and index, planting base, research and development and technology popularization, and pesticide control. In line with these situations, we put forward following suggestions. First, it is proposed to raise standard index and formulate national standard for Liupao Tea. Second, we should popularize the industrial mode of "market + association (enterprise) + base" and establish demonstration area for protection of Geographic Indication product Liupao Tea. Third, it is recommended to raise the production and processing threshold. Fourth, we should establish special production inspection and research and development institution. Fifth, it is suggested to set up independent supervision organization.

Key words Liupao Tea, Geographic Indication, Analysis, Industrial supervision, China

1 General information of relevant concepts

1.1 Relevant concepts of Geographic Indication production protection A Geographical Indication (GI) is a name or sign used on certain products to indicate a specific geographical location or origin that the product possesses certain qualities, enjoys a certain reputation, or possesses other characteristics. The *Agreement on Trade-related Aspects of Intellectual Property Rights* (Trips Agreement) of WTO takes GI as a commercial mark that WTO member state is obligatory to protect^[1]. A GI is a quality mark. Generally, with GI protection, the output will have an increase of 20% in economic benefits.

GI products refer to those products originated from specific region and designated with geographical name, and quality, reputation or other special features of these products depend on natural and humanistic factors of this region. Most GI products are agricultural products, foods, arts and crafts products, whose property system is firstly originated from France for special protection of alcohol products. There are generally two types of GI products. One type is planting and cultivation products from local areas, and the other is products produced and processed in accordance with local special process and raw materials wholly or partly from local or other areas. The essence of GI product protection is the concrete manifestation of origin designation system in economy^[2].

A famous, special, and excellent product should generally

possess four elements: geographical name (designated with the origin), special quality, reputation, natural and humanistic factors. Special quality is the basis for GI protection, and the connection between natural factor and/or humanistic factor and special quality is the key to GI protection. Natural factors mainly include soil, terrain, climate, and water quality; humanistic factors include social factor and cultural factor, mainly historical tradition, special production process, formula, etc. The quality or other special features of most agricultural type GI products are decided by natural factors; the quality of arts and crafts GI products depends on humanistic factors; and the quality of food type GI products is determined jointly by natural and humanistic factors.

1.2 General information of Liupao Tea Liupao Tea, like Yunnan Pu'er Tea and Hunan Anhua Dark Tea, belongs to dark green tea. Its history can be traced back to 1 500 years ago. It is named by Liupao Town of Cangwu County in Wuzhou. In *Annals of Cangwu County*, it states that Liupao Tea originates in prominent Liupao Town. It has mellow taste. It does not change over night. Its color, flavor and taste are all excellent. In the standard DB45/T581-2009 *Liupao Tea*, it is defined as dark green tea with Liupao flavor and "red, strong, stale and pure", with bud leaf and tender stem of *Camellia sinensis* L. O. Kunts as raw material, and produced as per primary and refining processes in appropriate processing regions^[3].

According to records of historical documents, since Jiaqing period of Qing Dynasty, there had been many factories and farmers engaged in production, processing and sales of Liupao Tea in Liupao Town of Cangwu County. In the 1950s to 1980s, Liupao Tea has been a stable export commodity of Guangxi Province. Liupao Tea is one of the 24 kinds of famous tea in whole country in Jiaqing period of Qing Dynasty, but its domestic market shrinks in the middle and latter periods of 1990s, and Liupao Tea has once been reduced to a "Declining

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Industry". In 2002, there are only two enterprises producing Liupao Tea in Guangxi. The output is less than 1 000 tons. The output value is lower than 20 million yuan. Domestic demand market is low, and 65% products are exported to foreign countries. During 2001 to 2006, Guangxi totally exported 2 310.5 tons of Liupao Tea, with an annual export of 385.1 tons.

To revitalize the Liupao Tea national industry, with suggestions of Guangxi Entry-Exit Inspection and Quarantine system, Wuzhou municipal government launched protection of Liupao Tea GI product in 2006. The State Administration of Quality Supervision, Inspection and Quarantine accepted application of Wuzhou City for protection of Liupao Tea GI product on November 30 of 2006, and approved the application with a number 2011 (33) on March 16 of 2011. Protection range of Liupao Tea origin involves the existing administrative division of Wuzhou City, including Wanxiu district, Dieshan district, Changzhou district, Cangwu County, Cenxi County, Teng County and Mengshan County. The geographical coordinates are 110°18' –111°40'E and 22°37' –24°18'N, with an area of 12 588 km².

2 Quality features of Liupao Tea

2.1 Sensory features of Liupao Tea Semi-finished Liupao tea has thick and strong leaf and black auburn color. Soaked in water, it is red and yellow. The fragrance and taste are mellow and thick, comfortable and delightful. Tea dregs are yellowish-brown. Finished tea leaf is in black auburn color and mixed with golden flower (some fungi) healthy to people. Tea color is

deep red and bright. The stale flavor is pure. It has smell of betel flavor. The taste is mellow, sweet and smooth. Generally, it features "red, heavy, stale and mellow". The tea dregs are auburn or black auburn, suitable for long time storage. The sensory requirements of Liupao Tea are listed in Table 1.

2.2 Physical and chemical indexes of Liupao Tea Special class to class 1: stem content $\leq 3.0\%$, water extracts (in dry state) $\geq 33.5\%$; class 2 to class 3: stem content $\leq 6.5\%$; water extracts (in dry state) $\geq 30.0\%$; class 4: stem content $\leq 10.0\%$, water extracts (in dry state) $\geq 28.0\%$.

2.3 Similarities and differences between Liupao Tea and other types of dark tea Similarities of dark tea: first, fresh leaves are coarse. Most are picked after fresh tips becoming tea buds. All have piling process. Some adopts semi-finished dry blank piling, such as Sichuan dark tea and Hubei brick tea. Some adopts wet blank piling, such as Hunan dark tea and Liupao tea. Second, all adopt steaming piling and slowly drying. The internal substance has certain change. Finished dark tea has black auburn color and glossy appearance. The tea color is orange yellow or orange red. The fragrance is pure, and the taste is smooth. The tea dregs are yellowish auburn and large. Third, finished tea is formed through pressing, for purpose of long distance transportation, storage and safe-keeping.

Compared with other types of dark tea, Liupao Tea can be distinguished mainly from sensory features. Simply speaking, Liupao tea features "red, heavy, stale and mellow".

Table 1 Sensory requirements of Liupao Tea

Class	Appearance				Internal quality			
	Tea leaf	Evenly broken	Color	Neatness	Fragrance	Taste	Tea color	Tea dregs
Special class	Tight and thin, round and straight	Evenly	Black auburn, glossy	Neat	Stale flavor, pure	Stale, mellow and thick	Deep red, bright	Auburn, thin and tender, soft, bright
Class 1	Tight, fairly round and straight	Evenly	Black auburn, glossy	Neat	Stale flavor, pure	Stale, fairly mellow and thick	Deep red, bright	Auburn, black auburn, fairly thin and tender, soft, bright
Class 2	Fairly tight and straight	Quite even	Black auburn, black, glossy	Neat, slightly containing tender stem	Stale flavor, pure	Stale, mellow and thick	Fairly deep red, bright	Auburn, black auburn, soft, bright
Class 3	Coarse and bold, twisted	Quite even	Black auburn, black, glossy	Neat, containing tender stem	Stale flavor, pure	Stale, fairly mellow and thick	Red and bright	Auburn, black auburn, fairly soft and bright
Class 4	Coarse and bold	Fairly even	Black auburn, black and fairly glossy	Neat, containing stem	Stale flavor, pure	Stale, mellow and normal	Red and bright	Auburn, black auburn, slightly hard, and bright

3 Analysis on key factors for protection of GI product Liupao Tea

3.1 Social environment

3.1.1 Humanistic features and historical origin of Liupao Tea. Liupao Tea has functions of relieving heat and driving away moisture, making eyes bright and emptying worries, as well as helping digestion. These are suitable for local climate factors, living environment and styles. Climate and geographical environment are similar in Guangdong and Guangxi provinces. In Tang and Song Dynasties, traditional tea drinking custom and

cultivation agronomy have gradually formed and developed, and local residents widely have tea drinking habits. By Jiaqing period, residents in Guangdong and Guangxi Provinces and overseas Chinese in Malaysia and other regions have been widely using Liupao Tea as drinks for driving away dysentery and relieving heat. At the same time, constant rise of Taoist and Buddhist temples greatly promotes prevalence of Liupao tea among common people in Guangdong and Guangxi regions.

Production and making process of Liupao Tea can be traced back to 1 500 years ago. *Records of Tong Jun collecting*

Materia Medica in the Northern and Southern Dynasties stated that there is a kind of big leaf tea, which is very bitter and astringent. Drinking this kind of tea, you will be sleepless all night. At that time, fresh leaves are firstly picked and processed to form bulk, cake or square shape compressed tea. In Song Dynasty, "tea and horse transaction" was popular. Brick tea was delivered to northwest to exchange horses. At that time, there was dark tea production in Hunan. Dark tea was compressed to bricks and transported to northwest. Fu-brick tea process is basic production method of Liupao Tea. *Records of Tong Jun collecting Materia Medica* indicates that Liupao Tea may be forerunner of Hunan dark tea. According to first edition of December, 2000 of *Chinese Famous Tea Record*, Liupao Tea was listed as one of 24 kinds of famous tea for its special betel flavor in whole country in Jiaqing period (1801) of Qing Dynasty^[4]. In Volume IX of *Annals of Cangwu County* (1874), it states that Liupao Tea originates in prominent Liupao Town. It has strong taste. It does not change over night. Its color, flavor and taste are all excellent. *Guangxi Local Records* (1915) states that "Liupao Tea comes from Cangwu, but mostly from Liupao and Wupao, and most famous in Liupao.

Chairman Mao Zedong has a close connection with Liupao Tea. According to *Chronicle of Literature and History* (Volume 10 of 2009), Liupao Tea is the bridge and link between chairman Mao Zedong and vice chairman Li Jishen whose hometown is Cangwu County^[5].

3.1.2 Fame. Liupao Tea had gained widespread reputation for its special betel flavor in Jiaqing period of Qing Dynasty and became articles of tribute. Since the period of the Republic of China, Liupao Tea became famous special local product of Guangxi and often used as special gift to present to central government and foreign guest.

Wuzhou is a famous overseas Chinese hometown and a starting point of Maritime Silk Road. Liupao Tea is a hard-to-get commodity. Along with the Maritime Silk Road, Liupao Tea is spread all over Hong Kong, Macao, and Southeast Asian countries. Its earliest consumers are the working class, especially miners in Nanyang (an old name of Southeast Asia) areas. Along with popularity in overseas market, for over 200 years, Liupao Tea has become an indispensable part of daily life of local Chinese, and it plays an active role in developing overseas relations. In recent years, Liupao tea has won Gold Medal and top prize "King of Tea" in various international tea expositions. In 2010, Liupao Tea obtained the qualification for entry to Shanghai World Exposition and became the only tea product of Guangxi Province. According to evaluation of Public Brand Value Evaluation Group of Chinese Tea Regions, Liupao Tea has a regional brand value of 830 million yuan, ranking in 28 of the whole country's tea brands and second place in dark tea^[6]. Liupao Tea has become a name card of Wuzhou City and one of "three treasures" in Wuzhou.

3.2 Climate features and ecological and geographic environment

3.2.1 Climate features. Liupao Tea has strong regional feature. Its survival is closely related with special climate factors in Wuzhou. In protection zones of GI product Liupao Tea crossed by the Tropic of Cancer, the solar radiation is strong, then

forms the subtropical monsoon climate, which features warm climate, plentiful rainfall, high air humidity, dry in winter, wet in spring, long in summer and short in winter, and long frost-free period. No clear distinction between four seasons in this region. According to meteorological data statistics in 1960 to 2000, the annual average total radiant quantity is 375.308 4 to 447.754 2 kJ/cm², and the average temperature of the whole year is 19.3 to 21.4 °C.

3.2.2 Ecological and geographic environment. The ecological and geographic environment refers to the sum of various effective natural elements such as environmental system, ecological system and resource system, for survival and development of human being. It is a biosphere consisting of air, light and heat circle, ground vegetation circle, water lithosphere, as well as various resources. The forest coverage in areas under jurisdiction of Wuzhou is up to 73%, so the vegetation is good and evergreen in four seasons. The soil in these areas is mainly clay or sandy loam with slight acidity. The pH value is in the range of 4.5 to 6.5. The soil layer is deep and loose, but enriched with various humus and nutrients, favorable water and manure conditions, so it is very suitable for growth of tea trees. In these areas, there are many rivers, 80% of which flow through Wuzhou, Guijiang river and Xunjiang river and meet to form Xijiang river. Xijiang river has an annual runoff of 7 002 m³/s. It can be seen that there is rich water resource and water quality is cool and sweet, providing excellent water resources for production of Liupao Tea. Wuzhou has typical low mountains and hills. Under the action of subtropical monsoon climate, there is frequent occurrence of mixed weather, such as cloudy, foggy and rainy, forming special small climate environmental conditions.

3.3 Production and processing

3.3.1 Technological process. Processing of Liupao Tea includes first manufacturing and refining.

3.3.1.1 Process of first manufacturing. Fresh leaves → de-enzyming → first twisting → heaping → second twisting → dehydration → semi-finished tea

3.3.1.2 Process of refining. Semi-finished tea → screening → blending → moisten heaping → steaming → brick tea processing → staling → finished tea

3.3.2 Technical requirements. Technical requirements for first manufacturing: select proper bud leaves as raw material, evenly de-enzyming to the state that leaves become soft, the color turns to dark green, and the smell of green grass basically loses. Twist when the leaves are still warm. Then, put them into machine and place them onto ground where clean liner is provided, to conduct heaping. When the heaping temperature reaches 55 °C, promptly stir the heap to dispel the heat. When the heaping temperature drops to 30 °C, conduct heaping again till it becomes proper. Twist the leaf rolling again till the moisture content less than 10%.

Technical requirements for refining: after screening, fanning, and stalk separating of semi-finished tea, carry out blending and heaping as per quality and class (heaping height: 60 to 80 cm); according to tea class and climate conditions, adopt first steaming heaping or cold water heaping to ferment (the heaping temperature shall be controlled within 45 to 55 °C. If

the heaping temperature is too high, promptly stir the heap to dispel heat. When the leaf color becomes reddish brown, and it gives out sweet-smelling, the heaping is proper). When the leaves are still warm, compress them to basket, brick, cake, or bowl shapes and place them to clean, cool, ventilated and foreign flavor free environment. After the leaf temperature drops to room temperature and moisture content falls to below 18%, firstly move them to caves for staling where the relative humidity is 80% to 90%, temperature within 23 to 28 °C, and free of foreign flavor. Later, move them to clean, cool, dry and foreign flavor free, and ventilated warehouse for staling. The staling time should not be less than 180 days.

3.3.3 Action of production and processing on formation of quality of Liupao Tea. Special quality of Liupao Tea is inseparable from its special production and processing procedure. Among the processes, moisten heaping is deemed as the key process for formation of special quality of Liupao Tea. Enzyme and microbial species groups in fermentation of moisten heaping have highly correlation. The essence of moisten heaping is a series of chemical change of chemical compositions (mainly tea polyphenol) occurred in the action of damp and hot and microbial enzyme. Action of microbial enzyme determines quality of Liupao Tea, so microbial species groups play a decisive role in quality of Liupao Tea. Main factors influencing microbial species groups include large environment (water, soil and climate) and small environment (temperature, humidity, trace element, and flora type).

Research made by Yang Jinquan shows that the microorganism which plays a major role in fermentation of moisten heaping of Liupao Tea is *Aspergillus* (*Aspergillus kawachii*, *Aspergillus awanori*, *Aspergillus flavus*, and *Aspergillus glaucus*), *Penicillium* (*Penicillium clirysogenus* and *Fungi Imperfecti*), *Rhizopus* (*Rhizopus nigricans*, *Rhizopus oryzae*, *Phycomycetes*), *Mucor*, etc.^[7]. Study conducted by Yang Fulin *et al.* indicated that the substance that plays a major role in special flavor of Liupao Tea is mycete; *Aspergillus* and *Penicillium* promote color change during making of dark tea; in the post fermentation period, a little golden yellow *Eurotiaceae* appears and generates amylase and oxidase^[8]. Research carried out by Yin Xumin *et al.* shows that after staling of Liupao Tea, we can see a lot of "golden flowers" which belong to *Aspergillus flavus* and can secrete amylase and oxidase, and can catalyze starch in tea to turn into monose and polyphenols compound to oxidize, consequently making the tea becoming reddish brown, eliminating smell of green grass, and improving fragrance and taste of tea. If the types, quantities and proportion of microorganism are different, the content and proportion of metabolite tea polyphenol, catechuic acid, theaflavin (TF), thearubigins (TR), amino acid, soluble sugar and other compositions generated during fermentation are different, and the flavor is also different. Since microorganism is diverse in different regions and the advantageous microbial species groups are different, the tea will have different flavor even produced as per the same process and material but in different regions^[9]. Research conducted by Yang Fulin *et al.* indicates that like other types of dark tea, Liupao Tea flavor is a multi-flavor complex mainly consisting of flavonoids and oxydate, tea polyphenol and oxydate. It also has the flavor of astringent catechuic acid, bitter trimethylxanthine, and fresh and sweet amino acid. "Red,

strong, stale, smooth and pure" features of Liupao Tea are inseparable from advantages flora during fermentation. In the action of extracellular enzyme secreted by microorganism, a series of reactions happen, including oxidation and condensation of tea polyphenol, decomposition and degradation of protein, decomposition of carbohydrate, as well as polyreaction of products. Then large molecular carbohydrate is decomposed into small molecular sugar and soluble sugar. The soluble sugar is an important matter for flavor and viscosity of dark tea, and it shows "sweet" feature in sense. The protein takes up 15% to 30% of the dry substance mass of the tea. Through processing, the protein is decomposed into many kinds of amino acid and provides dark tea with "mellow" and fresh taste. Tea polyphenol is the most characteristic substance in tea, and decomposed into TF, TR and even theabrownine (TB) in the action of polyphenol oxidase secreted by microorganism, and provides the tea with red or brown color^[8].

Wu Ping comprehensively summed up functions and mechanism of microbial species groups in quality of Liupao Tea, and survival rules and influence factors of microbial species groups. He believed that the purpose of moisten heaping is to promote tea material to form special qualities of Liupao Tea through a certain degree of fermentation^[10-11].

4 Thinking on industrial supervision of Liupao Tea

4.1 Problems influencing quality and industrial development of Liupao Tea The highly regional Liupao Tea happens to coincide with demands of modern peoples' fashionable product and healthy concept. Liupao Tea industry receives a rapid development. At present, it has developed into a pillar industry with output value of near one billion yuan. Along with market cognition of function and effect of Liupao Tea, this industry will be further expanded. The key to maintaining this industry is to maintain its quality and protection GI property. Liupao Tea becoming GI protection product gives the credit to its special quality, which is closely related with unique climate, ecological and geographic environment, microbial species groups, humanistic, historical and cultural factors in Wuzhou, as well as special production and process. The unique geographical environment, climate and soil features in Wuzhou provide basic conditions for microbial diversity and formation and cultivation of advantageous flora in Liupao Tea producing regions. Besides, the traditional "cave staling" provides biological foundation for maintenance and purification of advantageous microbial flora in the production of Liupao Tea. What's more, since Jiaqing period of Qing Dynasty, thanks to local climate, custom and tea drinking habit, the production of Liupao Tea has never been interrupted in Wuzhou, and the environment for microorganism is relatively stable. Comprehensive action of these factors is the major reason for formation of quality of Liupao Tea.

However, as GI product features quasi public goods, the nonexcludability will certainly cause many GI users only care for benefits of regional industrial brand, but unwilling to pay for maintenance and cultivation of regional industrial brand alone. Possibly, actions like "hitchhike" may appear and lead to quality decline of GI protection product, consequently influencing the development of entire industry. After Liupao Tea becomes a GI

protection product, its property protection will have legal safeguard and its industrialization will have a regional brand platform. Along with people's recognition of Liupao Tea and its functions and effects, Liupao Tea industry will have a greater expansion.

In the course of industrial development of Liupao Tea, following quality-related problems exist: low processing threshold, scattered and small scale of processing enterprises; low product quality and production indexes, not favorable to survival of the fittest enterprises; most processing enterprises do not have their own tea garden base, not favorable to improving quality of Liupao Tea and controlling abuse of pesticide; and low ability of research and development and technology popularization, as well as lack of public research and development and popularization platform.

4.2 Suggestions for quality and industrial supervision of Liupao Tea To fully utilize effect and resource of GI product Liupao Tea, and promote development of Liupao Tea industry without losing its special features, it is proposed to take proper measures and establish appropriate system to supervise the industry according to influence of Liupao Tea and the connection between Liupao Tea and the production regions. First, we recommend applying for formulation of national standard *GI Product - Liupao Tea* to State Administration of China for Standardization, to raise indexes of product standard. Second, it is proposed to popularize the industrial mode of "market + association (enterprise) + base", and establish demonstration areas for protection of GI product Liupao Tea, to raise utilization efficiency of technology and cut down use of pesticide. Third, government may take the lead in establishing special product inspection and research and development institutions, and increasing frequency of periodical random inspection and market supervision. Fourth, we should raise the production and processing threshold, standardize production and stabilize quality of Liupao Tea enterprises, cultivate and support leading enter-

prises, and speed up financial, technical, talent, and brand gathering of Liupao Tea. Fifth, we suggest setting up independent supervision institution, reinforce and perfect supervision functions of Liupao Tea industry.

References

- [1] SU YJ, KONG XJ. The theoretical foundation and strategic studies of the government marketing of geographical indication product[J]. *Guangxi Social Sciences*, 2010(10): 59–63. (in Chinese).
- [2] KONG YH. Analysis and research on protection of core technology of geography signs products[J]. *China Brand & Anti-counterfeiting*, 2011(6): 62–65. (in Chinese).
- [3] Bureau of Quality and Technical Supervision of Guangxi. Liupao tea DB45/T 581—2009 [S/OL]. <http://www.bzxk.com/Soft/DF-BZDB/157113.html>. (in Chinese).
- [4] WANG ZH, WANG GZ. Chinese famous tea of Guangxi Province [M]. Beijing: China Agriculture Press, 2000: 657–659. (in Chinese).
- [5] CENG M. Firmly friendship between Mao Zedong and Li Jishen through thirty-five years[J]. *Culture and History*, 2009, 10: 25–41. (in Chinese).
- [6] HU XY, CHENG DJ, LI C, *et al.* Common brand valuation assessment report at Chinese tea area in 2011[J]. *China Advertising*, 2011(5): 4–10. (in Chinese).
- [7] YANG JQ. Pile-fermentation of microorganism and Liupao tea[J]. *Yunnan Tea*, 1987, 4: 32–34. (in Chinese).
- [8] YANG FL, DENG FM, ZHAO LY, *et al.* Development of black tea microbiology[J]. *Journal of Microbiology*, 2006, 26(1): 81–84. (in Chinese).
- [9] YIN XM, WANG XP, JIANG B, *et al.* Research progress of microorganism in tea processing[J]. *Journal of Leshan Teachers College*, 2005, 20(12): 78–80. (in Chinese).
- [10] WU P. Effect of microbial population in the quality formation of Liupao tea and discussion on the purity of Liupao tea with Wuzhou I [J]. *Guangdong Tea*, 2007, 102(2): 12–14. (in Chinese).
- [11] WU P. Effect of microbial population in the quality formation of Liupao tea and discussion on the purity of Liupao tea with Wuzhou II [J]. *Guangdong Tea*, 2007, 103(3): 15–18. (in Chinese).

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3 Conclusion

This paper uses grey prediction model to conduct prediction analysis on the total volume of goods and materials that need cold chain transport during the Twelfth Five-Year Plan period. The results show that during the whole period of the Twelfth Five-Year Plan, the total volume of goods and materials of urban residents in Jiangsu Province that need cold chain transport will increase at an annual growth rate of 2.9%, which will bring good opportunities for enterprises engaging in cold chain logistics.

Based on the current situation, most producers have insufficient refrigerated trucks, not enough to confront the increase in cold chain logistics demand. Consequently, the relevant cold chain logistics service providers need to consider whether to purchase refrigerated trucks or cooperate with the third-party logistics companies for distribution. Based on the analysis in this paper, in the future, we can conduct research on cold chain logistics from the following aspects: first, what kind of distribution model should the cold chain logistics adopt; second, how to design the information management system of cold chain logistics to ensure the safe transport of goods.

References

- [1] MARIJA BOGATAJ, LUDVIK BOGATAJ, ROBERT VODOPIVEC. Stability of perishable goods in cold logistic chains[J]. *Int J Production Economics*, 2005(93/94): 345–356.
- [2] LAN HJ, RU YH. Demand forecast for Olympic food cold chain logistics[J]. *China Business and Market*, 2008(2): 19–22. (in Chinese).
- [3] LI JB, SUN LN. Demand forecast of the cold chain logistics based on the multiple linear regression analysis[J]. *Journal of Anhui Agricultural Sciences*, 2011, 39(11): 6519–6520, 6523. (in Chinese).
- [4] LIU BC, LIU YJ, JI XD. Logistics demand forecast of China based grey system theory[J]. *Journal of Zhejiang International Maritime College*, 2010(3): 22–26. (in Chinese).
- [5] XIA GE. Prediction of present situation development research on regional logistics demand[J]. *China Logistics & Purchasing*, 2010(4): 68–69. (in Chinese).
- [6] Union of purchase logistics. Report on China cold chain logistics development[M]. Beijing: China Material Press, 2010: 102–226. (in Chinese).
- [7] CHEN Z, WEN J, XIE Z. An application of grey forecasting model to foreign exchange rate analysis[J]. *Fuzzy Systems and Mathematics*, 2001, 15(3): 98–101. (in Chinese).
- [8] DENG JL. Textbook of grey system theory[M]. Wuhan: Huazhong University of Science and Technology Press, 1990. (in Chinese).