New Progress in the Research on Sericulture Resource Utility

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The comprehensive utilization of sericulture resources

mulberry resources

- Mulberry leaves
- Mulberry branches
- Mulberry fruit
- White mulberry root-bark

silkworm resources

- Young silkworms
- Silkworm pupa
- Silkworm moth
- Silkworm excrement
- Natural silk

Sericulture

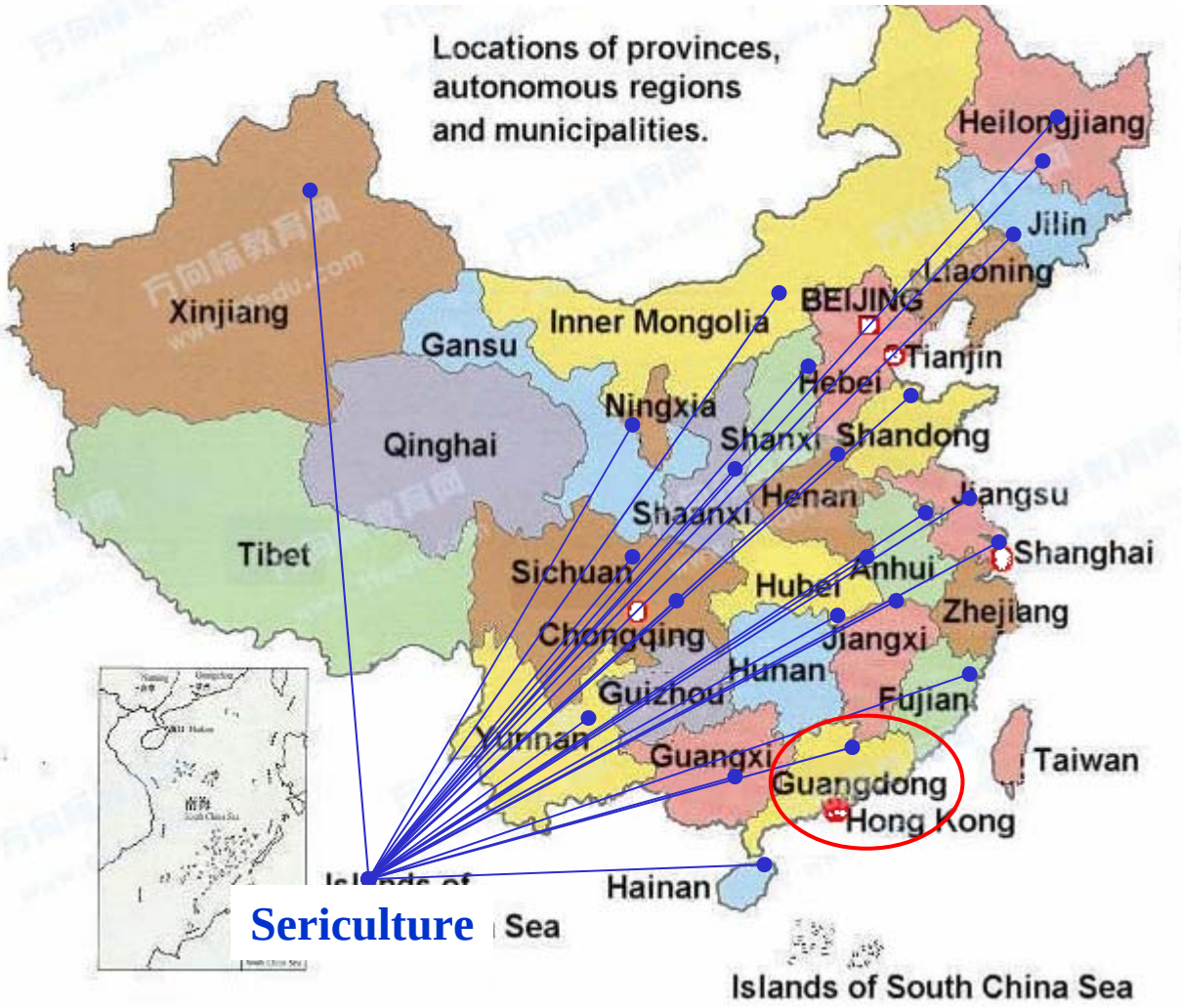
□ □

(CanSang)

Mulberry & Silkworm

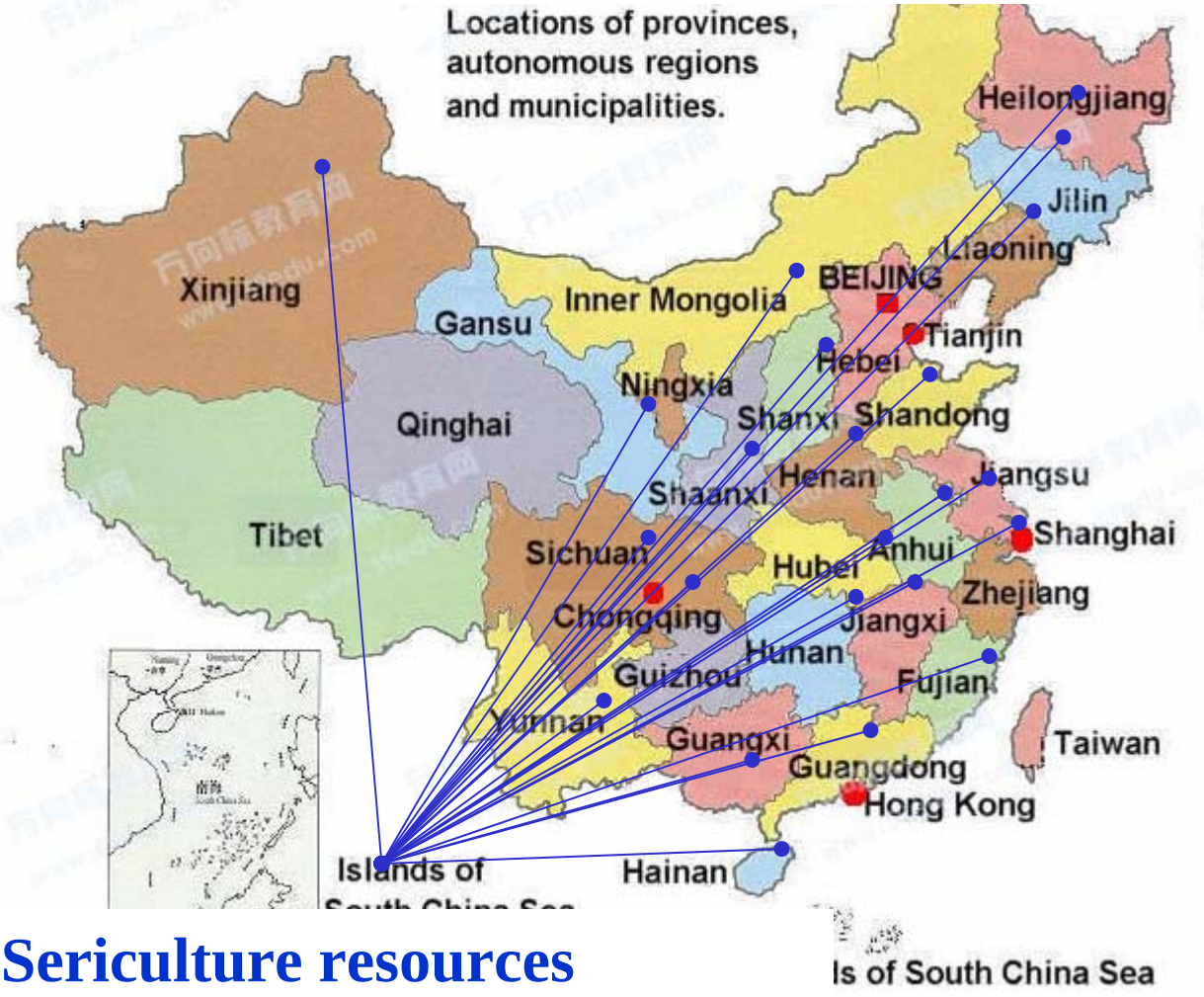
Sericulture is treasure

Sericulture distribution



Sericulture resources distributed over 1300 counties and 28 provinces

Plenty of resources of Sericulture



6000kiloton Fresh cocoon annually in China

- 120KT raw silk
- 480KT pupae
- 1800KT branch
- 600KT fruits
- 900KTexcrement
- 810Ktredundant

Sericulture resources distributed over 1300 counties and 28 provinces

What and How do China do it?

Contents

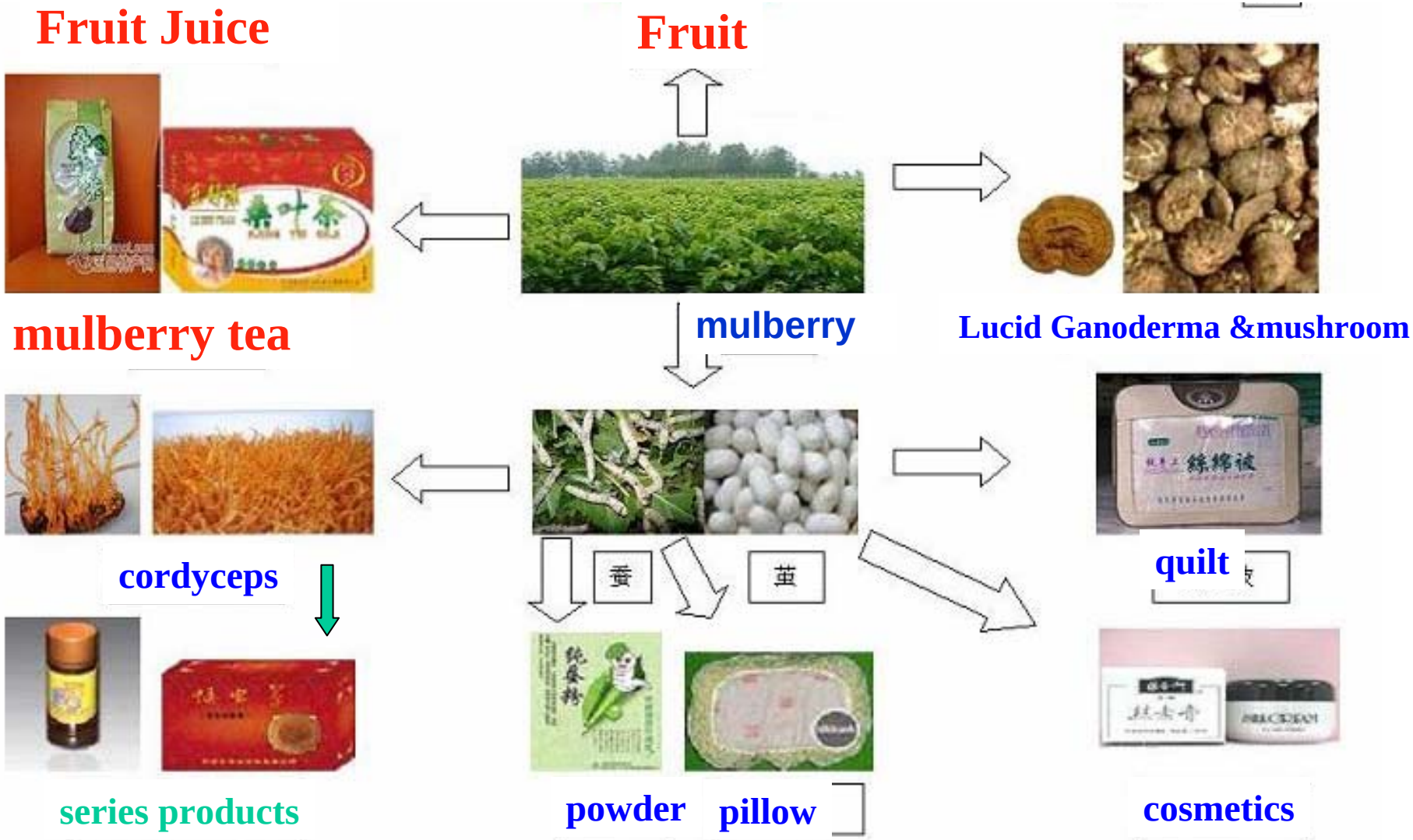



1. The present status of sericulture development in China

- **Sericulture production scale has resumed growth,efficiency gradually picked up.**
- **The sericulture production regions are gathering to the western China.**
- **The enterprise structure have been continuously adjusted and optimized.**
- **Sericulture industry has begun to diversify.**

2. The development and utilization of sericulture resources in China

2.1 Comprehensive utilization of sericulture resources technology has achieved preliminary results



2.2 Comprehensive utilization of mulberry resources

- **The mulberry tree resources utilization include the deep processing and exploitation of mulberry leaves, mulberry Branch, mulberry fruit, *Morus alba* and so on.**

1. **801 Kha(hm^2)**
2. **>3000 special germ plasm resource**
3. **15 species and 4 varieties**
4. **1300 counties**

1) Utilization of Mulberry leaves

The chemical constituents of Mulberry leaves

1) General Nutrition

- **Sugar, Amino acids, microscale elements**

2) Characteristics of chemical constituents

- **Alkaloids**
- **Flavonoids and flavonoid glycosides,** l-deoxynojirimycin(DNJ)□N-methyl-l-deoxynojirmycin□fagomine□4-O-β-D-glucopyranosylfagomine□
- **Steroidal components**
- **Essential oil**

Studies on the extraction, purification and immunoregulation of Mulberry Leaves

Flavonoids **Extract Process optimization, Ultrasound&microwave, Leaf mass percentage concentration , times of Extraction**

The immunoregulation evaluation of mulberry leave flavonoids

Table 1 The effect of flavonoids from mulberry leaves in affecting the immune organ of mice (mg/g, $\bar{X}$ ±s)

Groups	n	Spleen index	Thymus index
Control	10	3.80±0.03	1.73±0.31
Low-dose	10	4.41±0.04	2.04±0.58
Medium dose	9	4.59±0.07	2.13±0.61
High dose	9	4.50±0.05	2.29±0.71

Note: Control, normal saline. low, medium and high dose groups are 200, 300, 400 mg / (kg.bw.d) ,respectively .

Table 2 The effects of flavonoids from mulberry leaves in affecting the monocyte-macrophage phagocytic activity in mice ($\bar{\chi}$ ±s)

Groups	n	Correction expurgation index
Control	10	4.13±0.43
Low-dose	10	**5.41±0.32****
Medium dose	10	**5.50±0.24****
High dose	10	4.97±0.21*

Note: Control, normal saline. low, medium and high dose groups are 200, 300, 400 mg / (kg.bw.d) ,respectively ,*level of significance

Table 3 The effects of flavonoids of mulberry leaves in forming antibody in mice (±s) $\bar{X}$

Groups	n	Antibody formation calculation □AFC□
Control	10	1.18±0.04
Low-dose	8	1.37±0.03*
Medium dose	10	1.39±0.02*
High dose	10	1.44±0.05*

Note: Control, normal saline. low, medium and high dose groups are 200, 300, 400 mg / (kg.bw.d) ,respectively

Table 4 The effect of flavonoids from mulberry leaves to the humoral immune in mice (Hemolysin, $\bar{\chi}$ ±s)

Groups	n	Hemolysin
Control	10	116.10±12.69
Low-dose	10	132.22±11.27*
Medium dose	10	134.97±13.08*
High dose	10	136.23±10.01*

Note: Control, normal saline. low, medium and high dose groups are 200, 300, 400 mg / (kg.bw.d) ,respectively

Table 5 The effect of flavonoids from mulberry leaves in affecting the proliferation of spleen lymphocytes in mice (Survival Rate, $\bar{\chi}$ ±s)

Groups	n	Cell Survival Rate□%□
Control	10	18.79±1.76
Low-dose	10	23.68±1.51*
Medium dose	10	**26.09±0.99****
High dose	10	24.42±0.71*

Note: Control, normal saline. low, medium and high dose groups are 200, 300, 400 mg / (kg.bw.d) ,respectively ,*level of significance

Table 6 The effect of flavonoids from mulberry leaves in affecting the Spleen lymphocyte differentiation conversion rate in mice (Stimulation index, $\bar{x}$ ±s)

Groups	n	Stimulation index(SI)
Control	10	1.88±0.02
Low-dose	10	2.45±0.07*
Medium dose	10	2.51±0.03*
High dose	10	**2.71±0.04****

Note: Control, normal saline. low, medium and high dose groups are 200, 300, 400 mg / (kg.bw.d) ,respectively *level of significance

Table 7 The effect of flavonoids of mulberry leaves in affecting the Erythrocyte C3b receptor in mice (%, $\bar{x}$ ±s)

Groups	n	C3b(%)
Control	10	14.71±1.21
Low-dose	10	16.01±1.19*
Medium dose	10	17.05±0.99*
High dose	10	17.98±1.04*

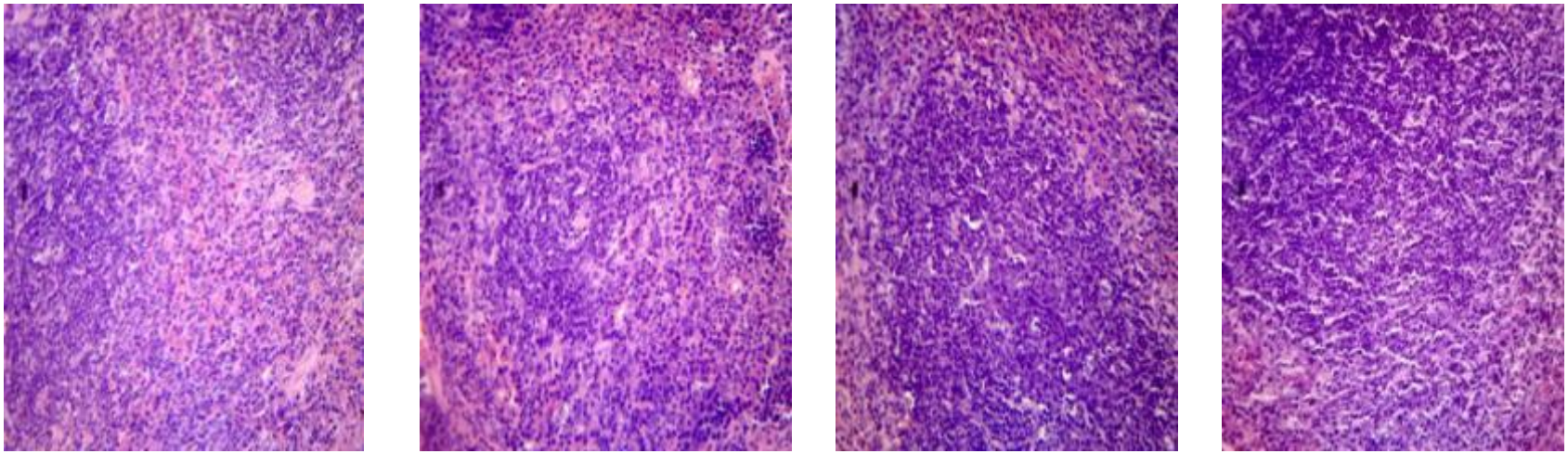
Note: Control, normal saline. low, medium and high dose groups are 200, 300, 400 mg / (kg.bw.d) ,respectively, *level of significance

Table 8 The effect of flavonoids of mulberry leaves in affecting the erythrocyte immune complex in mice (%, $\bar{X}$ ±s)

Groups	n	RBC-IC□%□
Control	10	14.29±1.52
Low-dose	10	12.73±1.01*
Medium dose	10	12.16±0.94*
High dose	10	11.03±1.17*

Note: Control, normal saline. low, medium and high dose groups are 200, 300, 400 mg / (kg.bw.d) ,respectively ,*level of significance

Comparison on the Tissue sections of spleen in mice

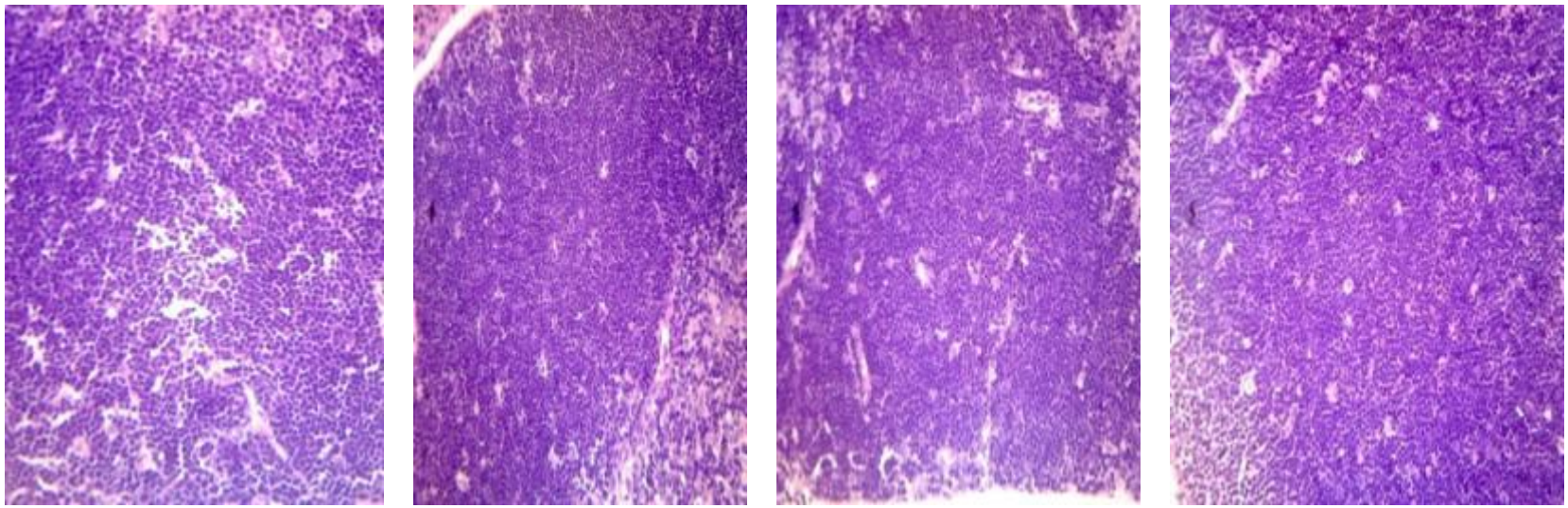


Control Low-dose Medium dose High dose

Tissue sections of spleen in mice HE staining 10 × 20

•Each group can promote the proliferation and differentiation of spleen lymphocytes. Compared with the control group, the splenic corpuscle was increased and the number of lymphatic also increase, and the middle dose group results are the best.

Comparison on the Tissue sections of thymus in mice



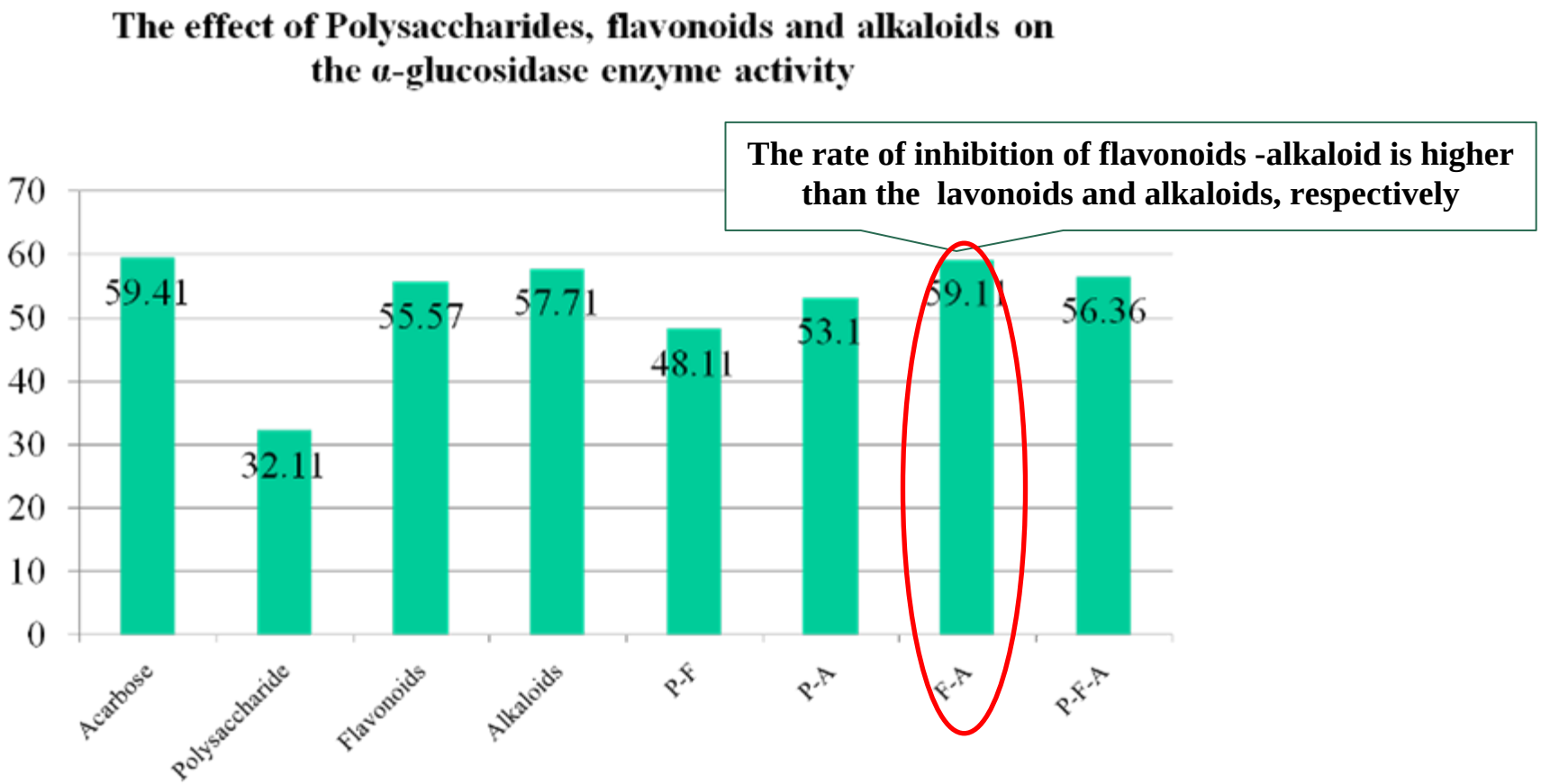
Control Low-dose Medium dose High dose

Tissue sections of thymus in mice HE staining 10 × 20

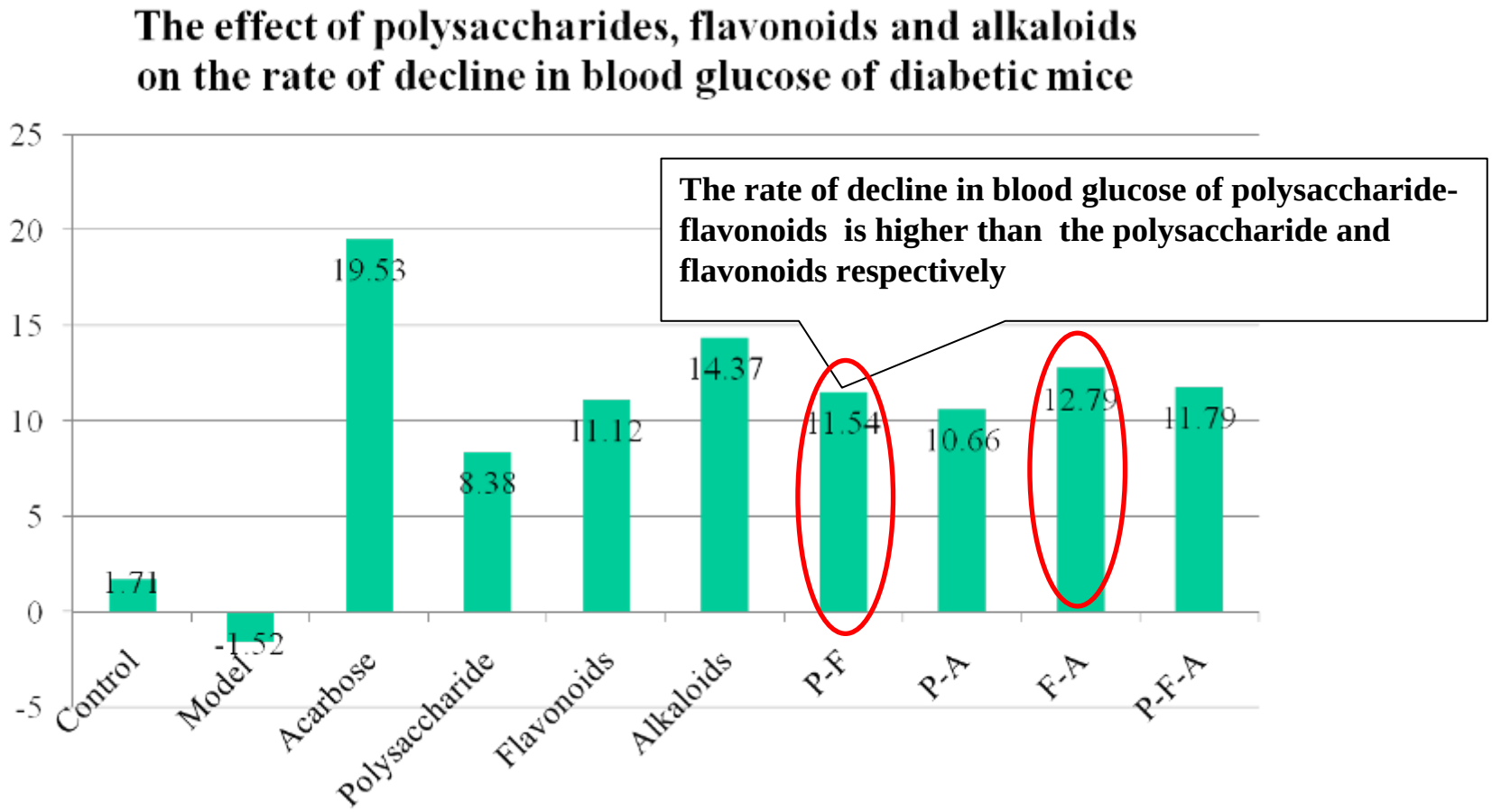
Flavonoids in mulberry leaves can stimulate the proliferation and differentiation of murine thymocytes.

Mulberry leaf alkaloid extraction and functions

Hypoglycemic Active Substances from Mulberry Leaves and Their Synergistic Effect on Hypoglycemic Activity



Note: P-F, Polysaccharide-flavonoids(1:1); P-A, Polysaccharide-alkaloids(1:1); F-A, Flavonoids-alkaloids(1:1); P-F-A, Polysaccharide - flavonoids - alkaloids (1:1:1)



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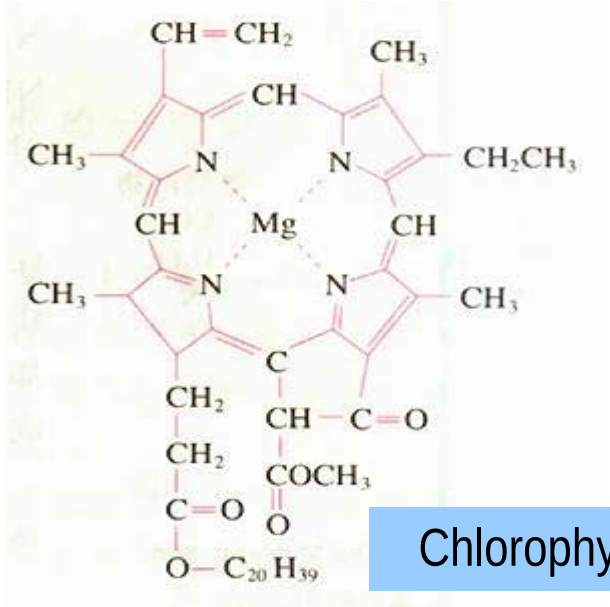
- **Polysaccharide and flavonoids from mulberry leaves have synergistic effect in lowering the blood glucose of diabetic mice**

Mulberry leaves flavor drinks

Xia Sang Ju Ji Chinese herb tea

Pigment from mulberry and silkworm feces

Uses: food and Cosmetics coloring, health food and medicine…



Chlorophyll

Food seasoning

steamed bread, noodle, all kinds of health food for keeping fit and ……

2. Utilization of mulberry branches

2. Utilization of mulberry branches

Mulberry Chinese herbal medicine

Mulberry branches ingredients for soups

Mulberry Tea branches

Mulberry Paper **Mulberry cosmetic** **Mulberry GLS** **Mulberrymedicine** **Charcoal**

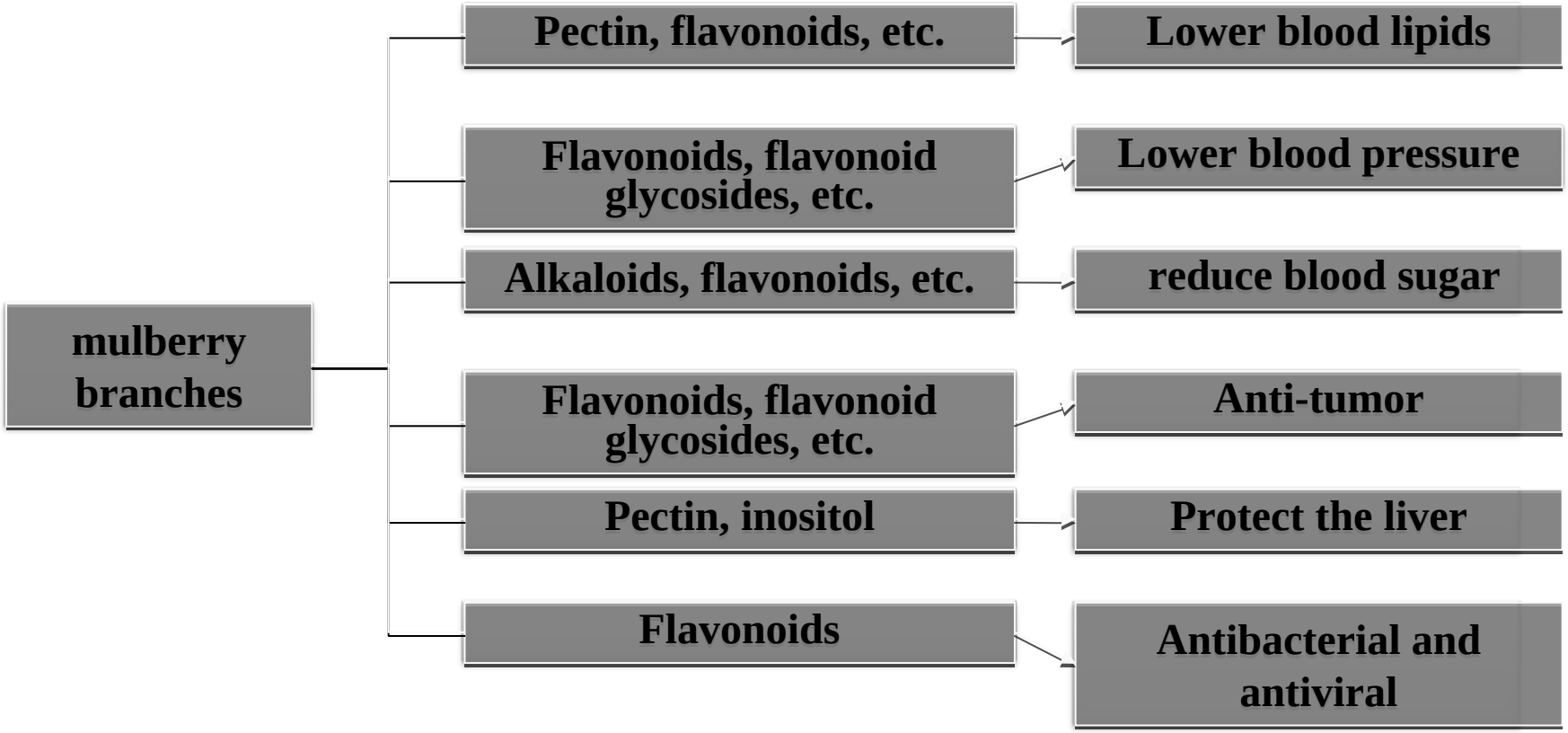
1 The chemical constituents of mulberry branches

Table Comparison of the chemical composition of different parts of mulberry branches

Materials	Water	Ash	Extract %		Lignin	Poly pentose	Pectin	Cellu-lose	Fiber
	%	%	1%NaOH	benzene -alcohol		%	%	%	%
Xylem	15	2.32	30.99	4.54	19.11	21.76	/	78.83	/
Phloem	20	4.41	34.54	/	9.81	11.28	8.72	/	54.31

Fiber is the main components of mulberry , so the utility of fiber is the key to achieve rational use of high-value .

2 The pharmacological effects of mulberry branches



3 Utilization of mulberry branches

- **(1) Cultivate Edible Fungus**

Jade yellow mushroom

Pleurotus geesteranus

mushroom

Auricularia auricula

oyster mushroom

Guangxi, South China

Mulberry branches cultivate Edible Fungus—




Dried mushroom, Ganoderma lucidum, mushroom, edible tree fungus

Utilization of mulberry branches——Mulberry Ganoderma lucidum and products

(2)Production of renewable-based sheet

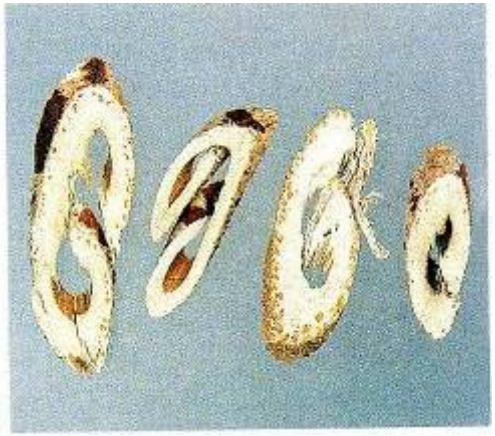
Mulberry Flooring

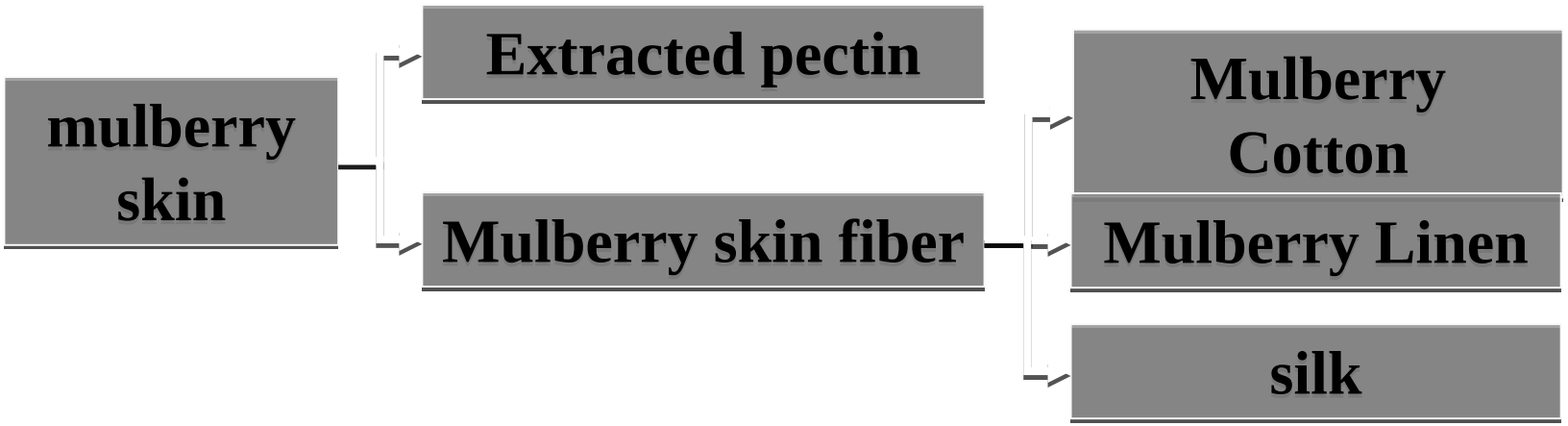

floor board

3 Utilization of the biomass energy of mulberry branches

- Mulberry branches
  - Combustion power generation
  - Charcoal, charcoal powder

4 Utilization of mulberry skin





3.Utilization of Mulberry fruits

Mulberry processing factory

3.Utilization of Mulberry fruits

Mulberry processing products

yoghourt

2.3.2 The comprehensive utilization of silkworm resources

- Young silkworms
- Silkworm pupa
- Silkworm moth
- Silkworm excrement
- Silkworm cocoon and silk

1. Utilization of Young silkworm

Living Insulin analogue

White muscardine
for Herbs

The Utilization of young Yellow Blood Silkworm

- **Nutrition Analysis:** protein, amino acids, fats, vitamins, etc.
- **Pharmacological effects:** lowering blood sugar, lowering blood pressure, protect the liver
- **Product Development:** silkworm powder, silkworm tablets, capsules silkworm

Yellow Blood Silkworm Products for Hypoglycemic and liver protection

Utilization of Silkworm pupa

2.Utilization of Silkworm pupa

Silkworm Pupa *Cordyceps* and products



Pupa flavor food



Silkworm pupa protein health products

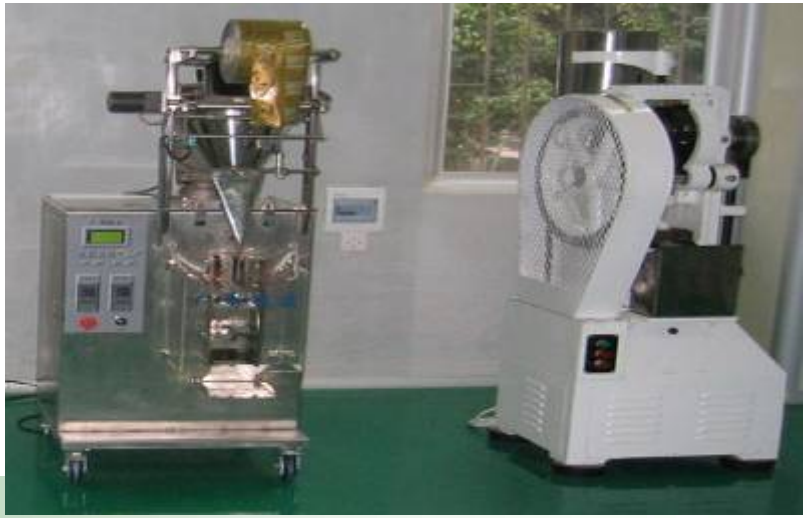



Separate the pupa protein by hand


Pupa oil separation

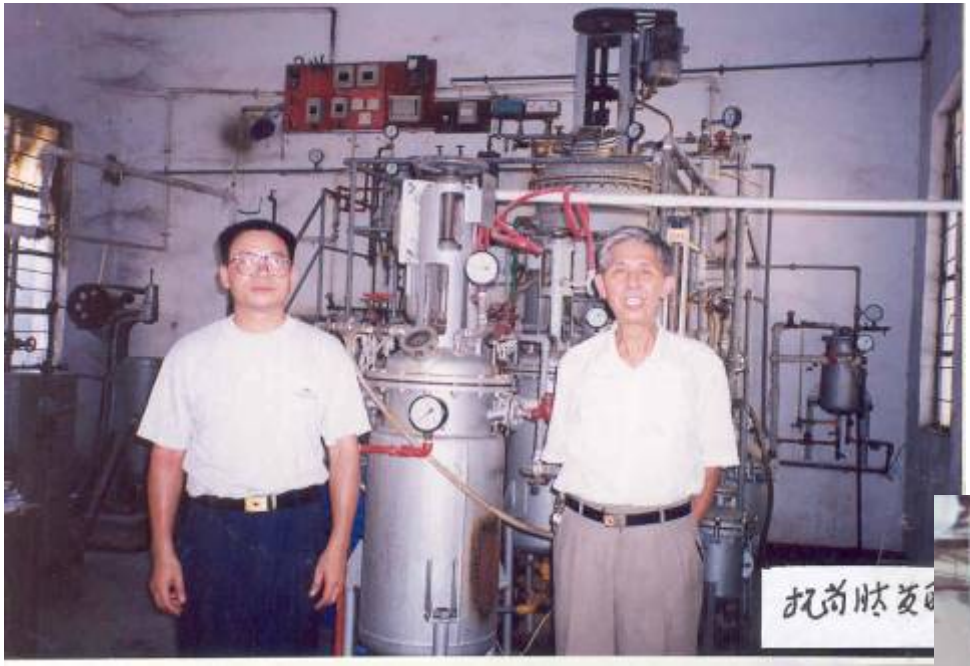
Juice factory——homogeneous, sterilization equipment

Pilot production line



Pupa nourishing kidney capsule

Utilization of Silkworm pupa: R & D and industrialization of Antimicrobial Peptides



Wild Silkworm, tussah

Tussah pupa

Trichogramma minutum **propagated with tussah eggs to control the pest of Lepidoptera,e.g. european corn borer, *Prodenia litura***

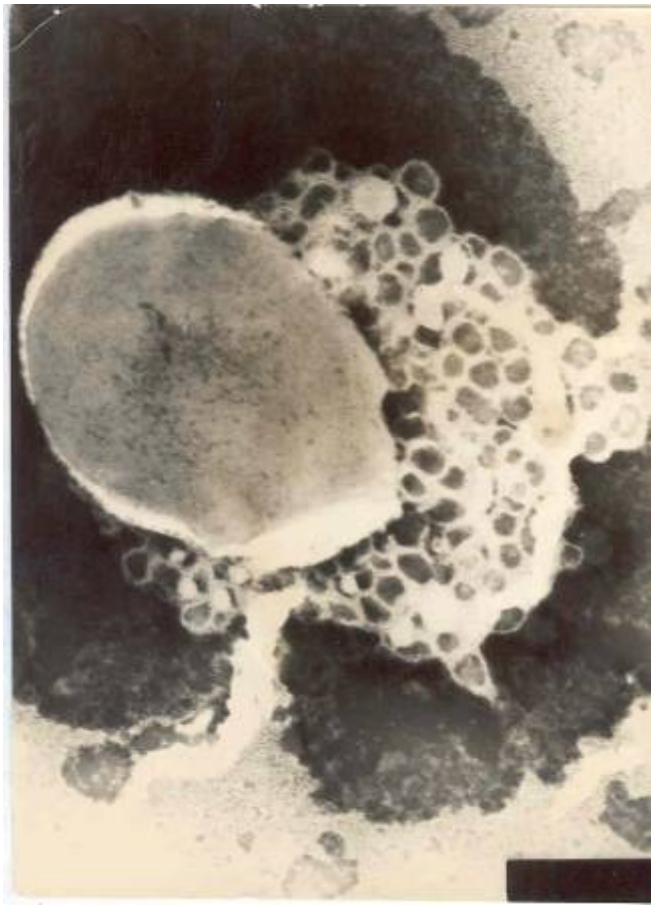
12650 *Chouioia cunea* Yang

Fall webworm,*Hlyphantria cunea* Drury

Antimicrobial Peptides, Cecropin

- **Cecropin may be developed as new anticancer drug. As it has a cytotoxic effect to selectively destroy the cancer cells but has minimum effect to the normal cells.**
- **Cecropin treated adenocarcinoma cells shown inhibition of cell growth and DNA synthesis indicating by lack of thymidine incorporation. Cecropin destroyed the calcium ion channel, resulting in the quick release of the calcium ion from the cancer cell.**

Utilization of Silkworm pupa: antimicrobial peptides



Antitumous effect

Award Certificates

3.Utilization of Silkworm moth

- **Males moths ——**

  sparkling wine, health food production,making medicine, etc.

- **Female moths ——**

  sparkling wine, used as feed, fertilizer, etc.

4. Utilization of silkworm excrement

silkworm excrement Pillow

Silkworm excrement health products

Organic fertilizer

extract chlorophyll from silkworm excrement

Silkworm excrement extract

Chlorophyll
1~1.5%

Pectin
15~20%

silkworm
excrement

β- carotene
0.2%

Sterol
0.2%

5.The utility of Silkworm cocoon and silk

Silk cosmetic

Silk products with historic culture

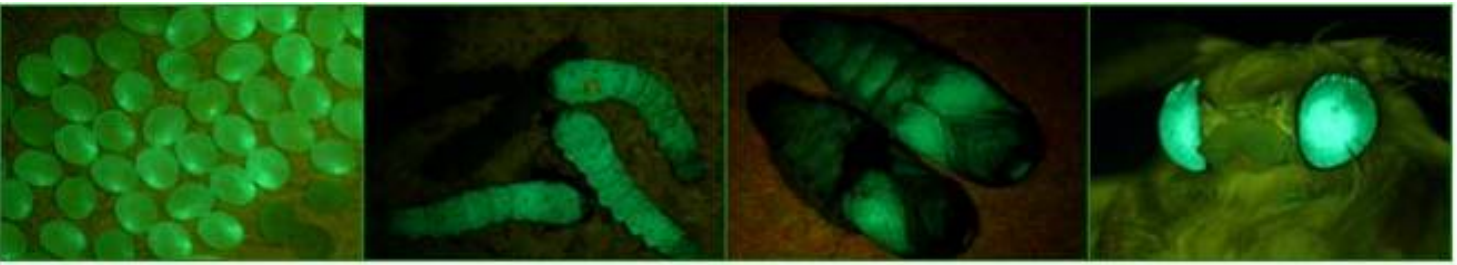
silk brocade book of “Sun Tzu on Art of War”

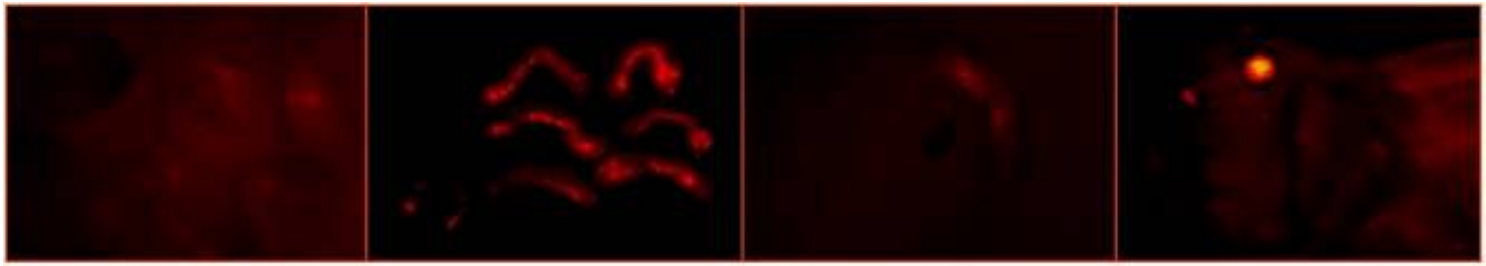
XU YAN FIGURE Hanging Scroll, ink and colour on paper Signed Xu Yan,dated dingsi, 1917, with one artist seal. Price□□460,000

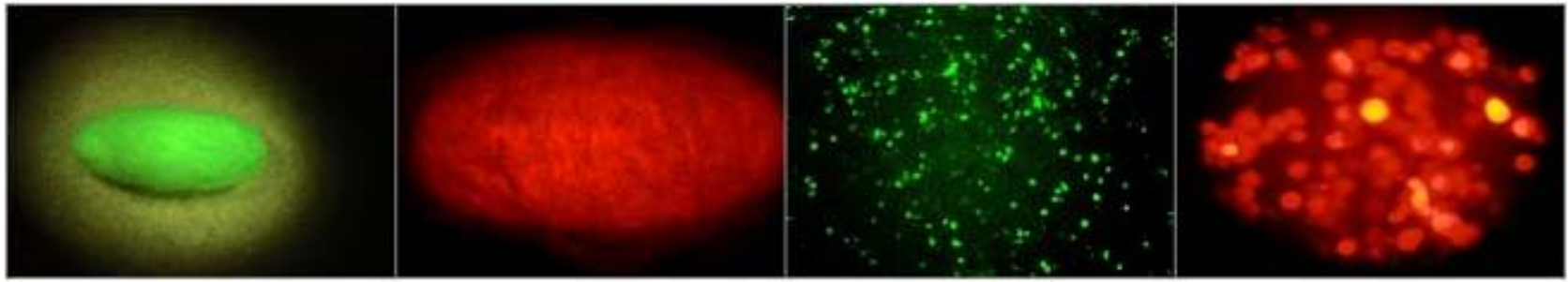
2.3.3 Sericulture biotechnology development

- Lepidopteran model insect
- Models of human disease
- protein production plant
- Insecticide target
- Bioactive molecules protein expression
- Green Chemistry
- Biosensors
- Interaction between plants and insects
- Biological control
- Biodiversity conservation
- Molecular diagnostics
- Disease models

Silkworm bioreactor :Using piggy BAC to transgene in Silkworm







Factory of silkworm bioreactor

The world's first genetic engineering oral protein drugs produced by "silkworm bioreactor"

Silkworm bioreactor…..

Nattokinase produced from silkworm bioreactor

oral insulin products

The world's first genetic engineering products produced by "silkworm bioreactor" in Haining,Zhejiang

Contents

3 Problems of the utilization of sericulture resources

Problems of the utilization of sericulture resources

- **The countryside labor force is lacking**
- **It is hard to promote or carry out the technology level of modern mulberry planting and silkworm feeding**
- **The mechanization level of silkworm feeding and mulberry planting is low**
- **The administrative policies on sericulture is not in place.**

Existing labor force in rural areas? Town?

No Concluding & Remarks

4 Trends of the utilization of sericulture resources

1 Technology development

- 3-D development of sericulture resources;
- Active ingredient extraction technology development;
- Deeply Study on processing of silkworm resources;
- Sorting out varieties Mulberry active constituents and pharmacological mechanism;
- R&D innovation natural health food with Mulberry&silkworm;
- Promoting and breeding diversity of silkworm varieties.

2 Market Development

- **Expand the application areas,and realize the industrialization**
- **Develop brand products**
- **Strengthen public service announcement of silk culture**
- **Implement market strategy of diversified silkworm products**

(3) Changing ideas

- **Silkworm not only for silk, for health**
- **Mulberry not only for silkworm, also for human and most of animals……..**
- **Well equipped machine for the sericulture……..**

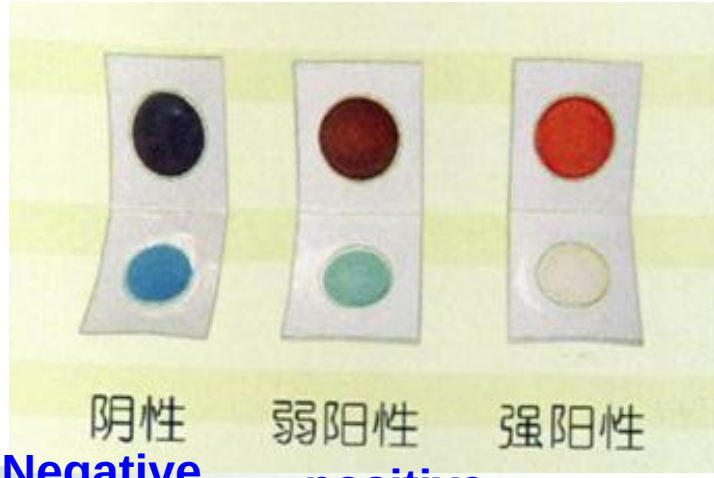
Microscope changing

Digital microscope

Detecting the residual Mulberry pesticides

Detection Card

Results



Negative

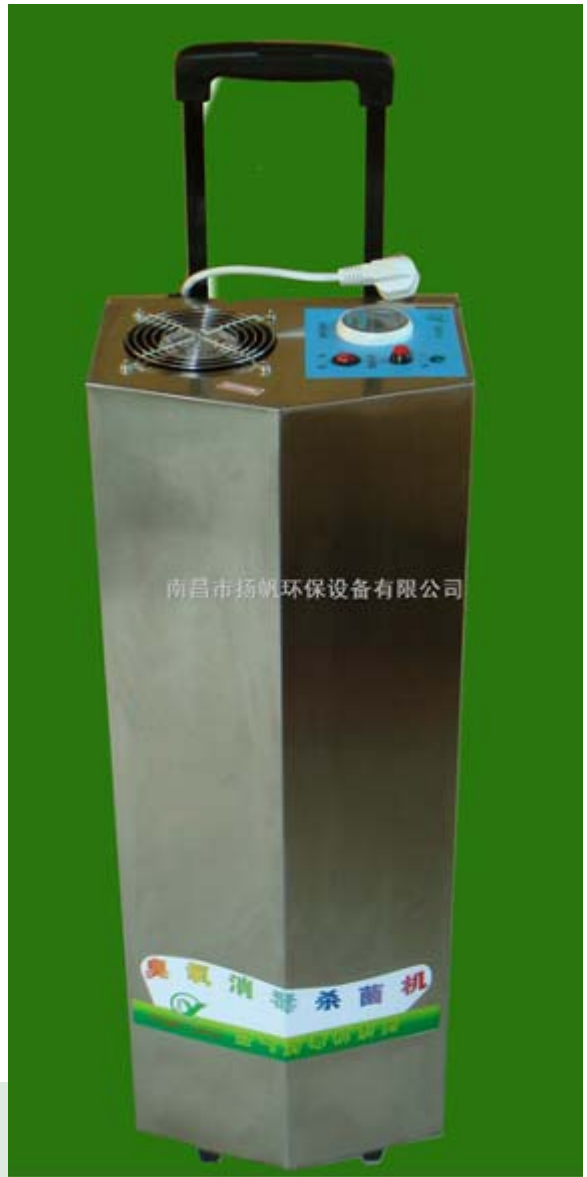
positive

Detection effective chloride card

4 Sterilizing instruments

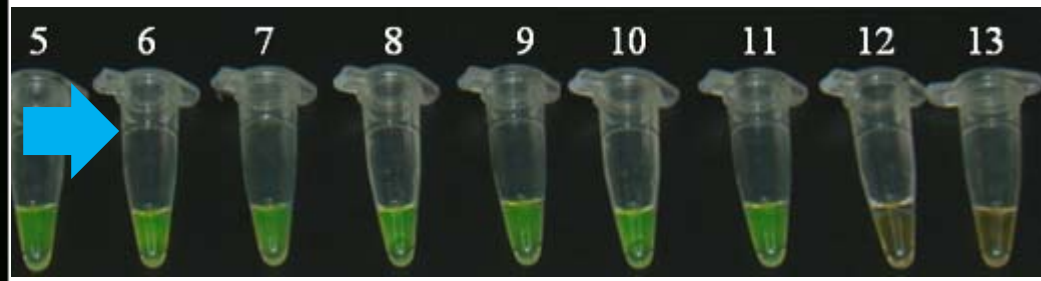
Ozone Generator

ClO2



Loop-mediated Isothermal Amplification (LAMP)

- **Silkworm Pathogens Rapid Diagnostic Kit**



Patent No. 201310026870.1

Diagnostic pebrine Kit

Equipment for glass bottle filling(left)and PET bottle filling(right)

Antibacterial peptide in feeds

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- ……

Thank you for your attention

Grazie mille!