

Edible Insects in China

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- History
- Common species
- Nutrition analysis
- Cooking ways
- Utilization



1. History of edible insects in China

- More than 3000yrs history of edible insects in China
(*Y.Zhou, 1981, S.W.Zhou. 1982, History of entomology of China*)
- In China ancient, edible insect as cate to respect gust.
- Some edible insects are both food and medicine
- Even today, edible insect is popular in restaurant.

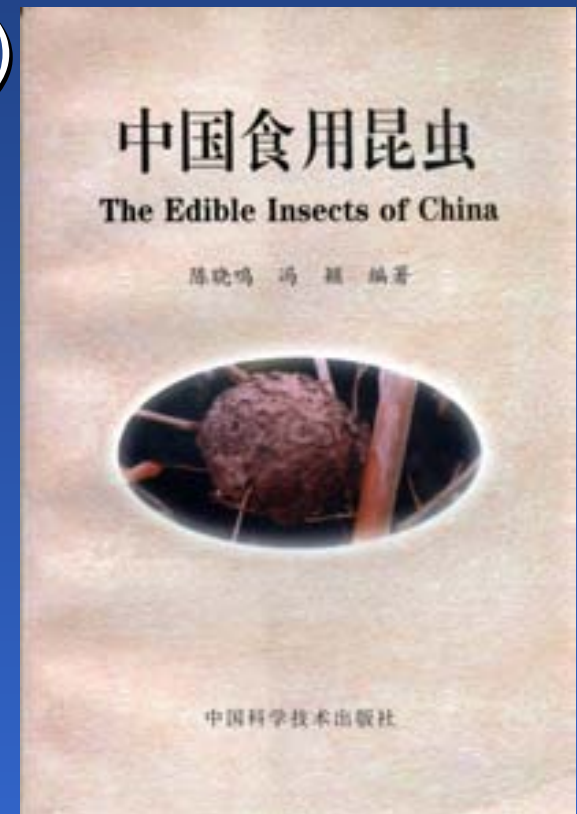


By historian

By entomologist

2. Common species of edible insects in China

there are 177 species that are from 96 genera, 54 families, 11 orders recorded in *The Edible Insects of China* (Chen & Feng, 1999)



(1) Ephemeraida

- There are 3-4 species as food.
- Common species is *Ephemerella jianghongensis*.
- The nutritious elements of *E.jianghongensis* have been analyzed.



nymph



Adult



nymph

(2) Odonata

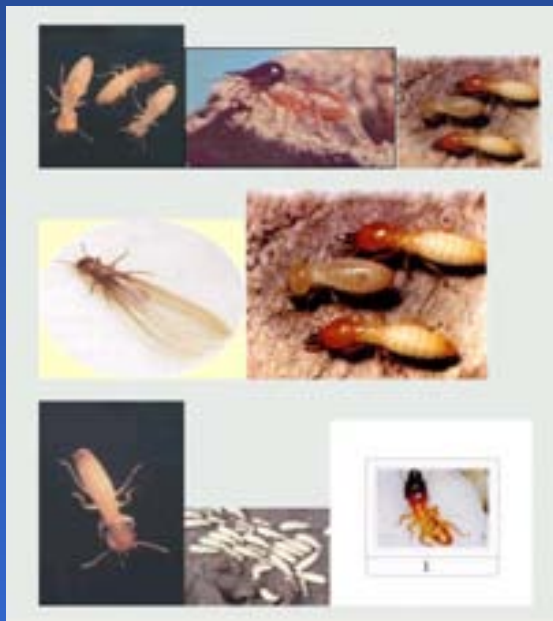
- 6 to 7 species dragonfly larvae are recorded as food.
- The nutritious elements of 3 species have been analyzed.

Dragonfly



(3) Isoptera

- 16 species from 3 genus and 2 families are recorded as food.
- The nutritious elements of 3 species have been analyzed.



termite



Orthoptera

- 9 species from 8 genus and 3 families are recorded as food.
- locust and cricket are common edible insects.
- The nutritious elements of 2 species have been analyzed.

cricket



Gryllotalpa orientalis



Patanga succincta

Locust



Oxya chinensis

Homoptera

- 7 species from 7 Genus and 5 Families are recorded.
- Common edible insect species is *Cryptotympana atrata*,
- The nutritious elements of 4 species have been analyzed.



insect egg
(*Ericerus pela*)



Insect eggs capsule



cicada



Hemiptera

- 7 species from 6 Genus and 3 Families are recorded.
- Common species are stinkbugs:
Tessaratomia papillosa, *Eurostus validus*.
- The nutritious elements of 4 species have been analyzed.



stinkbug



Coleoptera

- 30 species from 25 genus and 11 families are recorded.
- Common species : *Stromatium longicone*, *Sphenoptera kozlovi*, *Tomcus piniperda*, *Oryctes rhinoceros*,
- The nutritious elements of 13 species have been analyzed.



diving beetle



Larvae of chafer

Megaloptera

- There is only *Acanthacorydalis orientalis* being recorded as food.
- The nutritious elements of *A. orientalis* have been analyzed.



Adult



Acanthacorydalis orientalis

nymph

Lepidoptera

- 70 species from 25 genus and 16 families have been recorded. Larvae & pupae as food
- Famous edible insects, such as Chinese caterpillar fungus, insect tea, bamboo insect, silkworm and so on.
- The nutritious elements of 14 species have been analyzed.



Bamboo insect



Chinese caterpillar fungus



Silkworm pupae

Diptera

- There are 2 species from 2 genus and 2 families being recorded.
- The larva of housefly (*Musca domestica*) is common edible insect. *Acanthacorydalis orientalis*.
- The nutritious elements of *M. domestica* have been analyzed.
- Larvae are traditionally used to make cake.

Hymenoptera

- 32 species from 9 genus and 4 families have been recorded,
- Common species are bees, ants and wasps.
- The nutritious elements of 20 species have been analyzed.



Carebara lignata egg

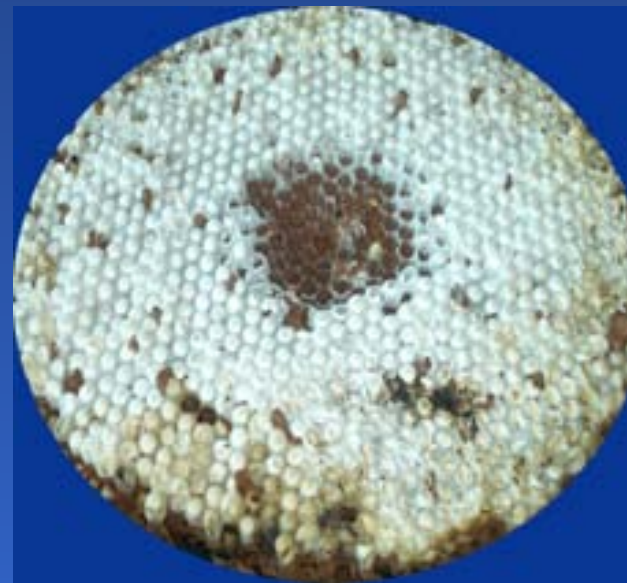


Vespa sp.





honeycomb



honeycomb

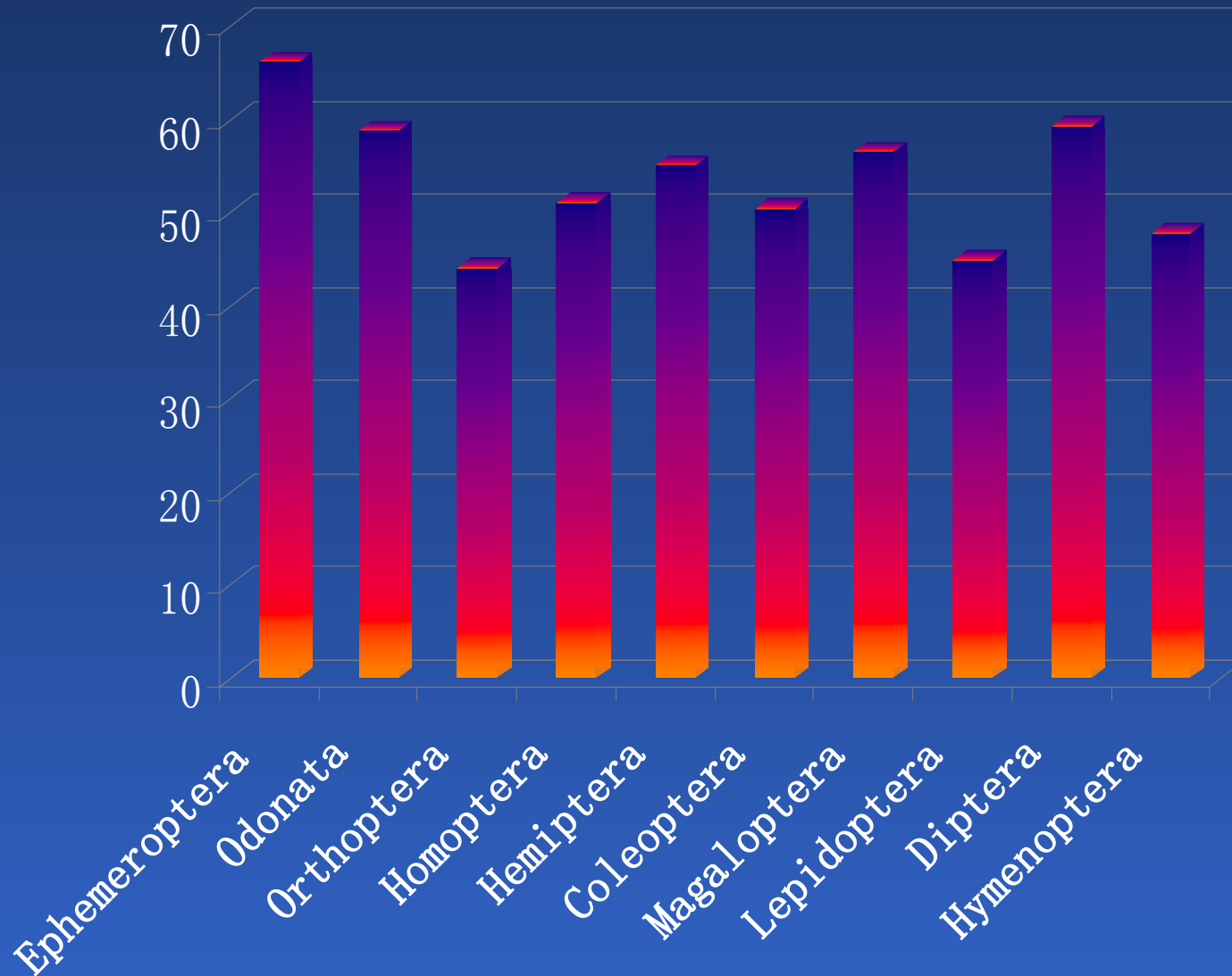


Edible insect in market

3. Nutritive value of edible insects

- ◆ Protein and amino acids
- ◆ Fat and fatty acids
- ◆ Carbohydrate
- ◆ Inorganic salts and trace elements
- ◆ Vitamins

(1) Protein : average content is higher than 40%(20-70%)

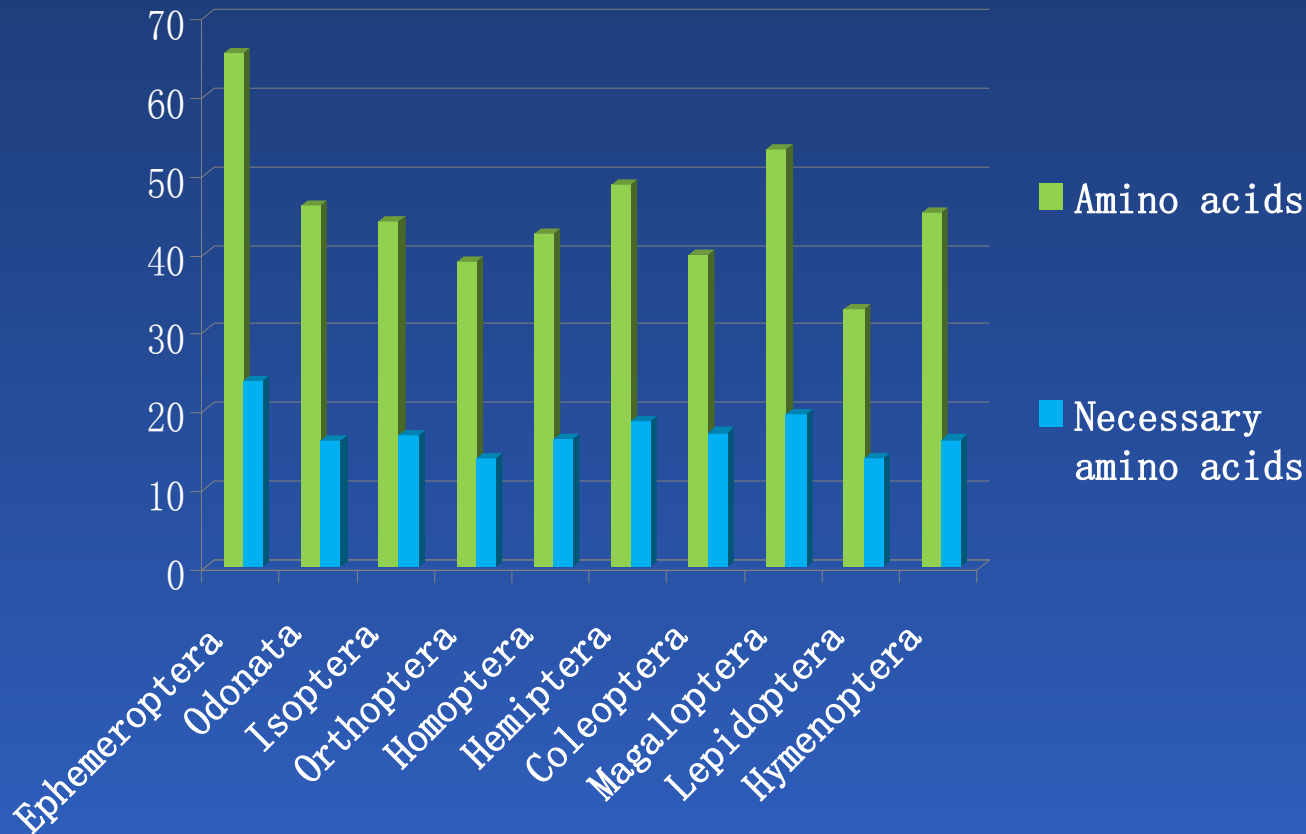


The protein content of edible insects in 10 orders (%)

(2) Amino acids

◆ Amino acids: 30-65%

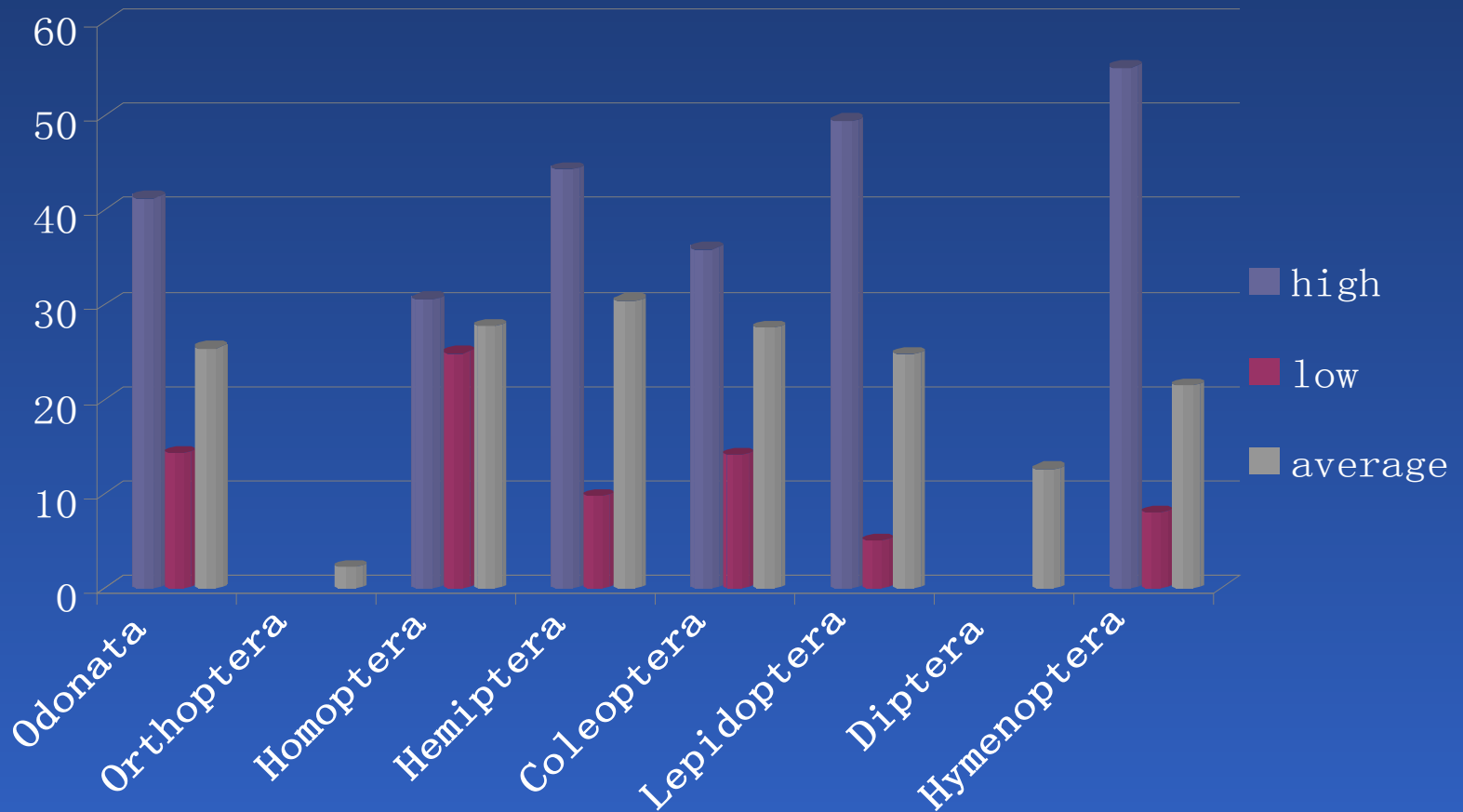
◆ Necessary amino acids: 10-30%



The amino acids amount of edible insects in 10 orders %

(3) Fat

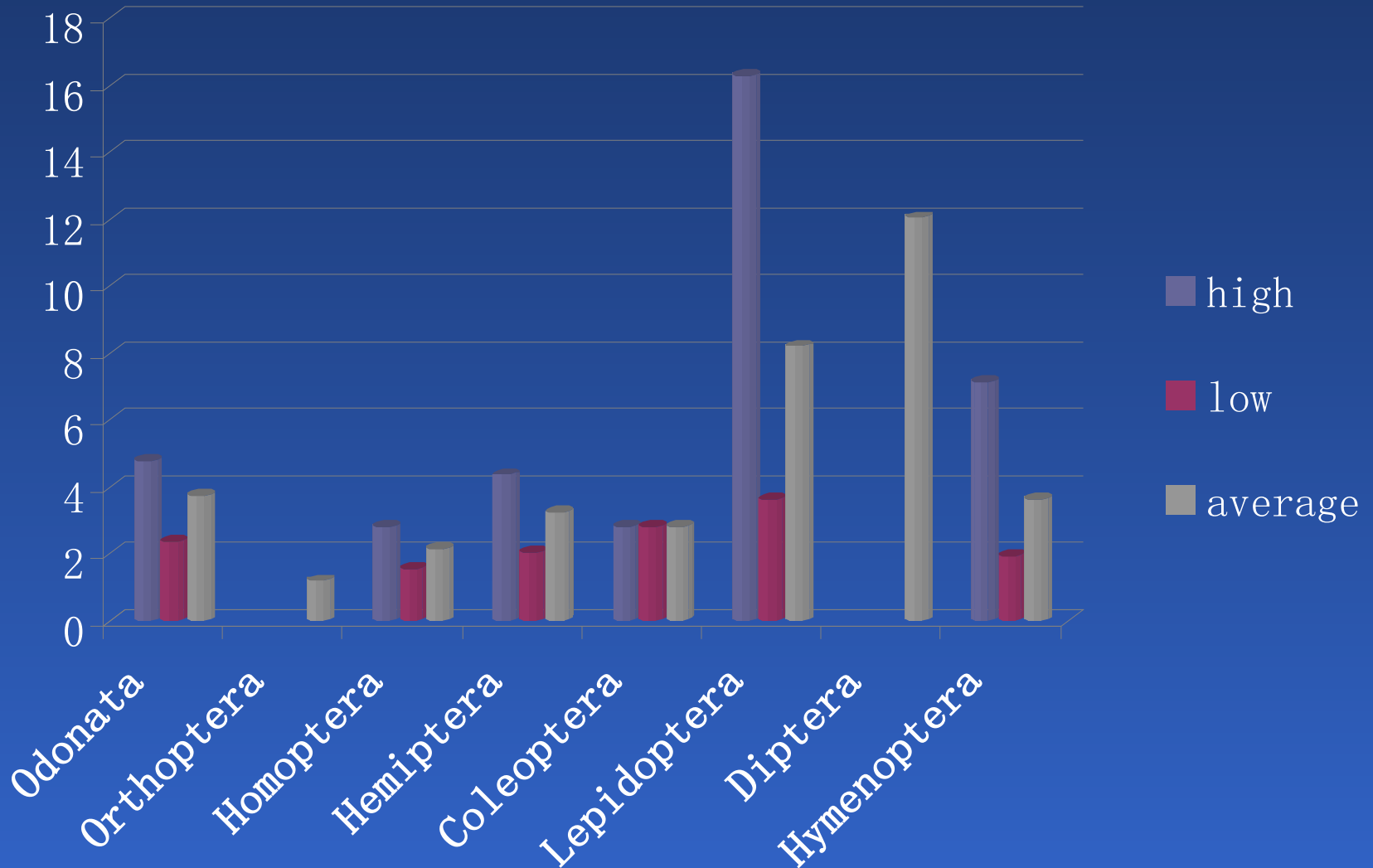
- ◆ content : 10-50% ,
- ◆ higher in larvae and pupae , low in adults



The fat content of edible insects in 8 orders (%)

(4) Carbohydrate

Content : 1-16%



The carbohydrate content of edible insects in some orders %

Inorganic salts and trace elements

- ◆ more than 30 species of insect have done nutritious analysis.
- ◆ rich potassium (K), sodium (Na), calcium (Ca), copper (Cu), iron (Fe), zinc (Zn), Manganese (Mn), phosphorus (P), high in calcium, zinc and iron.
- ◆ Edible insects can supply necessary nutritive elements for human.

The trance elements amount of some edible insects

mg/kg

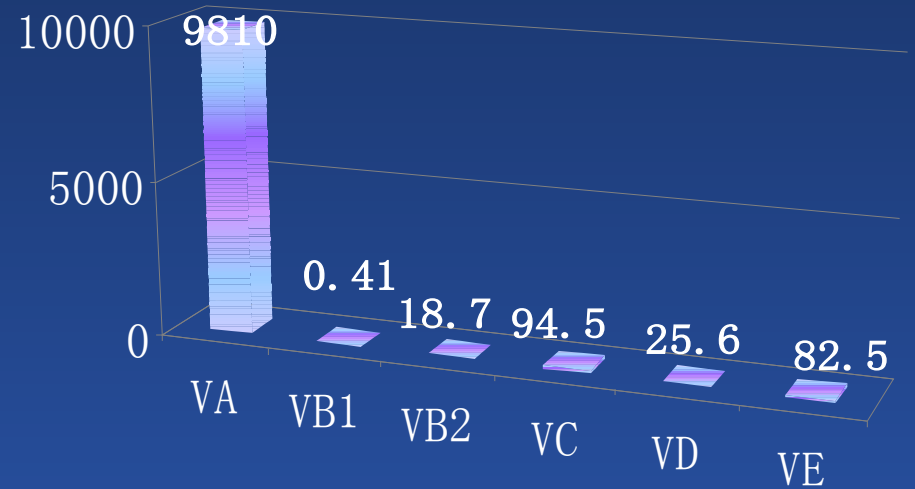
种类	K	Na	Ca	Ma	Cu	Zn	Fe	Mn	P
角突箭蜓 <i>Gomphus cuneatus</i> Needham	2 620	590	4 180	880	64.3	124.8	728.9	74.8	1 470
舟尾丝 ◆ <i>Lestes paraemorsa</i> Selys	2 930	2 020	2 160	970	64.8	147.7	1 198.0	58.9	2 470
红蜻 <i>Crocothemis servilia</i> Drury	3 330	2 310	1 510	950	50.6	103.8	461.6	27.2	1 420
云管尾角蝉 <i>Darthula hardwicki</i> (Gray)	2 120	610	280	4 500	56.9	544.3	100	13.6	
白蜡虫 <i>Ericerus pela</i> Chavanness eggs	6 300	8 9.51	353.7	1 200	23.6	164.2	133.1	26.74	6 000
小皱蝽 <i>Cyclopelta parva</i> Didthant	4 720	1 680	480	1 530	2.4	155.8	119.7	19.9	8 200
暗绿巨蝽 <i>Eusthenes saevus</i> Stal	610	780	280	260	45.4	78.0	98.3	16.3	1 520
长足大竹象 <i>Cyrtotrachelus bugueti</i> Guer	2 620	650	270	1 050	38.4	306.1	64.7	21.0	5 190
长足牡竹象 <i>C. Longimanus</i> Fabricius	1 740	510	390	480	22.9	127.1	66.3	25.9	2 920
华北大黑鳃金龟 <i>Holotrichia obliterata</i> (Faldermann)			397.22	455.78	18.86	101.33	1	46.50	
铜绿丽金龟 <i>Anomala corpulenta</i> Motschulsky			434.94	297.04	26.82	84.51	3	61.61	
凸星花金龟 <i>Protaetia aerata</i> (Erichson)			187.47	303.65	35.56	97.48	2	20.03	
桃红颈天牛 <i>Aromia bungii</i> Faldermann			131.56	220.54	23.97	98.76	3	15.47	
黄斑星天牛 <i>Anoplophora nobilis</i> Ganglbauer			133.56	105.20	10.42	95.42	2	9.56	
粒肩天牛 <i>Apriona germari</i> (Hope)			150.68	254.36	25.46	102.34	3	20.47	
麦蛾蛉虫 <i>Pectinophora Gossypeilla</i> (Saunders)			113.40	163.21	33.40	87.01	2	0	
米蛾 <i>Corcyra cephalonica</i> Staint			148.66	156.81	17.13	78.29	3	6.87	
亚洲玉米螟 <i>Ostrinia furnacalis</i> (Gunnee)			140.53	184.06	14.84	91.78	2	4.56	
金凤蝶 <i>Papilio machaon</i> Linnaeus	1 250	90.5	384	279	1.5	3.5	18.0	0.9	457
竹虫 <i>Chilo fuscidentalis</i> Hampson	2 620	740	880	1 060	11.1	109	57.1	41.8	1 690
柞蚕 <i>Antheraea pernyi</i> Guerin-Meneville	13	620	790	3 800	19.01	141.8	0.01	8.73	690
家蝇 <i>Musca domestica</i> Linnaeus	390	2 700	1 200	12 300	59	570	520	406	17
双齿多刺蚁 <i>Polyrhachis dives</i> Smith female adults	15		613.34	172.36	32.66	155.42	378.36	5	900
Male adults	600		585.28	163.78	27.08	148.83	391.56	101.8	

The vitamin amount of edible insects in certain orders

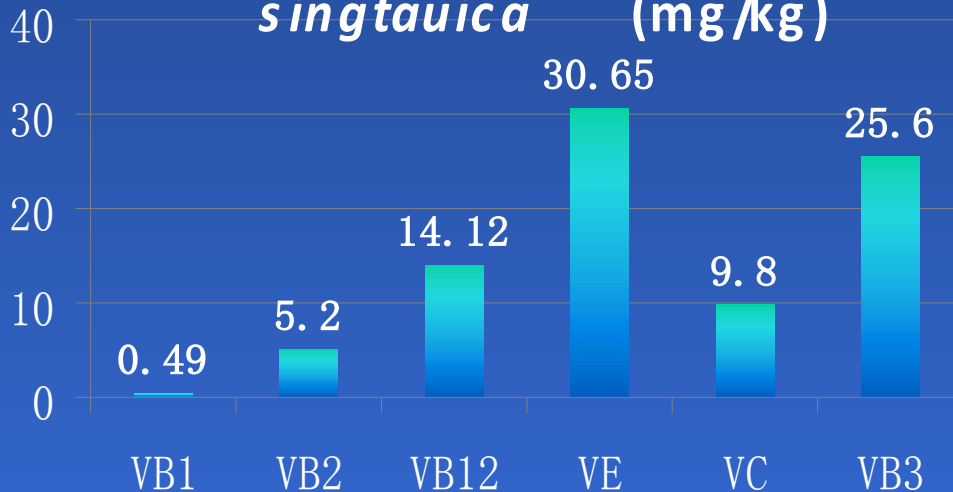
The larva of *Tenebrio molitor* (mg/100g)



The pupa of *Dendrolimus punctatus wenshanensis* (mg/kg)



The larva of *Clanis bilineata singtauca* (mg/kg)



The larva of *Apis cerana* (mg/100g)



Cooking ways

- Fry, fry after stewing
- braising, stewing,,
- boil , steaming,
- roasting

Industrialization of edible insect in China

- Artificial cultivation technique in large sale.
- Research and development health care food for different people, for example, children, old people and other people.
- Change insect original shape(powder, capsule and tablet) and accepted easily.



Bee larvae capsule



Insect egg capsule



Termite products

Some edible insect products in China



Ant products

Conclusion

- Edible insect is one special type of good protein resource.
- Edible insects are nutritious foods that supplement nutrition for people in developing area.
- By modern technique, edible insects can be made to health care food.
(enzymes ,hormones, polysaccharide *etal.*)

Introduction of RIRI



**Research Institute of Resource Insects (RIRI) ,
Chinese Academy of Forestry (CAF)**

■ **History : RIRI founded in 1955**

■ **Six research departments:**

➤ **Resource insect;**

➤ **Environment insect ;**

➤ **Forest resource & environment;**

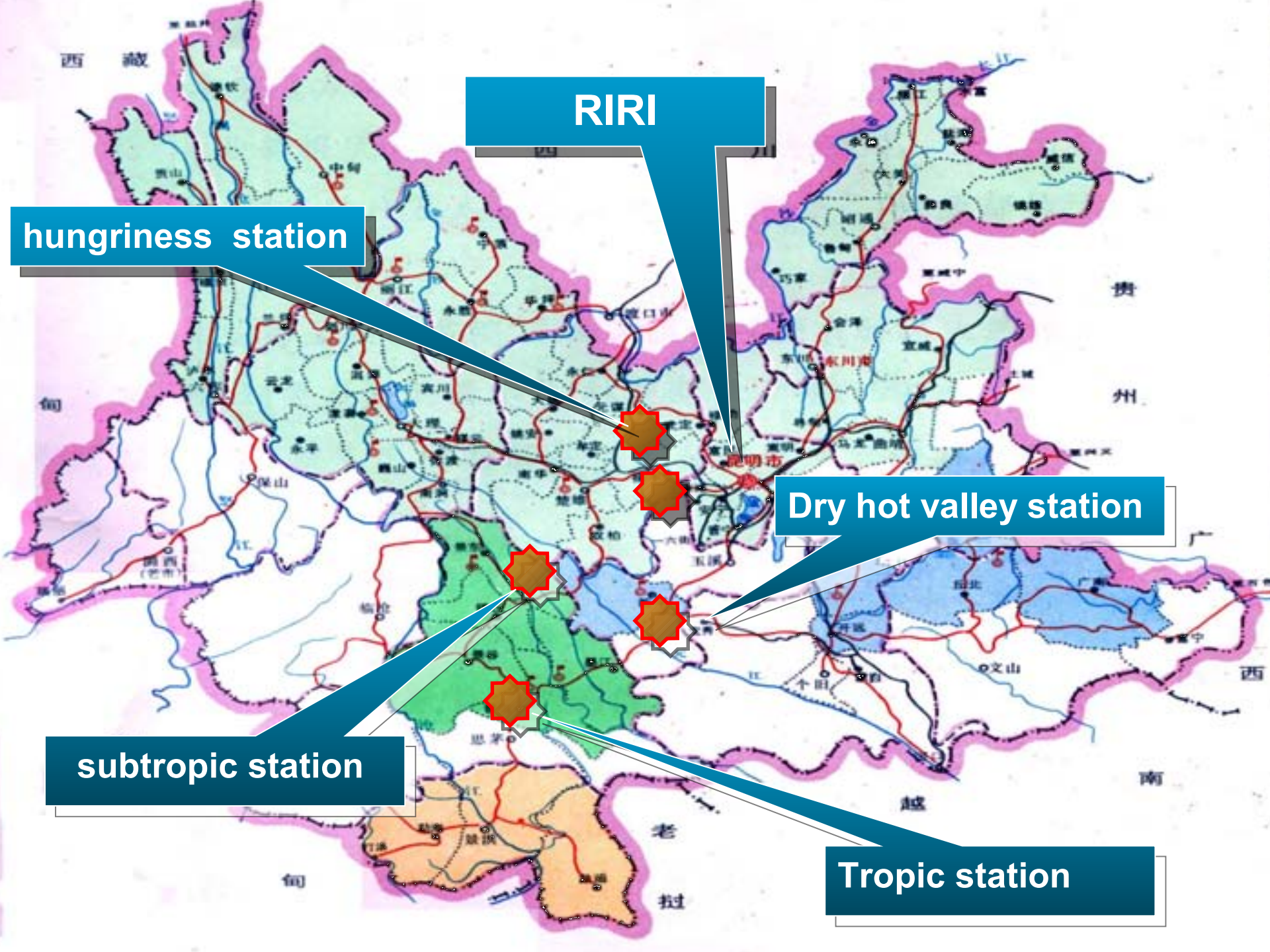
➤ **Ecology;**

➤ **Molecular biology and biological chemistry;**

➤ **Forest chemistry & production;**

■ **Four experimental stations:**

Tropic station ; subtropic station ; dry hot valley station & hungriness station



RIRI

hungriness station

Dry hot valley station

subtropic station

Tropic station

What are resources insects?

- Insect as beneficial resource for human being
- with important economic , ecological and scientific value
- Direct and indirect utilization

Resource Entomology

- Insect production as industrial raw materials (e.g. lac, insect wax, insect dye etc.)
- Honey bee
- Insect as medicine resource
- Insect as protein resource
- **Ornamental insects (butterfly)**

- **Pollination insects**
- **Natural enemy insects**
- **Insects benefit for environment**

Insect structure and function (bionics)

Economic

**narrow sense
(directly utilization)**

Ecology

**broad sense
(indirectly utilization)**

Science

1. Insect secretion as Industrial raw materials

1.1. Lac insect *Kerria lacca*



adult



resin

Lac insect

host tree

lac

Lac value

lac secreted by lac insect is an important chemical raw material, which is widely apply in chemical, food, machine and medical industries



Chemical industry



machine



food

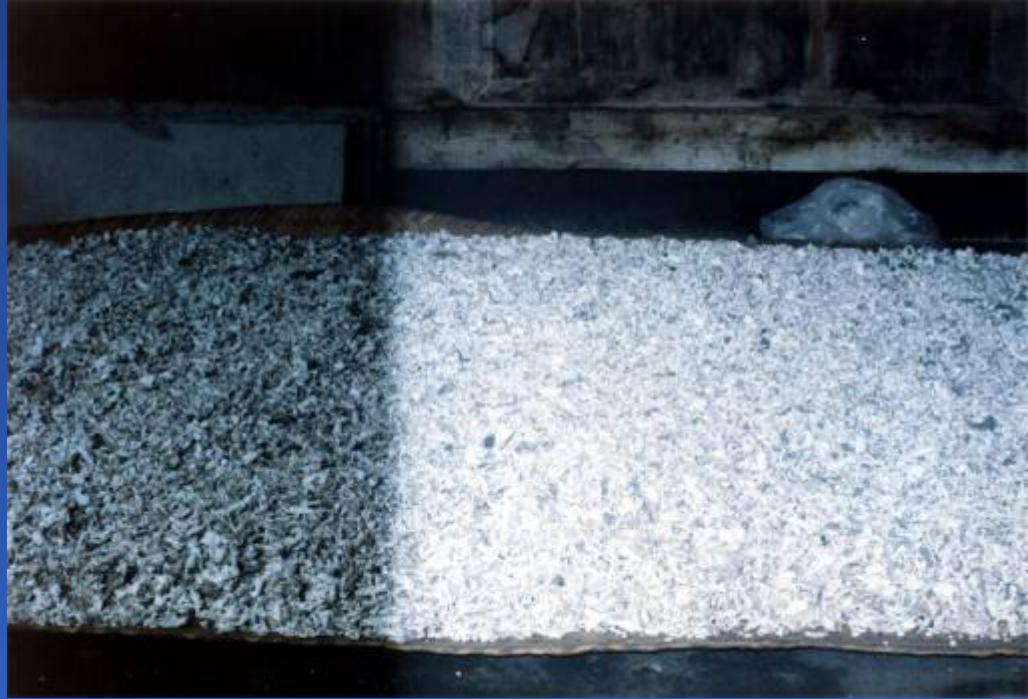


Fruit coating

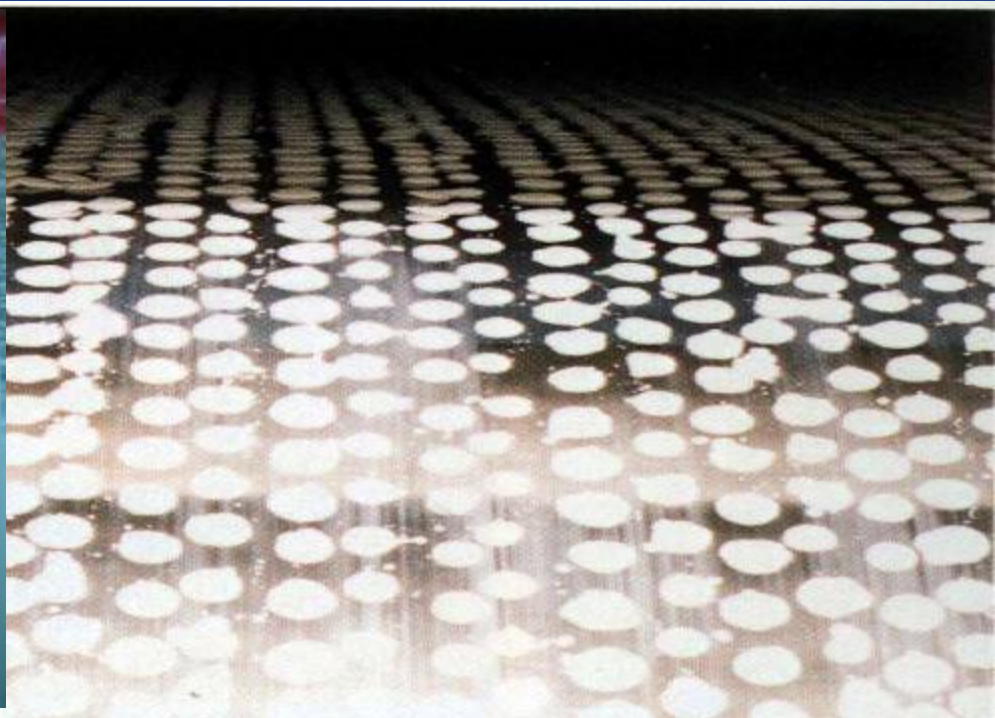
1.2. Insect wax

- Insect wax secreted by Chinese white wax scale insect (*Ericerus pela*)
- Apply in chemical, food, cosmetic and medical industries





Farmer harvest insect wax



Insect wax processing in factory

1.3. Insect dye

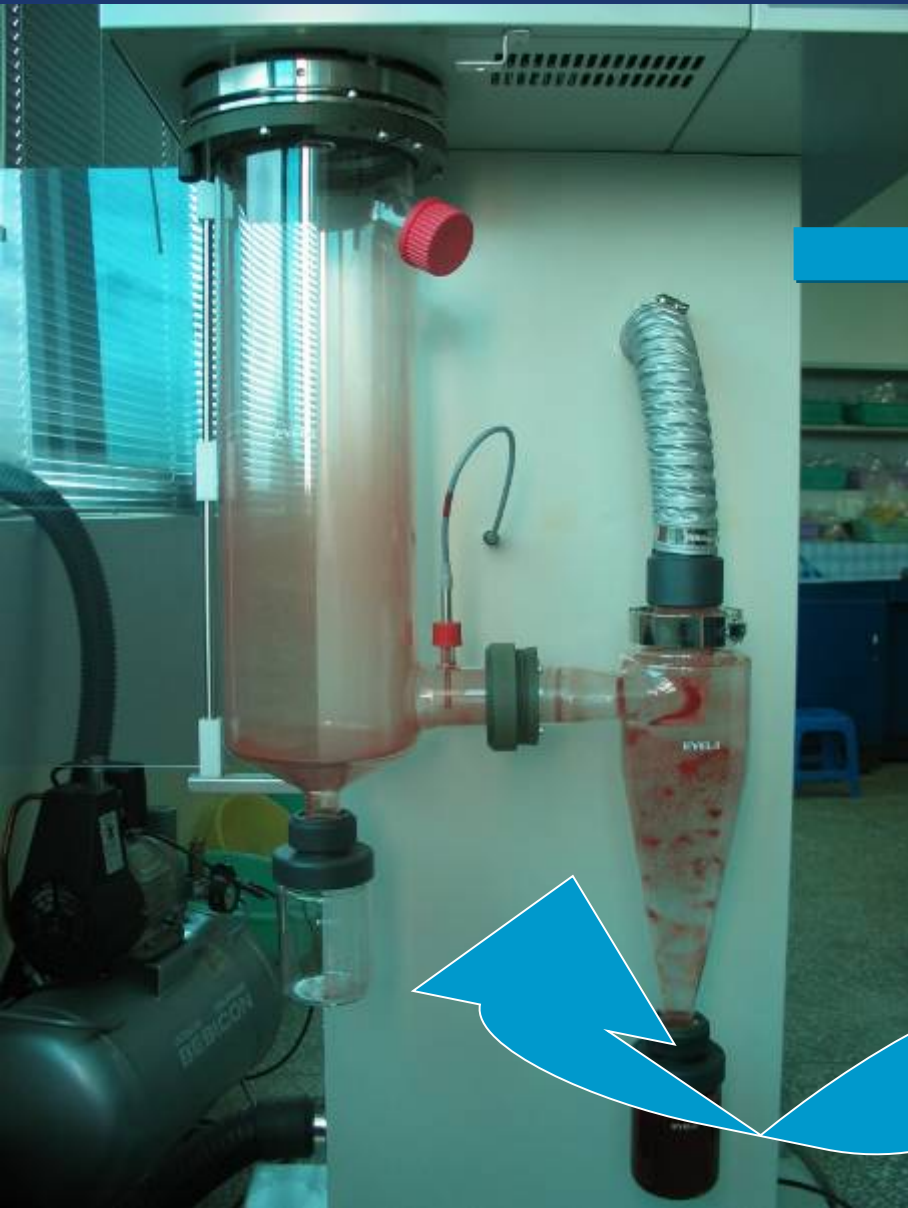
Cochineal Insect (*Dactylopius .coccus*)

Cochineal is a scale insect that live on cactus, red dye extracted from cochineal body is an important bio-dye which is applied in cosmetic, food, printing and dyeing



Cultivation of cochineal insect





Insect red dye



Dry cochineal insect

Insect production as Industrial raw materials

Chinese gallnut

- Chinese gallnut formed by aphids stimulated host tree (*Rhus*),
- Tannin extract from Chinese gallnut applied in chemistry, medicine, food, and cosmetics

Form process of Chinese gallnut



2. Insect as medicine resource

- There are about 250 species of insects as medicine in Chinese traditional medicine.
- More than 700 species insects can excrete 60 kind of insect toxin.
- There are founded more than 400 kind of antibacterial substances in insect in the world.

- Immunity
- Anticancer
- Hepatitis
-



Chinese caterpillar fungus

fungi

insect

infection



Cordyceps sinensis (Berk)

Hepialus armoricanus Oberthus



Mylabris phalerata
(**Caantharidin**)



Larvae of chafer



Stinkbug
Aspongopus chinensis



dung beetle



cricket

Some common medical insects in China

3. Butterfly Cultivation & Industrialization

- Artificial Cultivation in large scale
- Butterfly garden
- Butterfly artware





egg



larva

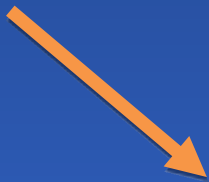


pupae



adult

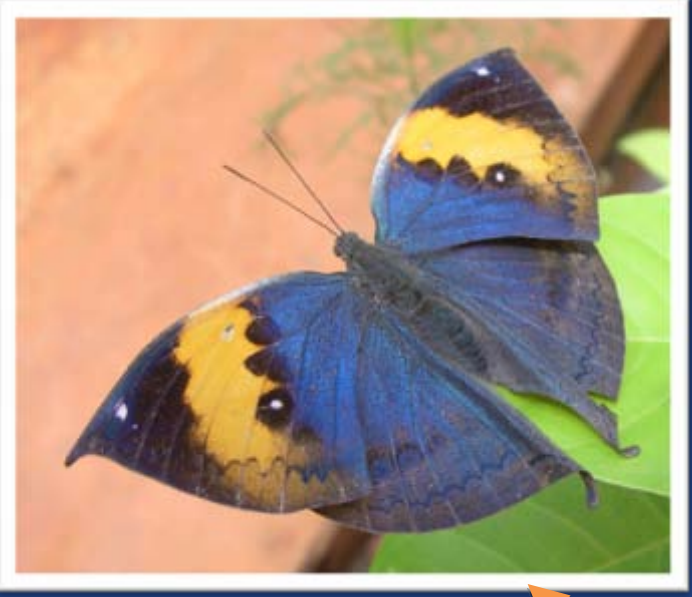
Life cycle of *Papilio machaon*



mimesis



mimesis



adult

Life cycle of *Kallima inachus*



egg



larva



pupae



Artificial Feeding



Larvae



Pupae





Butterfly garden

圓通山蝴蝶園



Flying Butterfly

wedding



Butterfly artware



4. Pollination insect

Studies on insect pollination
of bio-energy sources tree *Jatropha curcas* L

Order	species	Percent
Hymenoptera	19	54.29 %
Diptera	5	14.29%
Lepidoptera	4	11.43%
Hemiptera	4	11.43%
Coleoptera	3	8.57%
Σ	35	100%

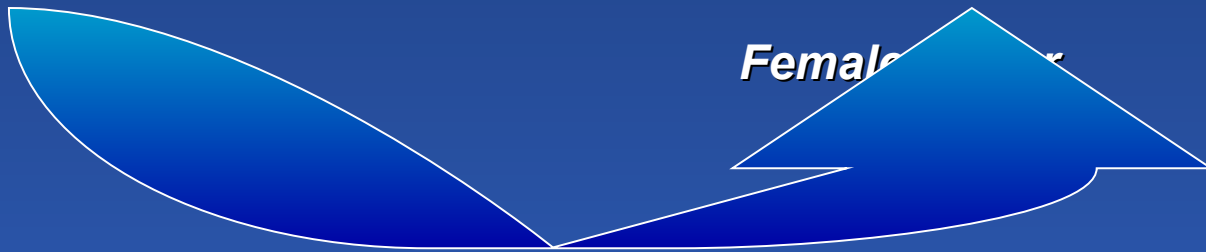
The pollination system of *Jatropha curcas*



Male flower



Female flower



flower visitor



Pigeonpea
(*Cajanus cajan*)

***Pigeonpea*, a tree pea that live 6-8years, is a protein resource**

Insect Cell Culture

The in vitro culture of cells taken from living insects, and make the cells grow continuously.



- More than 30 kinds of cell lines from different insect in RIRI.
- Use of cultured cell strains in place of animal experiments
- Propagation using cultured cells of insect virus
- Anti-microorganism substances produced by cultured insect cells



Blaps rhynchoptera



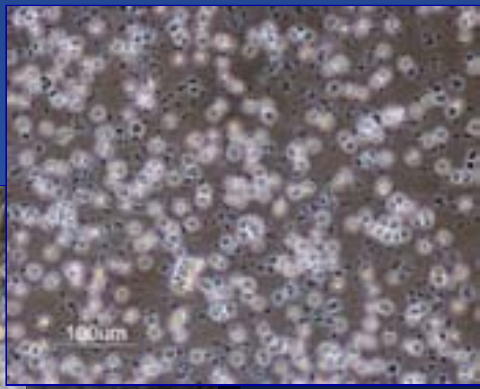
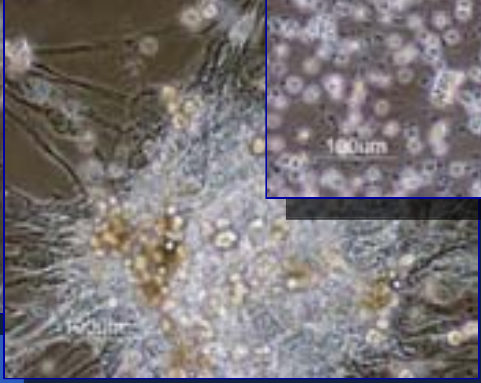
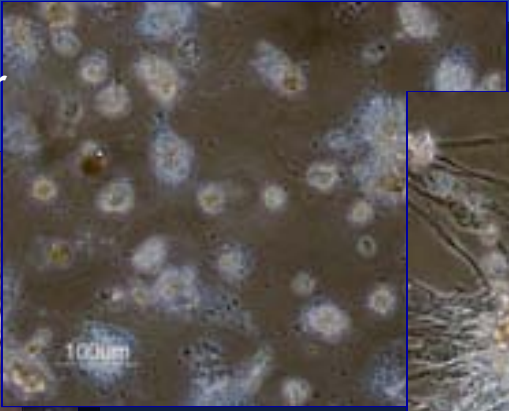
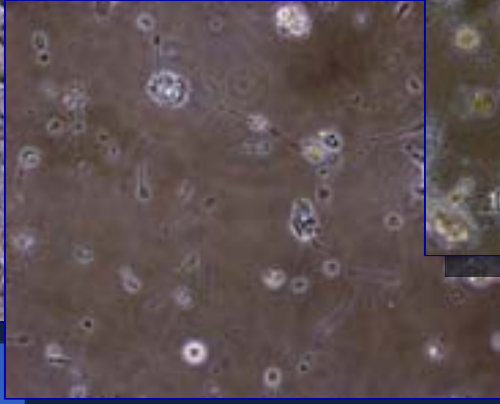
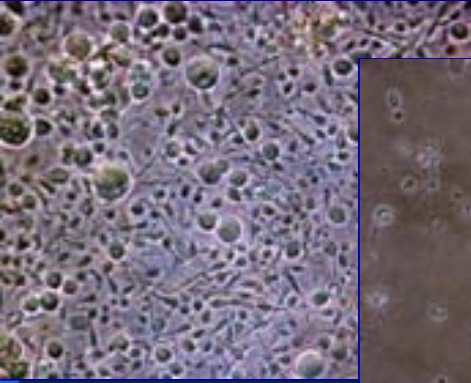
Tenebrio molitor



Bombyx mori



Hepialus gonggaensis



Dendrolimus punctatus tehchangensis

Welcome to visit RIRI
in Kunming, China!

