Vermicomposting agricultural waste into value-added products: 30yr's R & D in China

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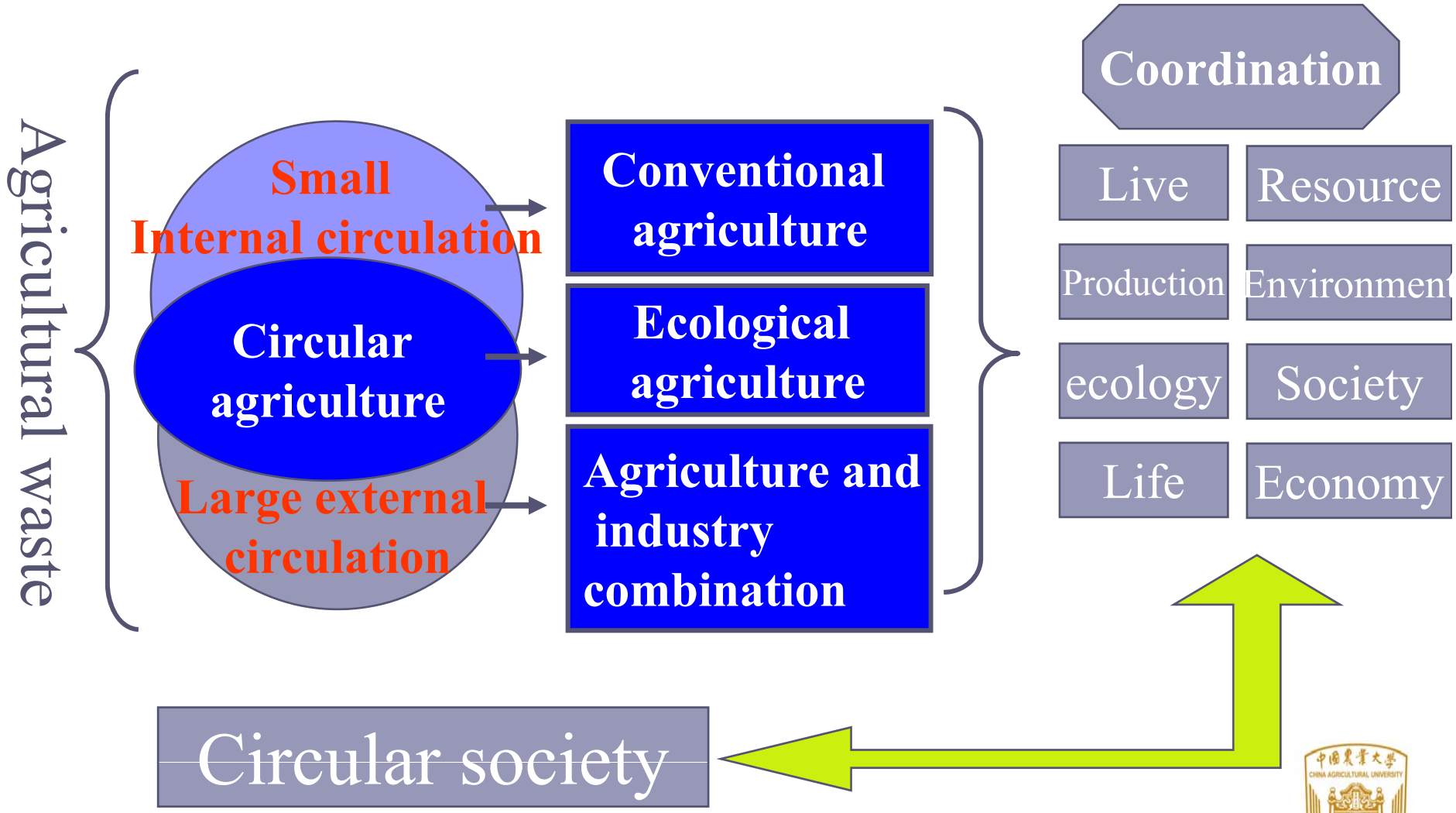
The Status of Agricultural Waste Utilization in China

Cyprus conference, 2016

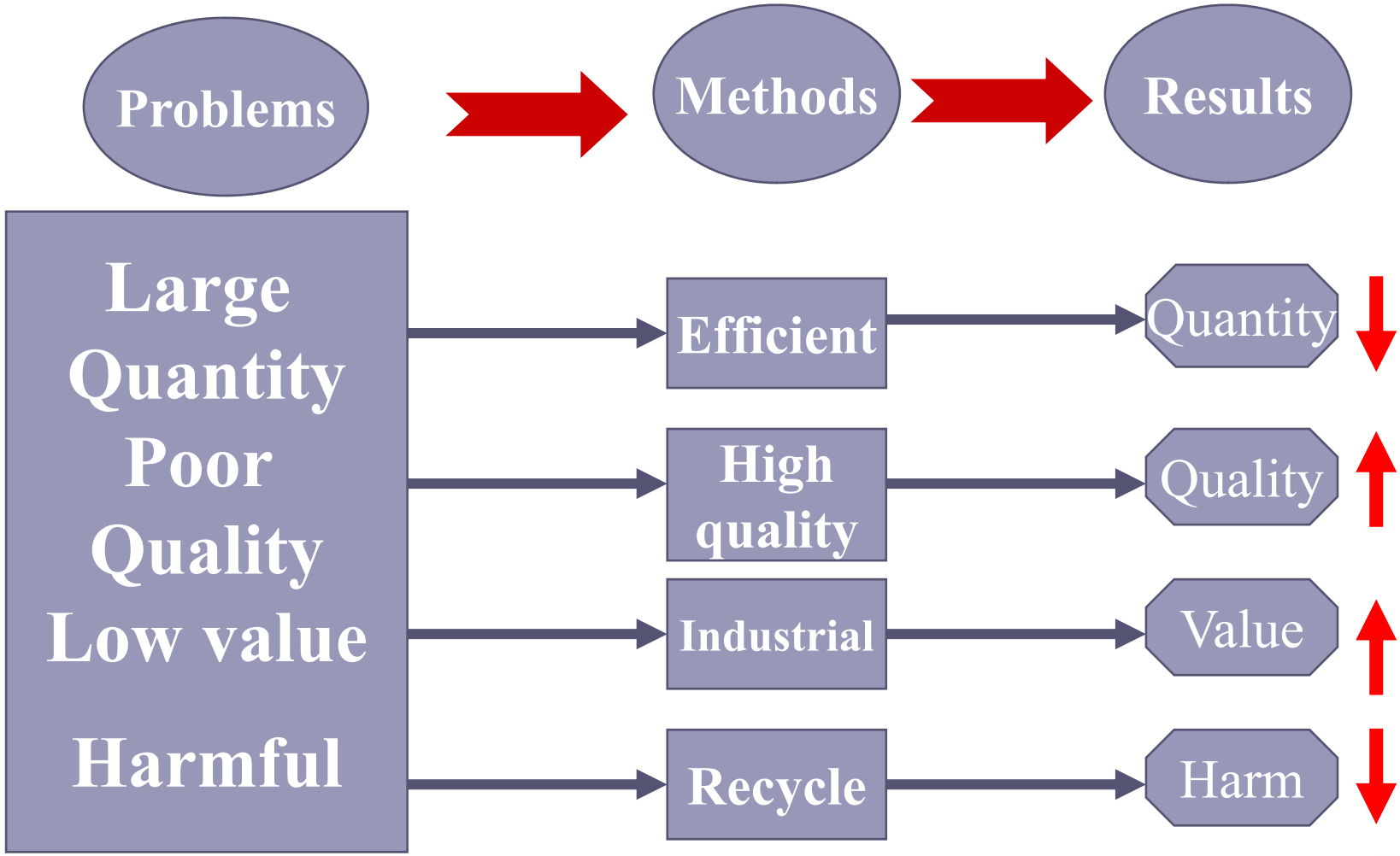
Total agricultural waste resources: **1 billion tons,** including

Crop straws: 0.7 **billion tons;** livestock manures**: 0.18 billion tons**

Agricultural Circular Economy Development Pattern



Use strategy



Ecological Utilization

Straw returning

Methane production

Edible fungi

Vermicomposting

Agriculture and livestock

composting

Multiple integration

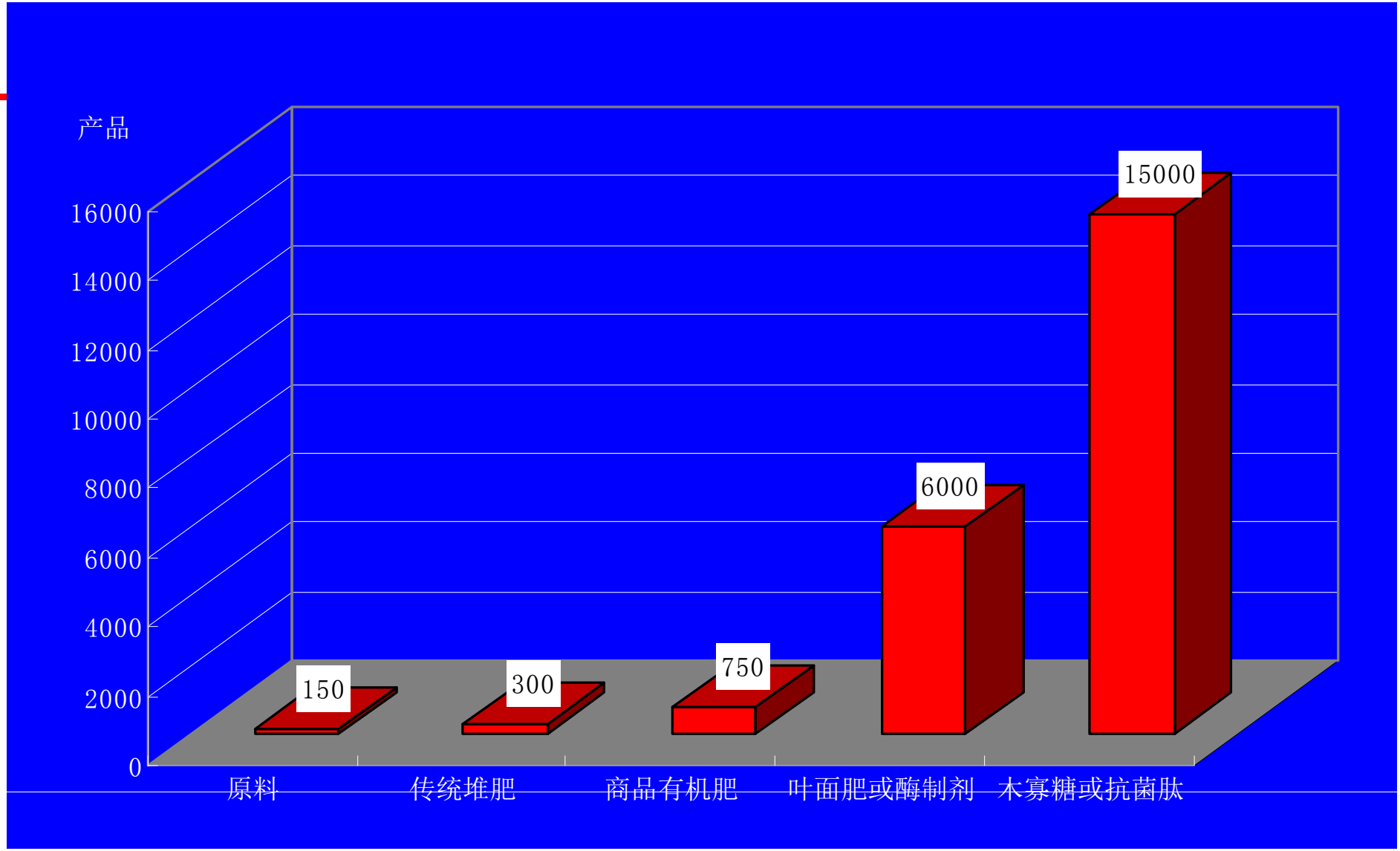
High Quality Use

Commercialization and Marketization

New products：

Biological preparation（Biological fertilizer、Biological pesticides Etc.）

Biochemical preparation（Amino acids、Enzyme、Oligosaccharides Etc.）



Comparison of the added value of the products developed from agricultural waste

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Vermiculture in China

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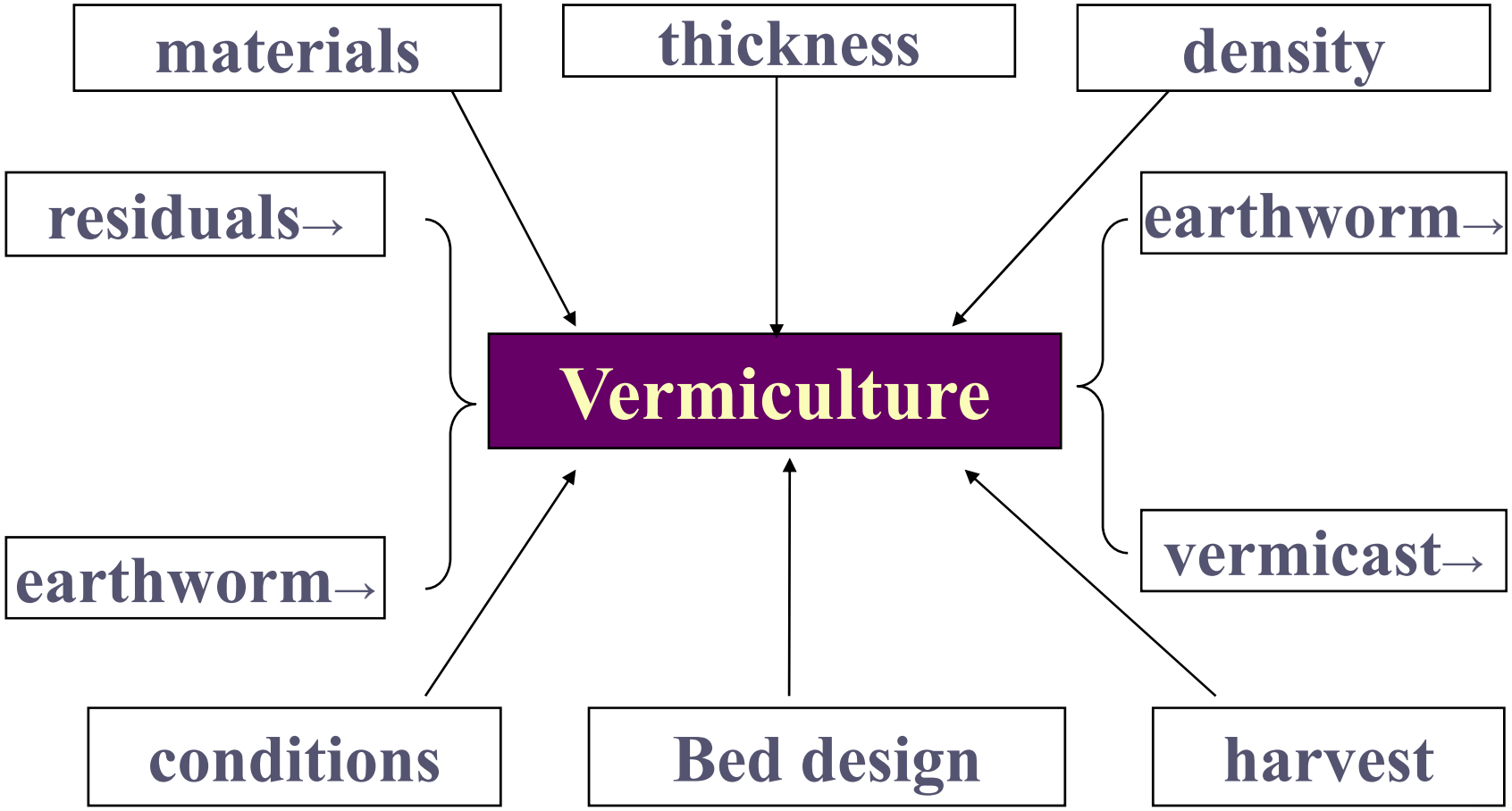
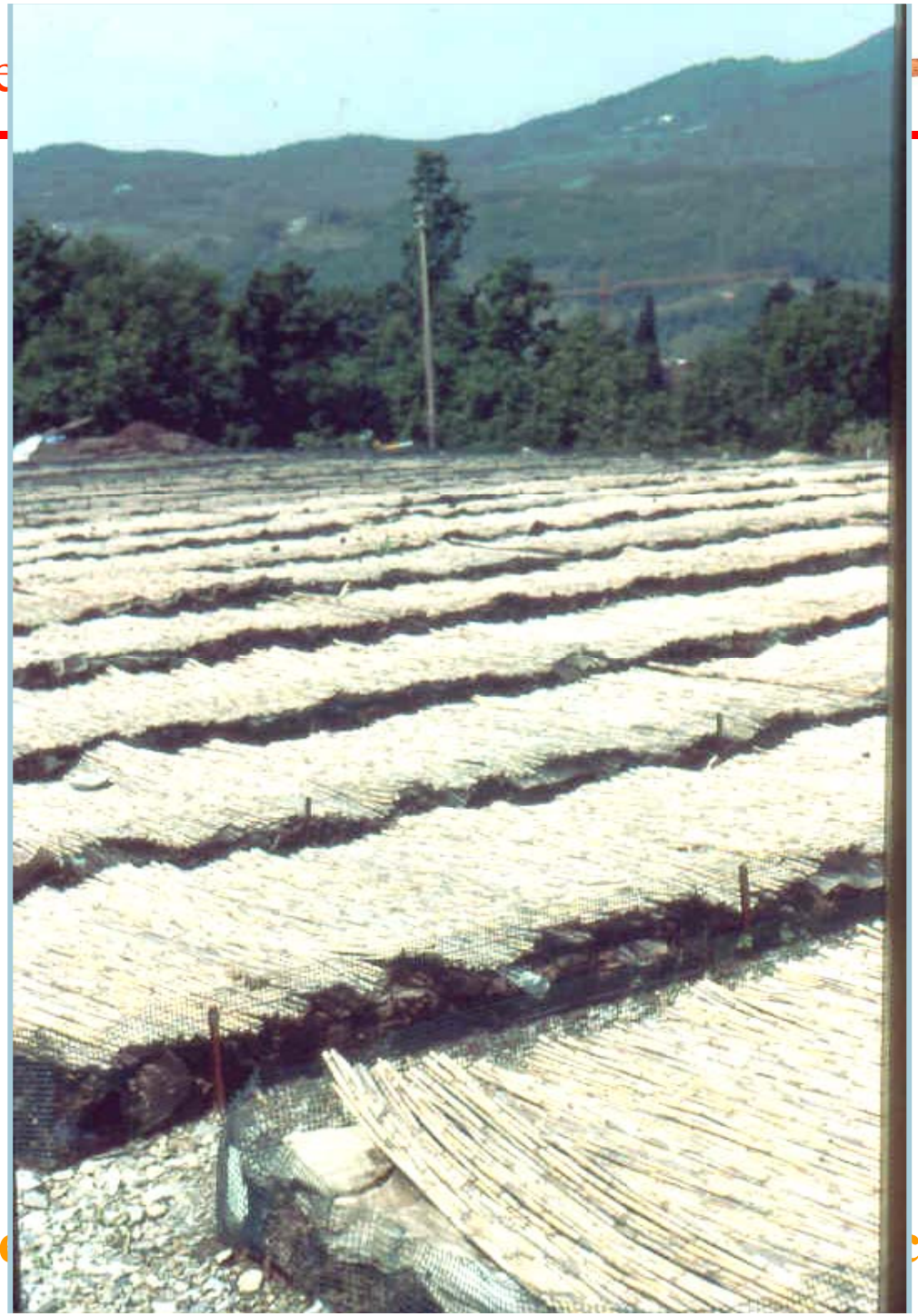
factors affecting vermiculture yield



Simple windrow system



Plastic Greenhouse System in North China

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国家农业综合开发项目

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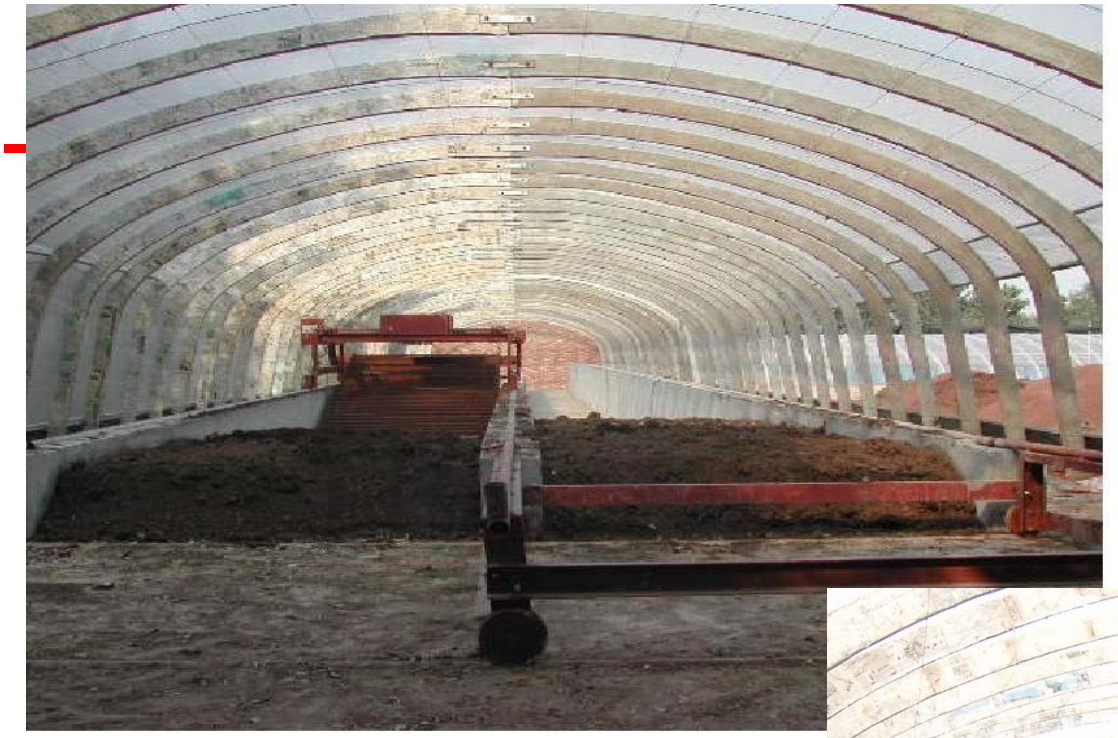

Composting pretreatment

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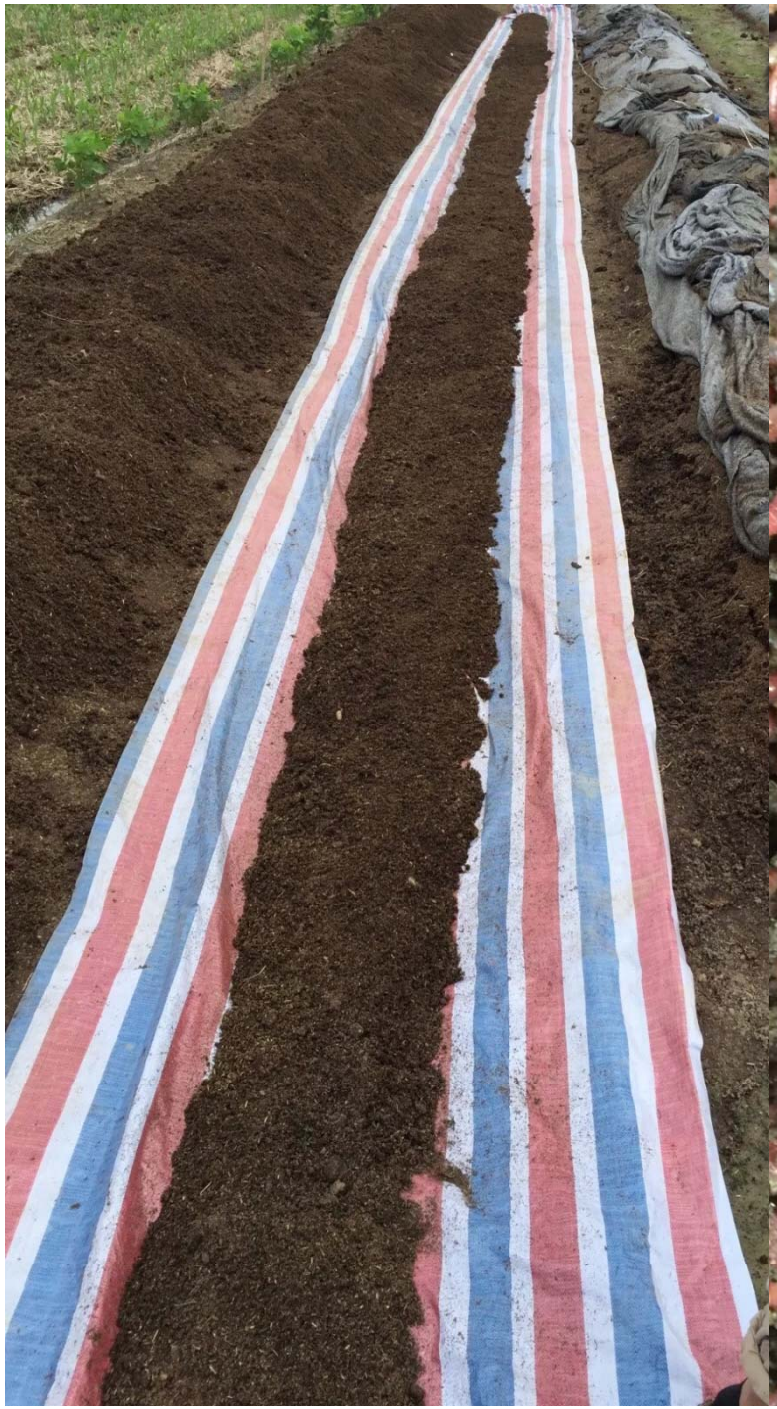
Intercroping system: vermiculture in field

Intercropping of vermicomposting and banana




使用过
“沃地龙蚯蚓菌肥”


未使用

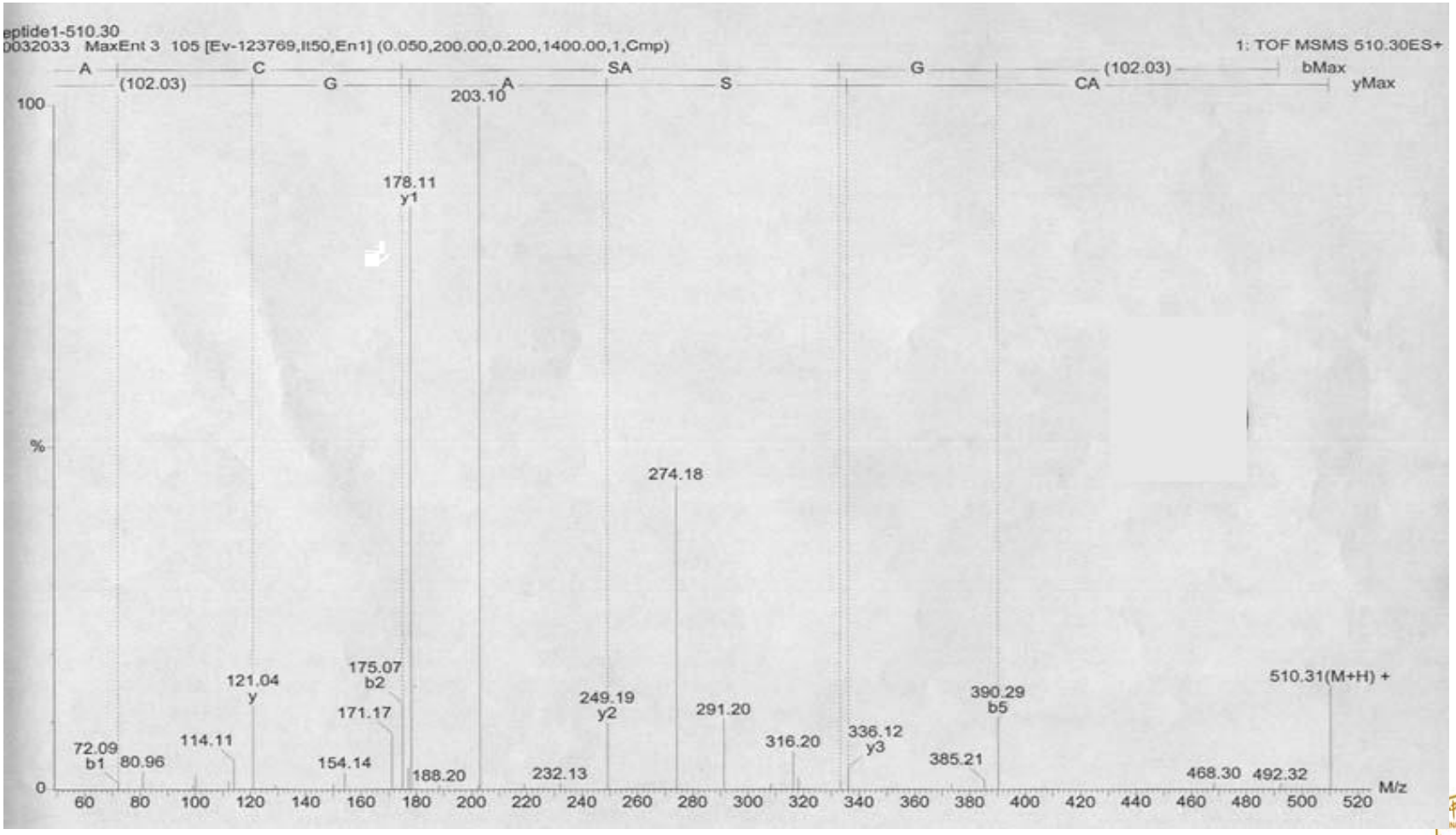
Antibacterial peptides in earthworm *Eisenia Fetida*

Sun (1995) found an antibacterial peptide that was composed of forty amino acids from earthworm at first in the world.

Name	Sequence of amino acid	Number of amino acid	Molecular weight	**Antibacterial characteristic**
EP1	/	40	4832	Bacteria and fungi resistance
EP2	*Ac-Ala-Met-Val-Ser-Ser*	6	535.27	Bacteria resistance
EP3	*Ac-Ala-Met-Val-Gly-Thr*	6	519.27	Bacteria resistance
EP4	/	/	About 20000	Bacteria resistance
ECP5-1	*Ala-Cys-Ser-Ala-Gly*	5	510.80	Bacteria resistance

The methods of earthworm peptide separation and purification have achieved the patent in 2004.

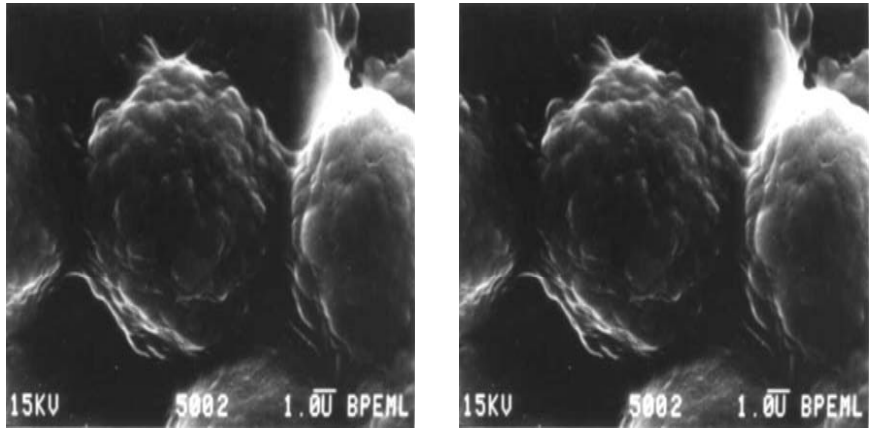
Sequence of amino acid in ECP_5-1



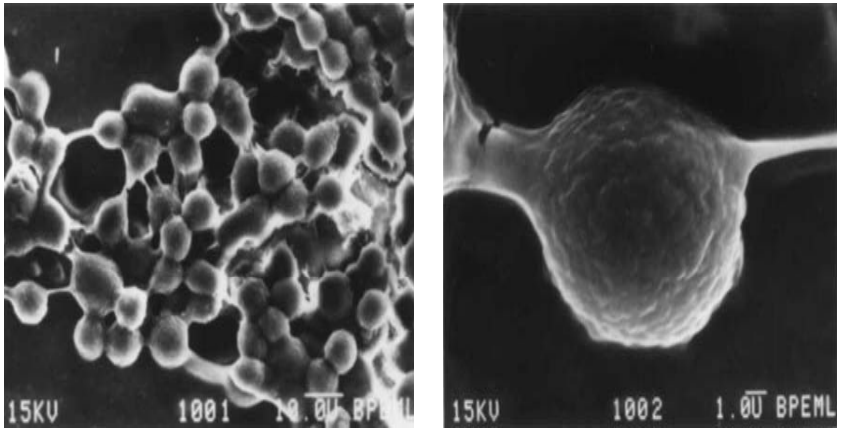
Ala-Cys-Ser-Ala-Gly

Influence of peptide on cancer cells

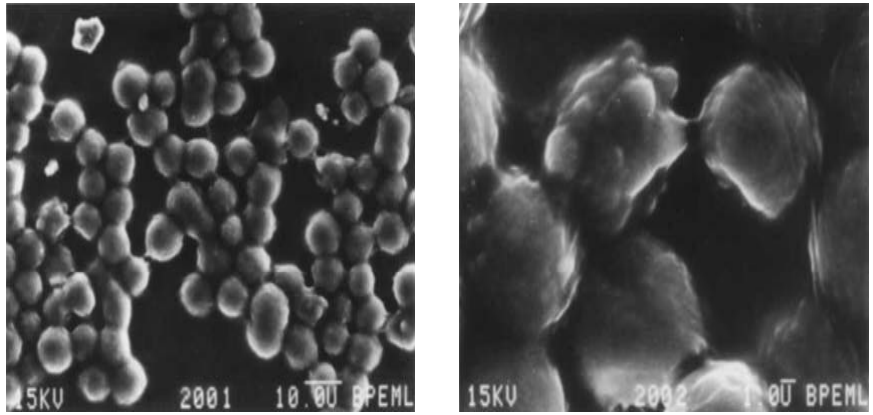
The resistance of EP_2 and EP_3 to MGC803 cell



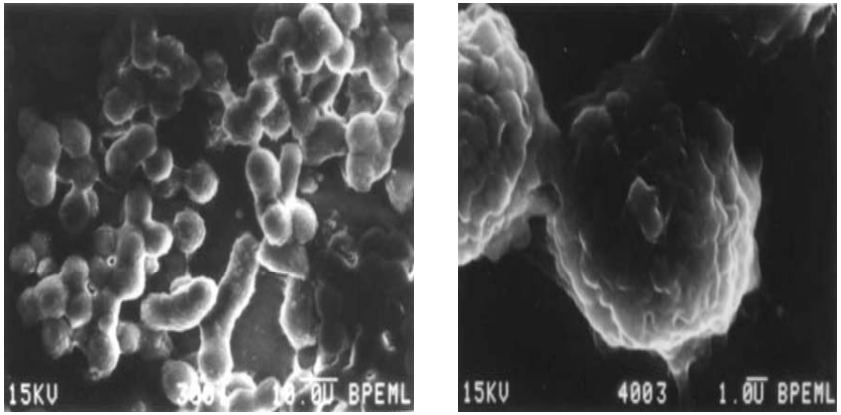
Scanning electron microsoopical observation on MGC803 cells which was untreated with antibacterial peptides



Scanning electron microsoopical observation on MGC803 cells treated with EP2 for 24h



Scanning electron microsoopical observation on MGC803 cells treated with EP2 for 48h



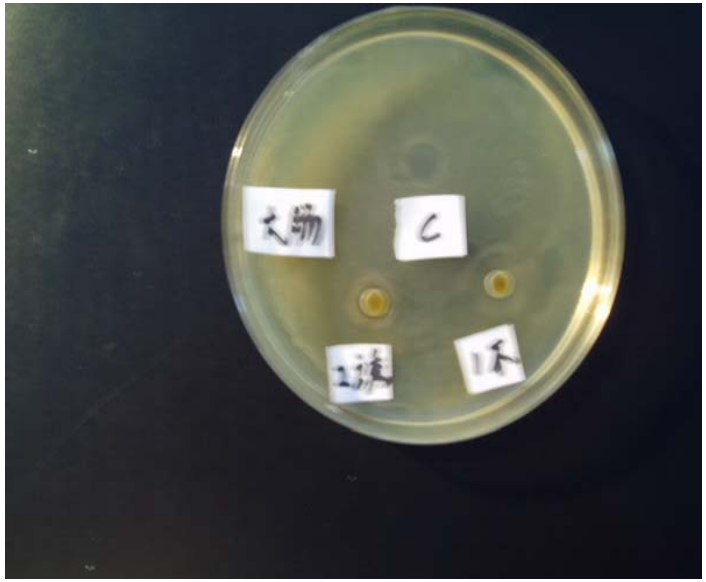
Scanning electron microsoopical observation on MGC803 cells treated with EP3 for 24h

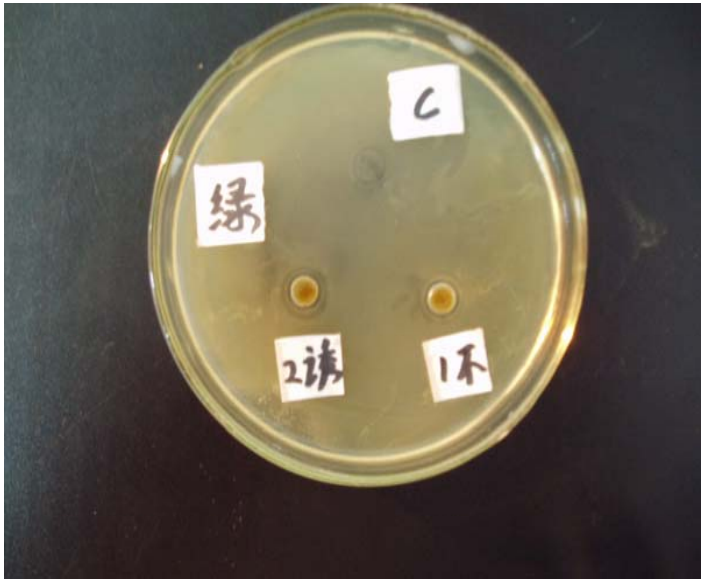
The character of earthworm antibacterial peptides

- The antibacterial peptide had stable physicochemical properties such as heat stability and wide pH scope. There was little influence of pH 3, 5, 7, 9, 11 on the antibacterial activities of antibacterial tetradecapeptide. And the antibacterial tetradecapeptide could keep when storing 180 days in home temperature.

- The antibacterial mechanism and character of the five earthworm peptides was also researched in our group .

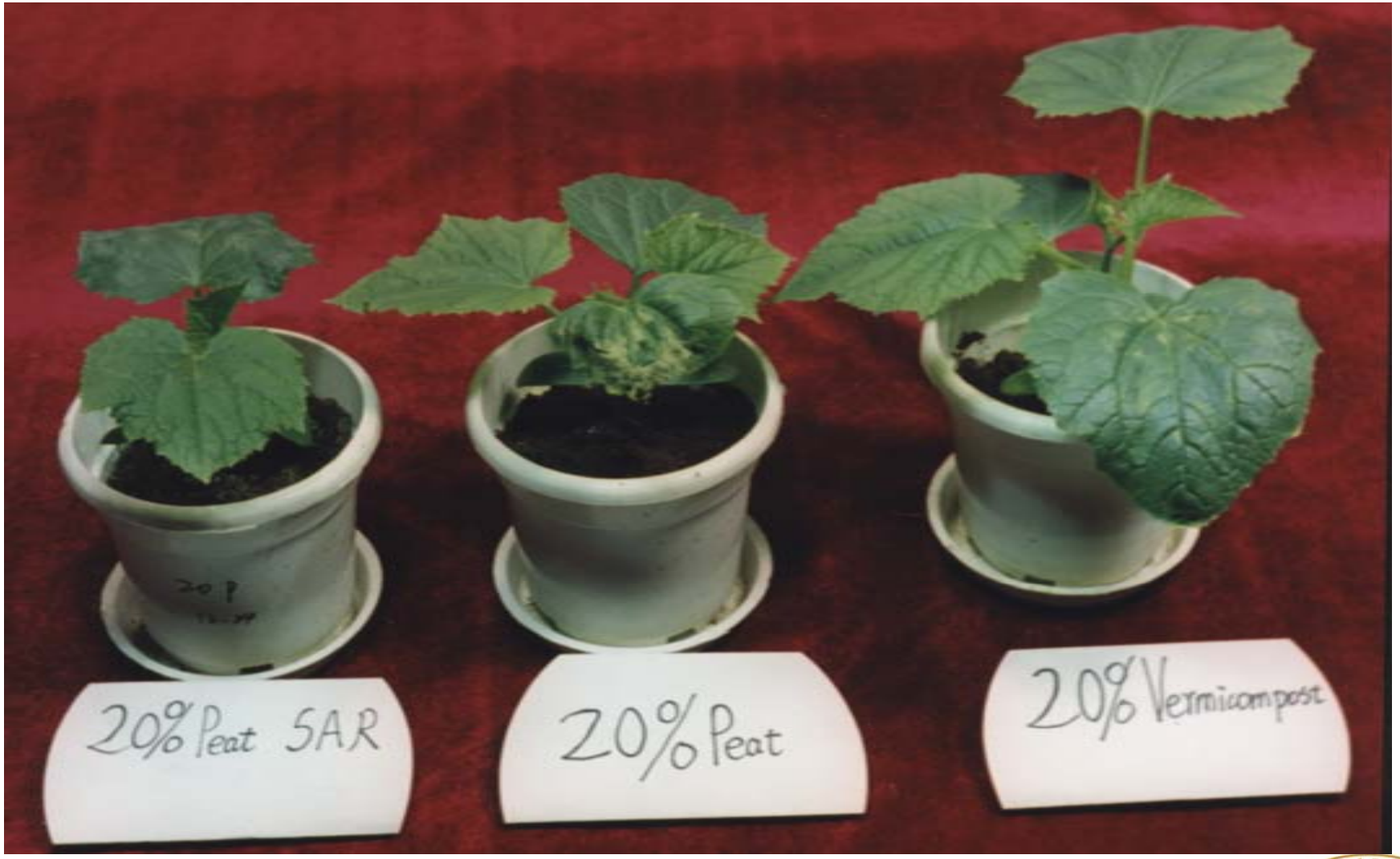
Influence of *Escherichia coli* on the antibacterial function from *Eisenia fetida*





We have a new finding that fat from earthworm have the function of bacteria resistance.

Vermicasts as function fertilizer



The resistance of vermicompost to anthracic of cucumber

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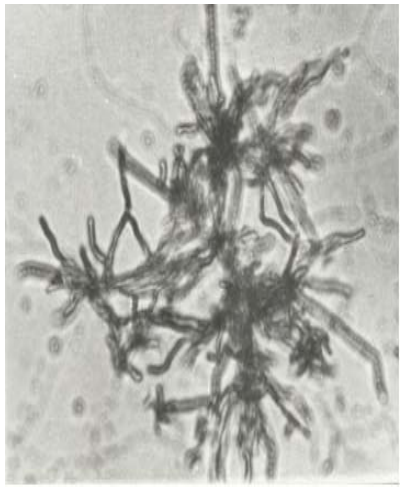
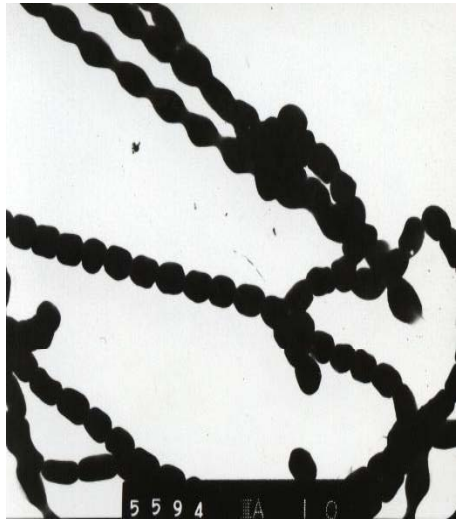
Two function microbes from vermicompost

- 0103A (*Streptomyces globisporus*)
- 0104A (*Streptomyces syringini*)

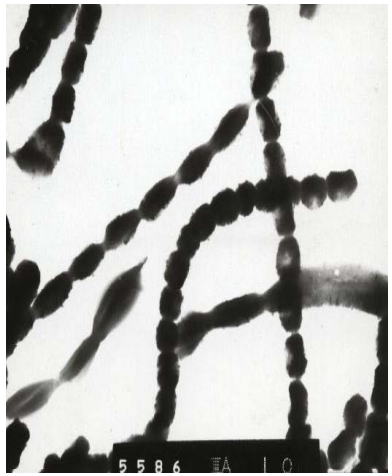


Fibrillae of 0103A spores



Spores of 0103A

Fibrillae of 0104A spores



Spores of 0104A

Bioreactor for waste conversion

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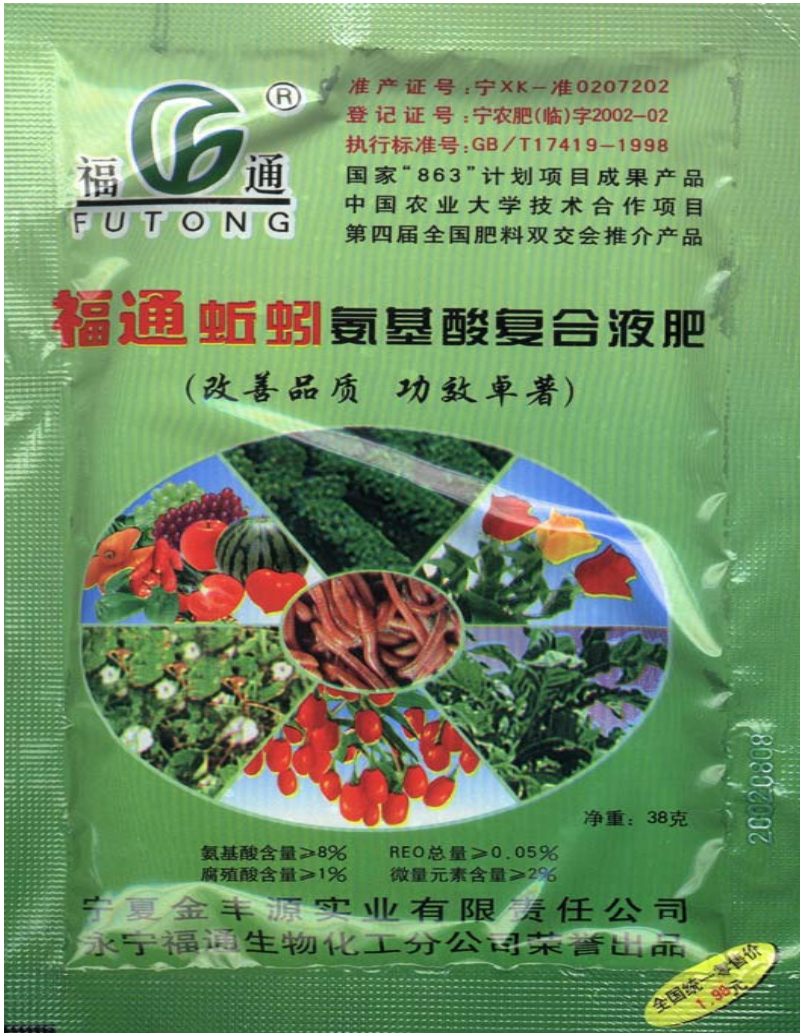
A Chinese patent

Function liquid fertilizer



Earthworm Products

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Earthworm Products

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Some products developed in CAU

① products processed from earthworm

- amino acid for animal nutrition
- foliar fertilizer with amino acid
- amino acid biopestcide

② vermicompost:

- commercial fertilizers
- soil less culture medium

amino acid processing from earthworm

Worm →hydrolyzing with enzyme

→ raw amino acid → adding microelement

→AA additives

→ chelating → chelated AA →AA foliar fertilizer

→AA pesticides

amino acid products: biochemical fertilizer

Micro-ecological adjustant and function fertilizer

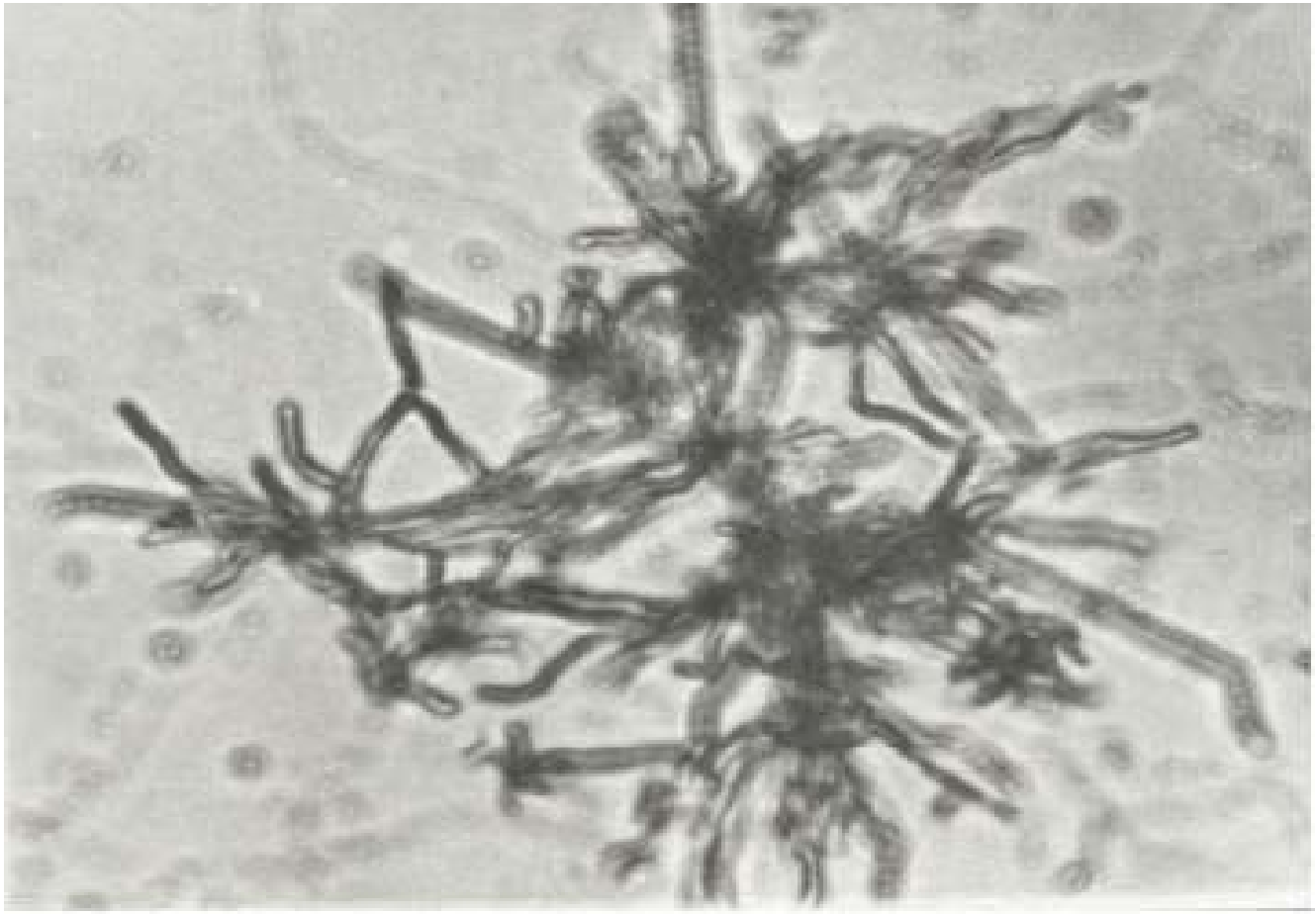
① Some effective antagomistic microorganisms were selected from vermicompost (Streptomyces spp)

② Micro-ecological adjust agent and soil conditioner plant rhizogenic agents

③ Antibacterial fertilizers and soil regeneration (Soil-borne disease of Cucumber seedlings)

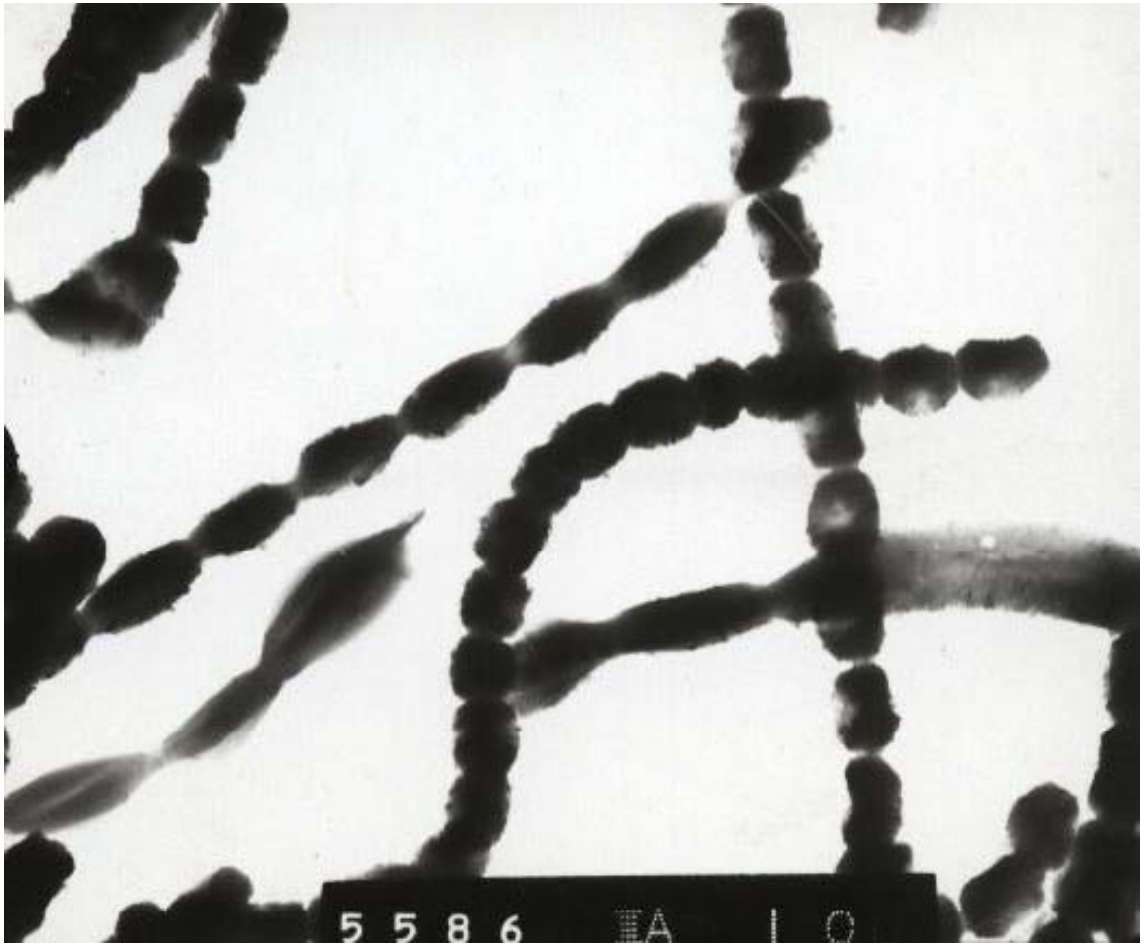
④ Multi function fertilizers

Bacterium(0103A) from vermicast



mycelium

Bacterium(0103A) from vermicast



Earthworm peptide and new pesticide-fertilizer

① 4 peptides extracted from earthworms

② effective methods for earthworm peptide processing （3 patents）

③ 3 producing lines in China for the new fertilizer

④ 2 nation certificates for new organic fertilizer

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pesticide-fertilizer made of earthworm in China

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New products and Application of anti-bacterium fertilizers in China

1. Multi-function biological organic fertilizer:
   Vermicomost and effective microorganism
2. AA foliar fertilizer:
   Earthworm and microelements
3. Antibacterial peptide fertilizer:
   Biochemistry, earthworm
4. Vermicompost tea:
   Vermocompost and effective microorganism

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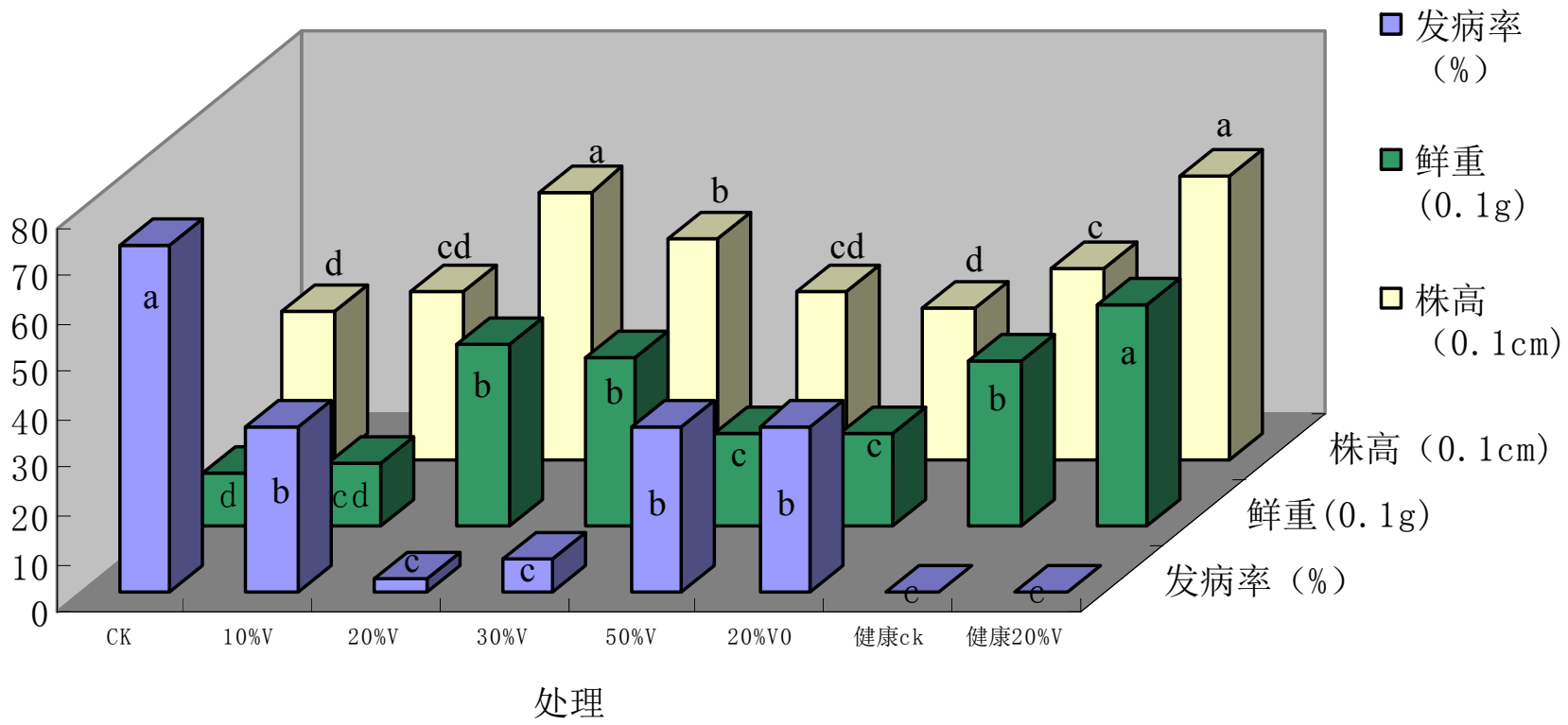
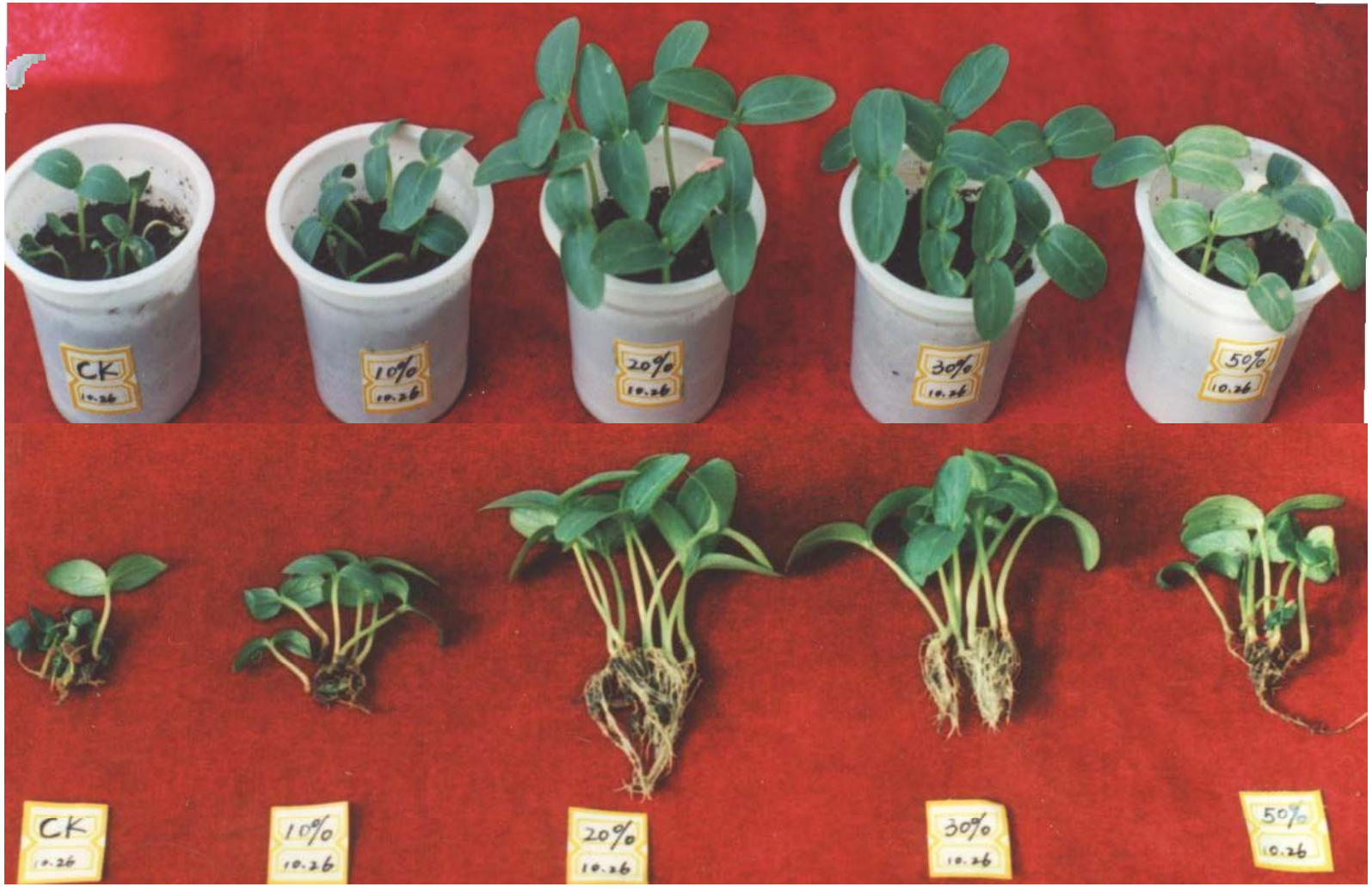
Antiblastic effect of vermicompost on some plant disease



（V-Vermicompost）

prevention and cure effect on cucumber



Application on vegetable production

豆角试验效果

胡罗卜试验效果

花叶茂盛色彩艳丽延长花期

花叶茂盛色彩艳丽延长花期

Experiment of Earthw rm AA additive on fish

Experiment of Earthworm AA additive on pig

CK

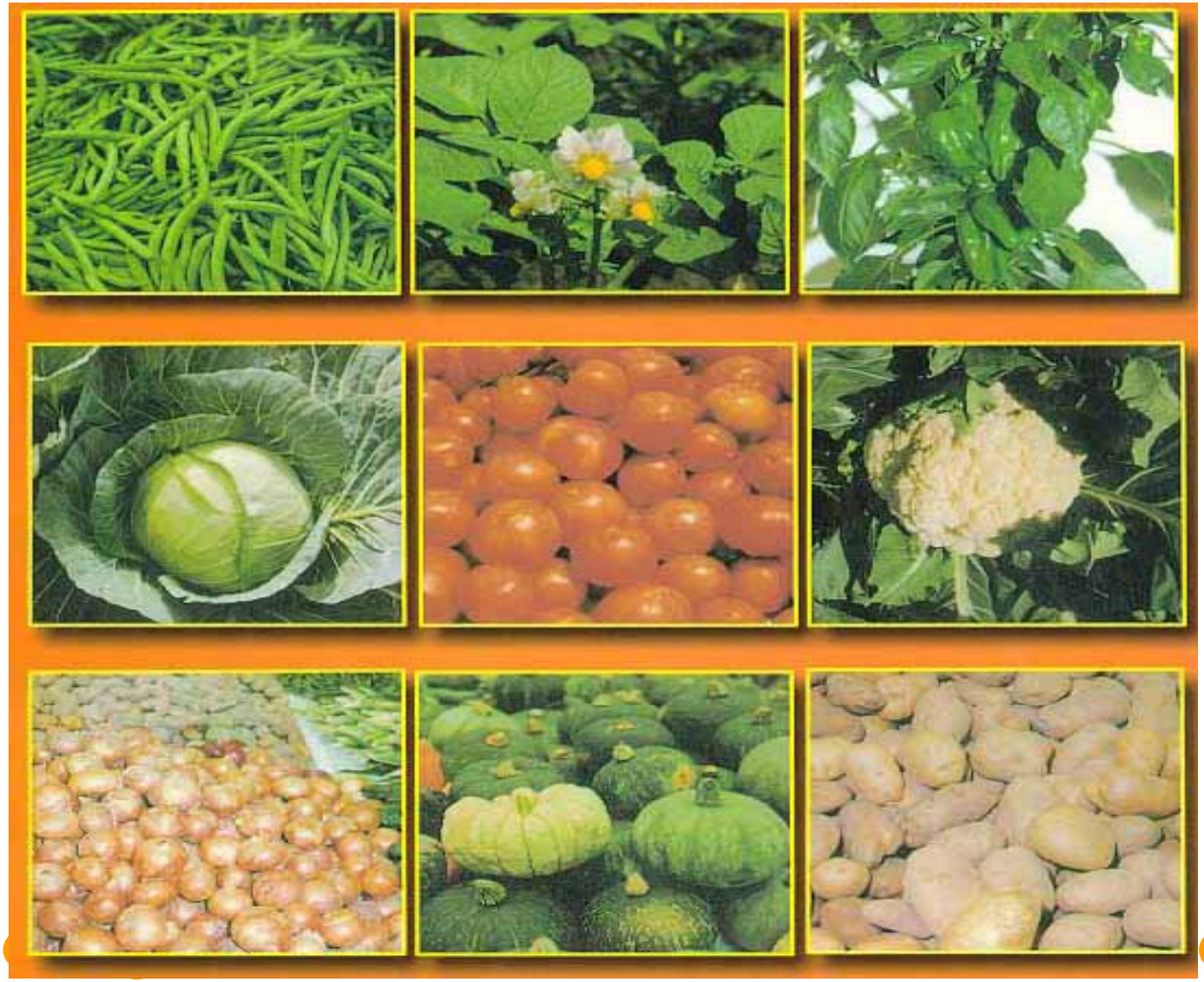
AA additive


复合蚯蚓营养液研制与应用试验研究
课 题 验 收 会


美国甜椒
科 属：茄科
原产地：南美

Application of vermicompost on alone (Tongzhou, Beijing)

Wide foreground of vermiculture and vermiproducts in organic food production



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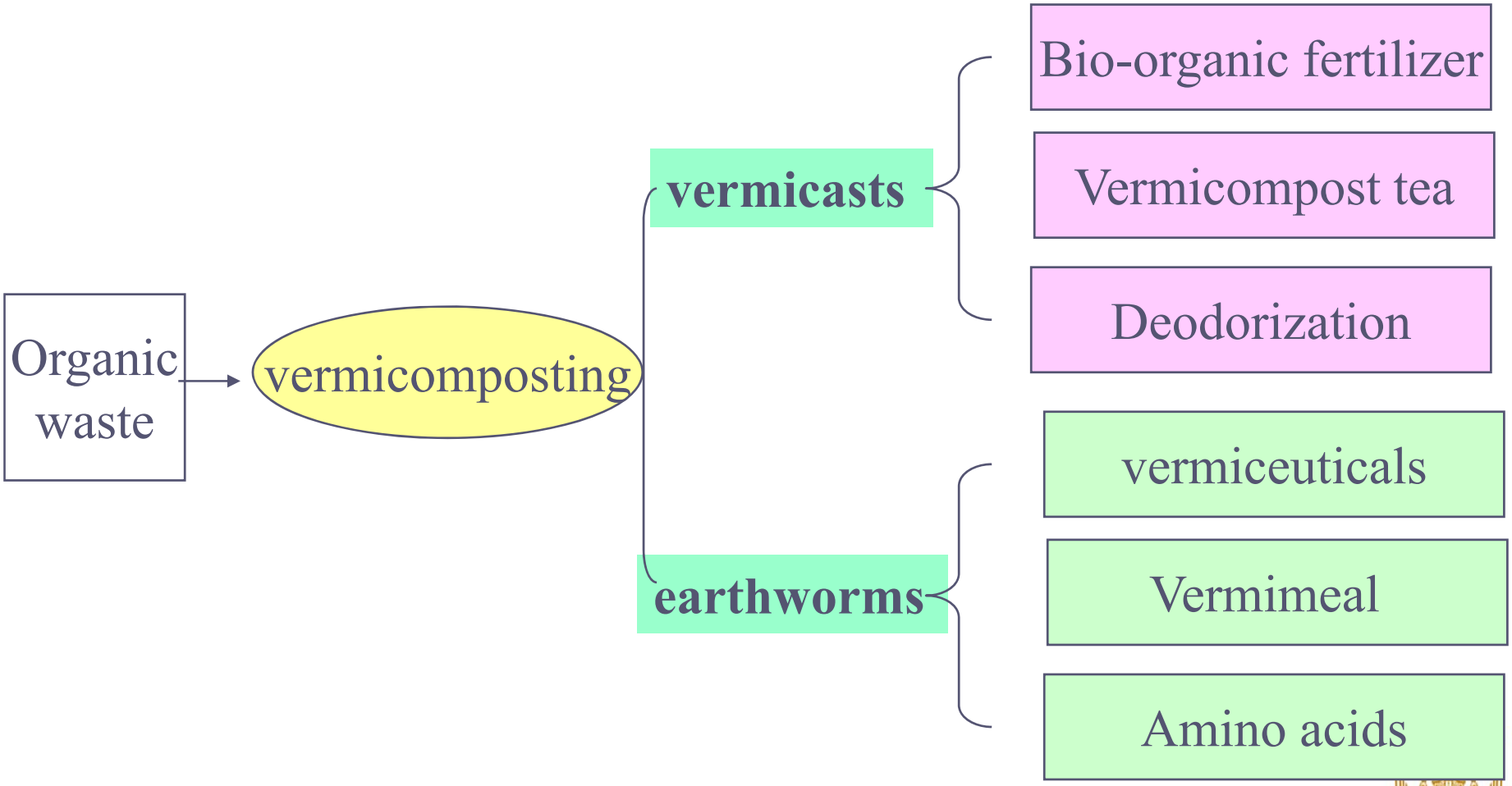
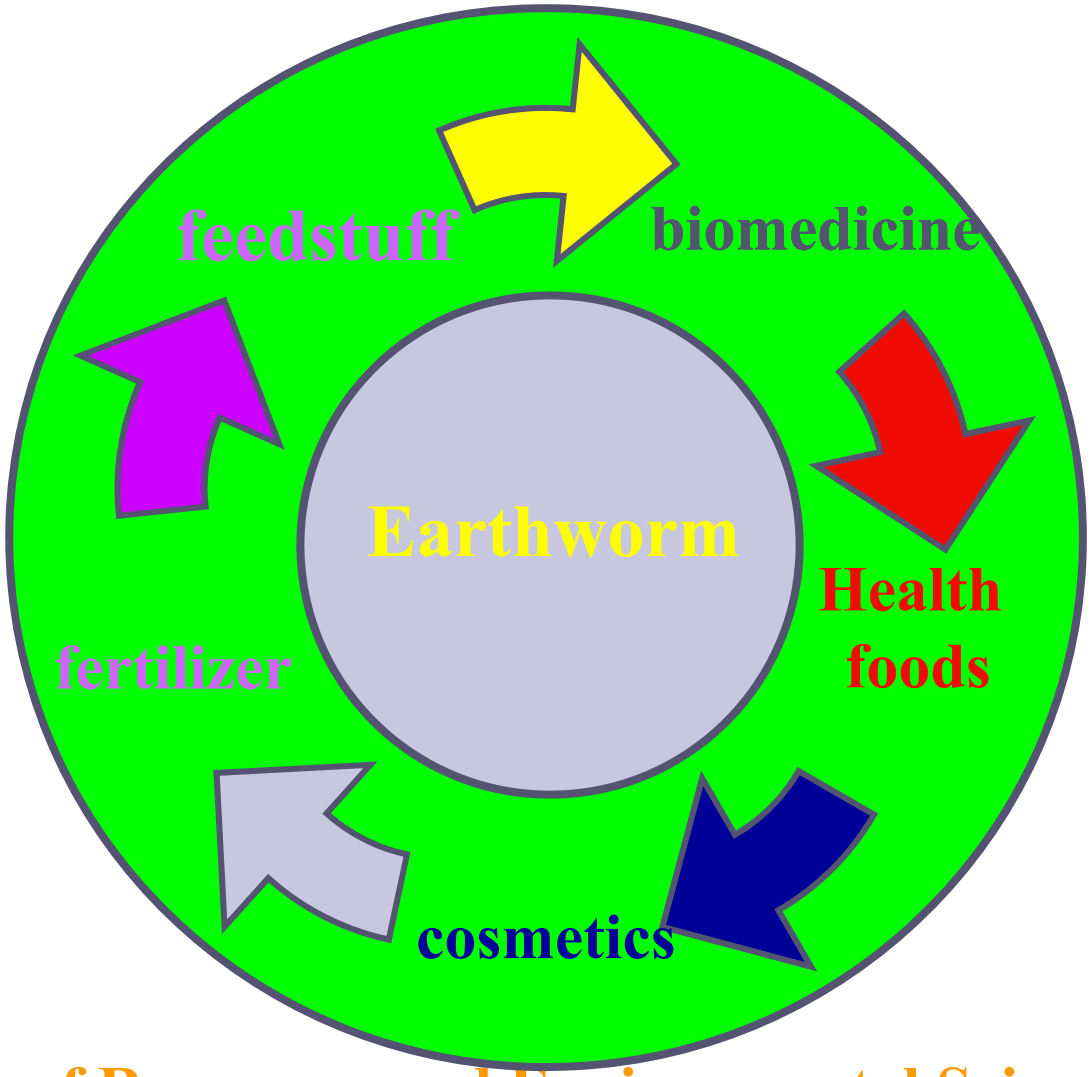
Earthworm (cast) and products processing

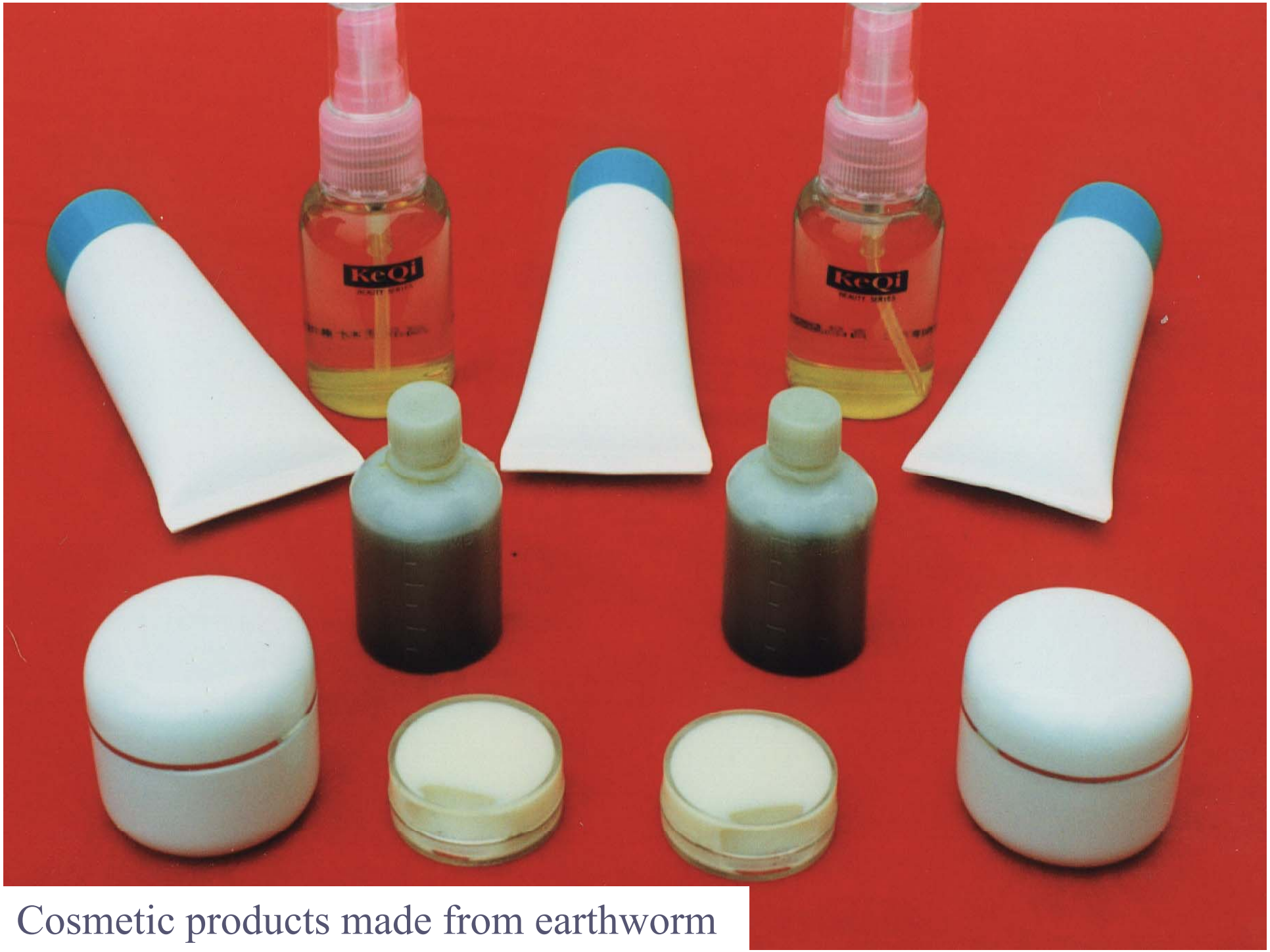


earthworm industrial chain



Medicine enzymes and Cosmetic products

Medicine enzymes from earthworms



Cosmetic products made from earthworm


TIANDESK
THANKS !