The Antibacterial Performance of Natural Bamboo Fiber and Its Influencing Factors

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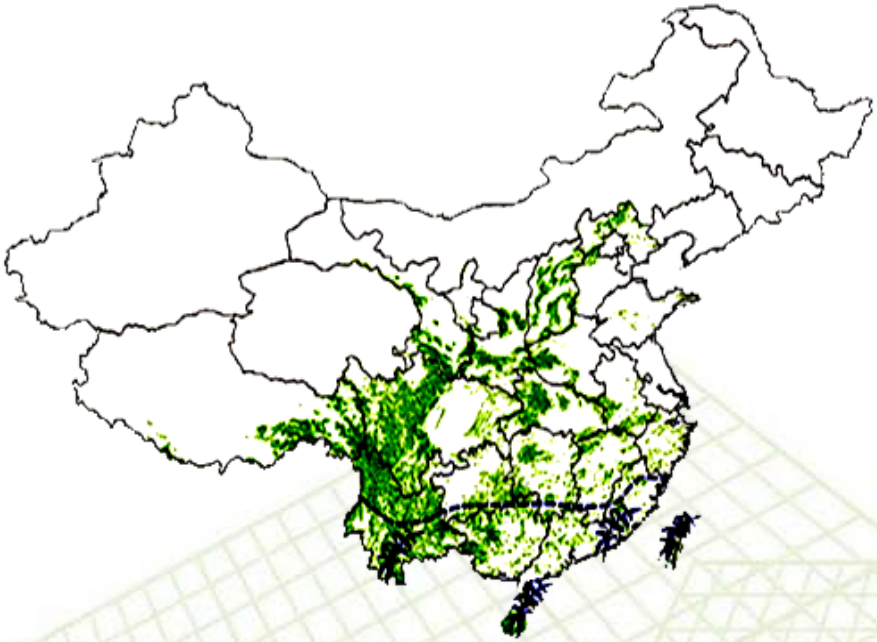
Contents

Introduction



- **Chinese Bamboo Resource**

More than 40 genus and 500 species in China.

Bamboo forest area: 5.38 million ha.

Bamboo annual yields: 20 million ton.

Introduction

- **Textile fibers from bamboo**
  - **Regenerated bamboo fiber (RBF)**

Bamboo pulp→ smashing→dipping→alkalization→ sulfonation → dissolution →screening →spinning→ plasticizing →washing → cut off → refining→ drying

Introduction

- **Textile fibers from bamboo**
  - **Natural bamboo fiber (NBF)**

bamboo spliting → alkali degumming → acid rinsing → water rinsing → dewatering → shaking → drying → combing

Introduction

- **Advantages of natural bamboo fiber**
  - **Saving cultivated land for cotton**
  - **Natural and environmentally friendly**
  - **Moisture absorption and comfortable**
  - **Natural antibacterial function?**
- **The aim of this study**

To investigate the natural antibacterial property of natural bamboo fiber and its influencing factors.

Materials and Methods

- **Materials**
  - Natural bamboo fiber from *Neosinocalamus affinis*
  - Cotton, Jute, Flax, Ramie, Regenerated bamboo fiber
  - Bamboo bundle，bamboo powder


Cotton


Ramie

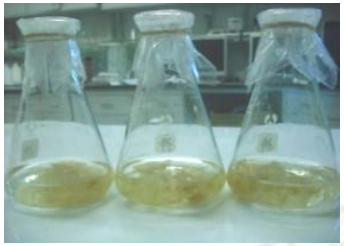

Flax


Jute

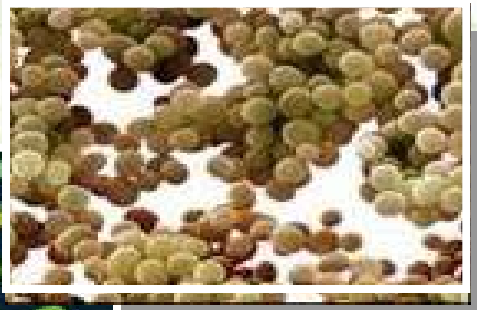

RBF

Materials and Methods

- **Antibacterial test**
  - Dynamic test (GB/T 20944.3-2008)



- **Microorganisms**
  - *Escherichia coli* (E. coli, 8099)
  - *Staphylococcus aureus* (S. aureus ATCC 6538)
  - *Candida albicans* (C. albicans, ATCC10231)



Materials and Methods

- **Hygroscopicity test**
  - **Referring to GB/T 9995-1997 and GB 6529-86**
  - **Conditioned fiber to balance state at 20℃ and 65% RH, and then dried them to constant weight at 105±2 ℃.**

$$W = \frac{G - G_0}{G_0} \times 100$$

W is the moisture regain, %, G is the wet weight of the fiber, g, G_0 is the dry weight, g.

Materials and Methods

- **Extraction**
  - Referring to the method used in papermaking process (GB/T 2677)
  - Extraction dissolvent: cold water, hot-water, ethanol, benzene, benzene/ethanol mixture, 1% NaOH.

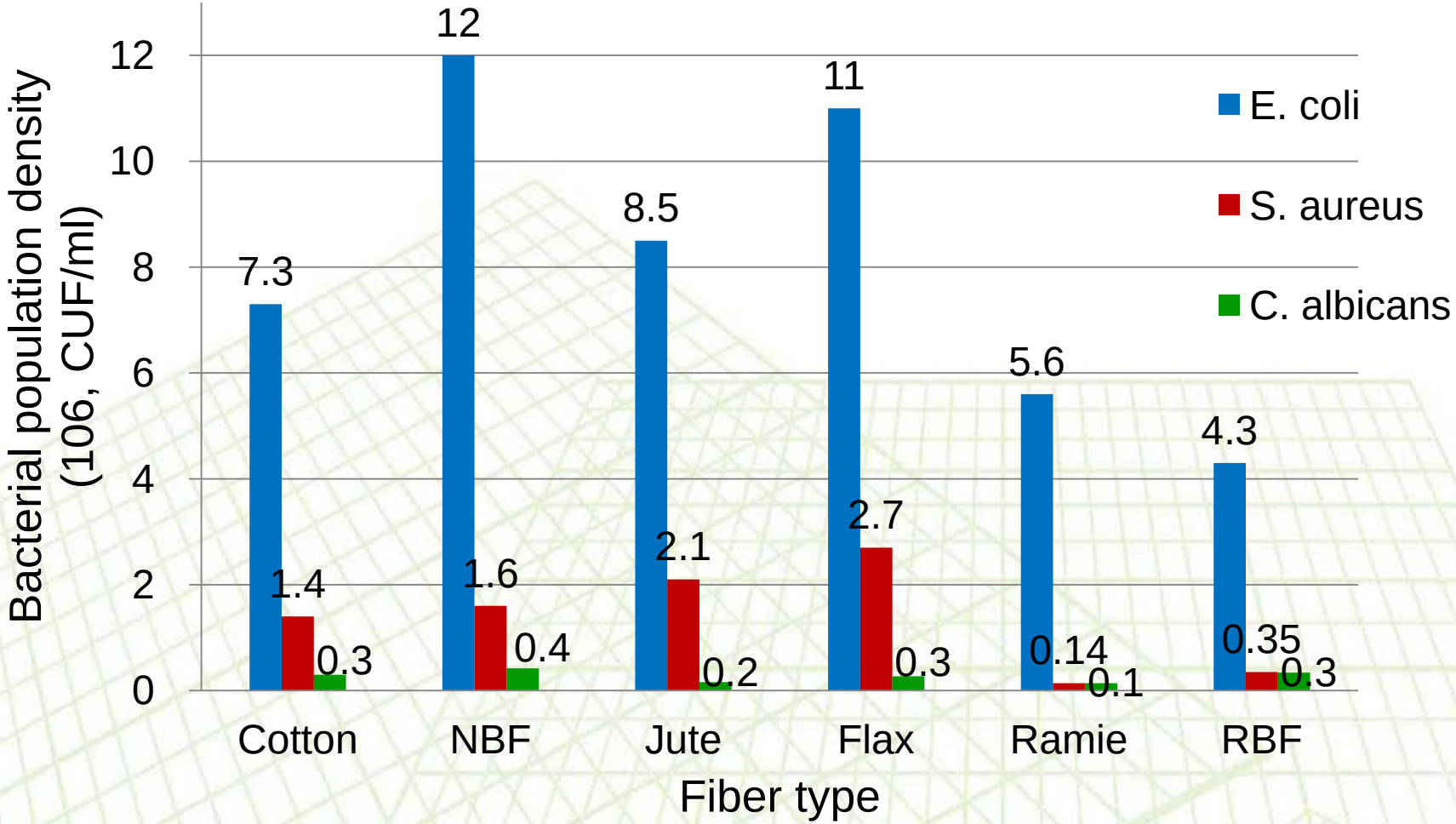
Result and Discussion

Results of the antibacterial test

fiber type	Bacteriostatic rate(%)		
	E. coli	*S. aureus*	*C. albicans*
Untreated cotton	0	0	0
NBF	0（-68.9）	0（-13.2）	0（-41.3）
Jute	0（-15.9）	0（-48.4）	48
Flax	0（-45.0）	0（-88.8）	8.7
Ramie	24.3	90.2	54
RBF	41.4	75.8	0（-12.8）
Antibacterial cotton	>99	100	100

Note: NBF=Natural bamboo fiber, RBF=Regenerated bamboo fiber

The bacterial population density on each sample after shaking 18h



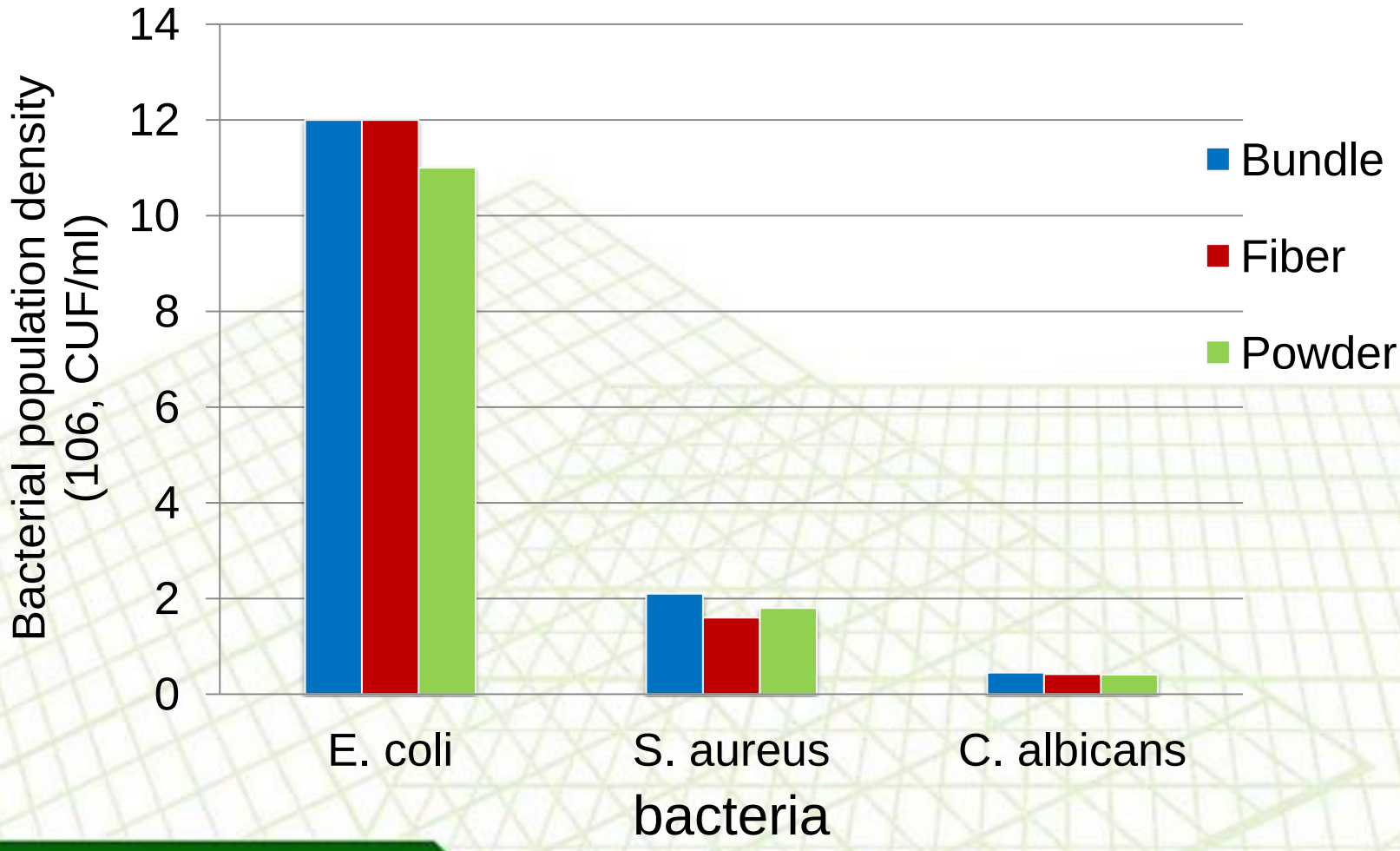
Antibacterial Efficiency of different extraction method

Extraction dissolvent name	antibacteria Efficiency（%）		
	Escherichia coli	Staphylococcus aureus	Candida albicans
Cold-water	64.35	10.91	0
Hot-water	69.57	30.91	0
Ethanol	18.26	7.88	0
Benzene	0	0	0
Benzene/ethanol	4.35	36.36	0
1% NaOH	58.26	67.88	0

The bacteriostatic rate on different shapes of bamboo

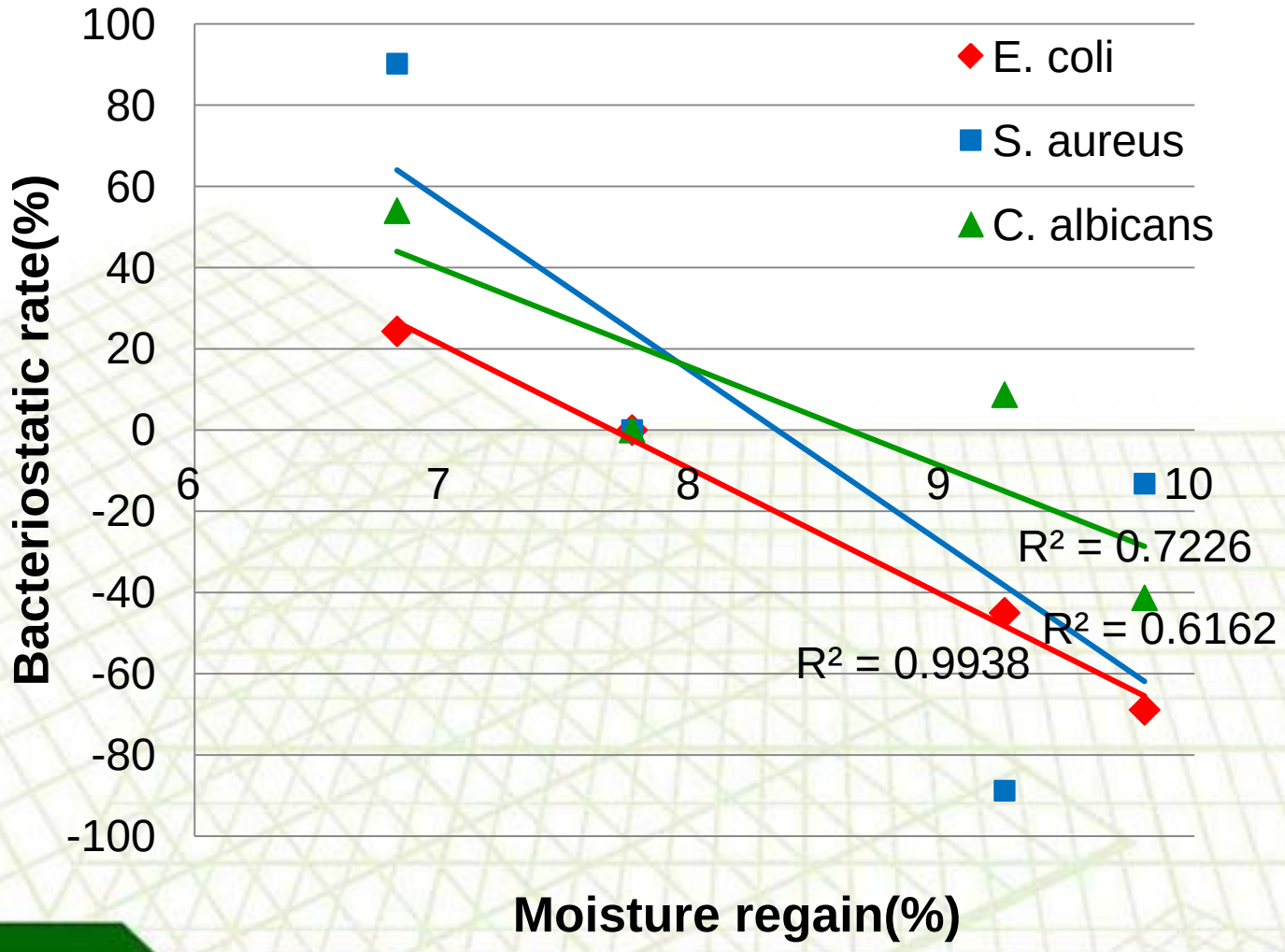
Bamboo shape	Bacteriostatic rate(%)		
	Escherichia coli	Staphylococcus aureus	Candida albicans
Bundle	0(-69.0)	0(-75.0)	0(-45.5)
Fiber	0(-68.9)	0(-13.2)	0(-41.3)
Powder	0(-54.9)	0(-50.0)	0(-33.4)

The bacterial population density on different shapes of bamboo



The relationship between moisture regain and bacteriostatic rate

Fiber	Moisture regain (%)
NBF	9.80
Cotton	7.75
Flax	9.24
Ramie	6.81
RBF	12.09



Conclusions

- Natural bamboo fiber has no antibacterial property compared with other textile fiber.
- The shape could not impact the antibacterial activity of natural bamboo fiber.
- The hygroscopicity may be a influencing factor in antibacterial performance of fiber.
- Extractives have influence on the antibacterial property of natural bamboo fiber.

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