



Original Article

## The effectiveness of coconut water in inhibiting *Shigella sp.* bacteria from diarrhea

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### ARTICLE INFORMATION

Received: January 02, 2019  
 Revised: January 10, 2019  
 Available online: July 26, 2019

### KEYWORDS

Diarrhea; Anti-Bacterial Agents; *Shigella sp* bacteria; Coconut

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### ABSTRACT

**Background:** Diarrhea is still a serious problem for some people. It can be affected by the *Shigella sp.* bacteria. Some villagers drink tender coconut water (*Co-cos nucifera L*) to cure diarrhea. Some types of consumed tender or green coconut are green coconut, brown coconut, *wulung* green coconut, and *wulung* brown coconut. It is necessary to determine the contribution of coconut types to treat diarrhea caused by the *Shigella sp* bacterium.

**Objective:** to determine the benefit of several types of coconut water toward diarrhea caused by bacteria such as *Shigella sp.*

**Method:** The method implemented was to determine the benefit of tender coconut water toward *Shigella sp* bacteria was experimental study through Kirby-Bauer test (antibiotic disc). The study selected water of green coconut, brown coconut, *wulung* green coconut, and *wulung* brown coconut, while the positive control used *Lodia* diarrhea drug and negative control used aquadest (Purified water). Testing data of green coconut water toward *Shigella sp.* was analyzed through analysis of variance (ANOVA) with F test at 95% significant level. Then it was continued by Duncan test at 95% significant level.

**Results:** The results of testing some green coconut water, positive control and negative control on *Shigella sp* bacteria can be seen from the clear zone formed around the antibiotic disc, green coconut showed 6.63 mm, brown coconut was 6.57 mm, *wulung* green coconut was 16.63 mm, *wulung* brown coconut was 9.23 mm, *Lodia* diarrhea drug was 12.33 mm and purified water was 7.27 mm.

**Conclusion:** all green coconut water is able to inhibit the growth of *Shigella sp.* The best inhibitor is obtained from the administration of *wulung* green coconut water with 16.6 mm diameter of the inhibition zone

### INTRODUCTION

Diarrhea is still a serious problem for some people. Diarrhea can be affected from several organisms such as the Rotavirus, Adenovirus and some bacteria such as *Shigella sp*, *Escherichia coli*, *Vibrio cholerae*, and other bacteria. Besides, diarrhea can be stimulated by malabsorption, parasites, allergies, immunodeficiency and food poisoning<sup>1</sup>. Extraordinary event (KLB) of diarrhea occurred in 2015, there were 18 incidents which occurred in 11 provinces, 18 districts/cities with 1,213 number of sufferers and caused 30 people die (2.47%)<sup>2</sup>.

Diarrhea caused by *Shigella sp* in Indonesia was relatively high which caused 29% of dysentery sufferers die<sup>3</sup>. If no treatment given to dysentery sufferers, there will be high possibility to be serious and even death<sup>4</sup>.

Some villagers consume tender coconut water to treat diarrhea. It is now becoming popular to have medicinal tender coconut (*wulung* green coconut) to heal some illnesses such as diarrhea. It shows that some are recovered and some are reducing the intensity from diarrhea after drinking the tender coconut water<sup>5</sup>. Based on the study<sup>6</sup>, tender coconut water is commonly used to treat diarrhea suf-

<https://doi.org/10.30595/medisains.v17i1.3796>

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ferers.<sup>7</sup> Besides, this water is also beneficial to cure intestinal worm and cholera, to reduce itching due to small pox and some other skin diseases.

Currently, it is familiar with medicinal coconut or people called as *wulung* coconut. This coconut has a pink color in the mesocarp (coir). On the outer skin (epicarp) the color is not always green but sometimes brownish<sup>5</sup>. *Wulung* coconut is able to cure various types of diseases. Therefore, people have been using coconut water for a long time to treat poisoning. Even *wulung* coconut water is also believed to be able to cure Hand, Foot and Mouth disease<sup>8</sup>. Based on the available strengths, it is necessary to conduct a test to tender coconut water in curing diarrhea caused by *Shigella* sp bacteria.

## METHOD

### Research materials

The instruments used in this study were autoclave, Laminar Air Flow (LAF), micropipette, petri dish, and test tube. The materials used included alcohol, Nutrient Agar (NA) media, Nutrient Broth (NB) media, antibiotic disc, green coconut, brown coconut, *wulung* green coconut, *wulung* brown coconut, *lodia* diarrhea drug as positive control and purified water as negative control.

### Experimental design

This study was an experiment to reveal the benefit of tender coconut water to *Shigella* sp bacteria by Kirby Bauer method (antibiotic disc). The diameter of the inhibition zone formed was measured at the time of observation.

### Working procedure and research variables

#### Bacterial rejuvenation

Bacterial rejuvenation was carried out by inoculating 1 needle from *Shigella* sp bacteria on NB medium and incubating for 1x24 hours at 37 °C.

#### Treatment preparation

The extraction from coconut water from each green coconut, brown coconut, *wulung* green coconut and *wulung* brown coconut was placed into a sterile test tube and treated aseptically. Positive control was done by adding 1 gram of *lodia* with 10 ml of sterile purified water, while the negative control used sterile purified water. A sterile NA medium and other equipments were sterilized.

#### Kirby Bauer test (antibiotic disc)

Sterile NA medium was poured into sterile petri dishes. 100 µl rejuvenated *Shigella* sp bacteria was placed on a spread plate and flattened with *drugalsky*. Then, each 3 blank discs were inserted with dripped coconut water (green coconut, brown coconut, *wulung* green coconut, *wulung* brown coconut), for positive control was dripped with *Lodia* diarrhea drug and negative control was sterile

purified water. Next, the inhibition zone was observed and measured formed around the antibiotic disc.

### Research analysis

The results of inhibitory zone diameters measurements were analyzed through analysis of variance (ANOVA). If there was a significant difference, Duncan Multiple Range (DMRT) test was continued at the 95% significant level and explained descriptively.

## RESULTS

The results of the average diameter in inhibition zone of each treatment were as follow; green coconut at  $6.63 \pm 0.25$  mm, brown coconut at  $6.57 \pm 0.51$ mm, *wulung* green coconut at  $16.63 \pm 4.84$  mm, and *wulung* brown coconut at  $9.23 \pm 1.98$  mm. The average diameter of inhibition zone for positive controls (*lodia* diarrhea drug) was  $12.33 \pm 1.01$  mm and negative control (purified water) was  $7.27 \pm 1.32$  mm (Table 1). The diameter of the inhibitory zone for each treatment can be seen in Figure 1.

The results indicated that the treatment of green coconut, brown coconut, *wulung* green coconut, *wulung* brown coconut, and purified water presented no significant difference in affecting the growth of *Shigella* sp. In the treatment of *wulung* brown coconut and diarrhea drug (*lodia*) illustrated no significantly different, and the diameter of the inhibition zone was wider than that of green coconut water. Whereas, the treatment of *wulung* green coconut water was significantly different from the other treatments. It could be seen from the extent of the inhibition zone created.

## DISCUSSION

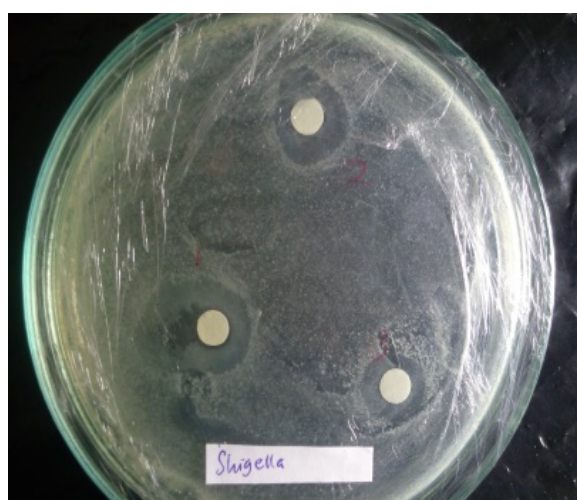
The treatment of *wulung* green coconut contributed the widest inhibiting zone compared to other treatments. The ability of coconut water to inhibit the growth of *Shigella* sp bacteria was due to the presence of tannin compounds found in coconut water. It was supported by<sup>5</sup>, that tannin and antidote (anti-toxin) in *wulung* coconut water could inhibit bacterial growth.

The mechanism of tannin in inhibiting *Shigella* sp. was by terminating the cell membrane, inactivating essential enzymes, and decoding the function of genetic material<sup>9</sup>. Meanwhile, according to<sup>10</sup>, the mechanism of tannin as an antibacterial was to inhibit the reverse transcriptase enzymes and DNA topoisomerase so that bacterial cells would not appear. Besides, tannins have anti-bacterial activities related to their ability to activate adhesion of microbial cells as well as enzymes, and interfere protein transport in the inner cell layer<sup>11</sup>. The presence of tannins in green coconut water contributed to inhibit the growth of *Shigella*. Sp. as one of the bacteria which causes diarrhea.

**Table 2.** The result of inhibiting zone diameter in some coconut water, diarrhea medicine and purified water toward shigella sp. bacteria.

Intervention	Inhibiting zone diameter of <i>Shigella</i> sp. bacteria (mm)			Average diameter of inhibiting zone (mm)
	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	
<i>Wulung</i> green coconut	21.8	15.9	12.2	16.63±4.84 <sup>a</sup>
<i>Wulung</i> brown coconut	11.0	9.6	7.1	9.23±1.98 <sup>bc</sup>
Green coconut	6.9	6.4	6.6	6.63±0.25 <sup>c</sup>
Brown coconut	7.0	6.0	6.7	6.57±0.51 <sup>c</sup>
<i>Lodia</i> diarrhea drug	11.4	13.4	12.2	12.33±1.01 <sup>b</sup>
Aquades	7.0	6.1	8.7	7.27±1.32 <sup>c</sup>

T= test, a = strong inhibiting, b = moderate inhibiting, c = weak inhibiting

**Figure 2.** Diameter of inhibiting zone *Shigella* sp. bacteria of *wulung* green coconu

For negative control, sterile purified water, the test results obtained clear zone around the antibiotic disc. The inhibition was due to the occurrence of water osmosis into bacterial cells which caused the bacterial cells to experience lysis. It was supported by <sup>12</sup>, which stated that one of the causes of lysis cells was the imbalance of osmotic pressure between environmental and cell pressures. If the environmental conditions were more hypotonic than the pressure conditions in the cell, or the conditions in the cell are more hypertonic than the environmental conditions, the cell would experience lysis. As a result, the cells would develope and eventually break.

As a positive control, the *Lodia* diarrhea drug was selected which was able to form inhibitory zone against *Shigella* sp. The active compound of *Lodia* was Loperamide HCl. *Lodia* was an antibiotic for diarrhea which worked by inhibiting bacterial cell wall synthesis. *Lodia* worked directly on cell membranes of microorganisms, increased permeability and caused leakage of intra-cellular compounds, interfered with the function of 30 S or 50 S ribosomal units to inhibit reversible protein synthesis, binded to 30 S ribosome subunits and interfered with protein synthesis, affected bacterial nucleic acid metabolism, and retained important enzymes from folate metabolism.

According to <sup>13</sup>, stated that *Loperamide* was antimotility drug. Meanwhile <sup>14</sup> the way *Loperamide* worked was to slow down intestinal motion and made stools more dense. *Loperamide* was also used to reduce the amount of fluid which came out in patients who had an ileostomy, and to treat diarrhea in people with inflammatory bowel disease.

## CONCLUSIONS AND RECOMMENDATION

Coconut water is able to inhibit *Shigella* sp bacteria which causes diarrhea. Green coconut water, brown coconut water, *wulung* brown coconut water, *wulung* green coconut water, diarrhea (*lodia*) and purifiedwater can inhibit the growth of *Shigella* sp. Meanwhile, the *wulung* green coconut water was the most effective and significant to inhibit the growth of the bacteria compared to other treatments with the diameter of the inhibition zone is 16.6 mm. Further research is required on what levels of tannins and types of specific compounds exist in green coconut water.

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