Abstract. This study investigated the effects of brown seaweed extract nanoparticles on liver enzymes of broiler chickens. The drinking water of broiler chickens were treated with no additive (negative control), zinc bacitracin (0.25 g/L; positive control), brown seaweed extracts (2.50 or 5.00 g/L), or brown seaweed extracts nanoparticles (25 or 50 mL/L). The safety of water additives was observed through the serum concentration of aspartate aminotransferase, alanine aminotransferase, and aspartate aminotransferase:alanine aminotransferase ratio as the biochemical marker for hepatocellular injury. Results showed that aspartate aminotransferase was significantly elevated \( (P < 0.05) \) in the chicks treated with zinc bacitracin, when compared to the negative control. Meanwhile, both brown seaweed extracts and brown seaweed extracts nanoparticles did not alter aspartate aminotransferase compared to negative control. Water additives showed negligible effects on alanine aminotransferase and aspartate aminotransferase:alanine aminotransferase ratio. It could be concluded that brown seaweed extract nanoparticles could be considered as a safe drinking water additive for broiler chickens.

Keywords: aspartate aminotransferase · brown seaweed · liver enzyme · nanoparticle · poultry

1 Introduction

Broiler chickens is currently recognized as one of the most important livestock commodities to fulfill national meat demand in Indonesia. According to DGLAH [1], broiler chicken population is increase from year to year, with the increment rate of 6.31\% in the last five years. DGLAH [1] also reported that about 71.5\% national meat production originate from broiler chickens. For these reasons, efforts to increase efficiency of broiler chicken production is highly essential to support the fulfillment of national meat demand.

Antibiotic growth promoters (AGP) have been used intensively to improve efficiency of broiler chicken production for over six decades [2]. However, the overuse of AGP led to the emergence of multi-resistant pathogenic microbes growth which threaten both animal and human health. [3–5] For this reason, the use of AGP is now prohibited in
broiler production [3]. In Indonesia, the ban of AGP was started from 2018 [6]. In the absence of AGP, many problems in the growth and health conditions of the birds as well as increasing production cost were reported [7–10]. Therefore, finding safe alternatives for AGP is highly crucial for sustainable broiler chicken production.

Natural extract nanoparticles have recently emerged as promising alternatives to antibiotic growth promoters in the poultry industry. A meta-analysis study by Andri et al. [11] showed that nanoparticles inclusion improved body weight gain and reduced feed conversion ratio without any adverse effect on feed intake of broiler chickens. However, it should be noted that the use of nanoparticles products has potent cellular toxicity [12]. This is because nanoparticles can penetrate every part of the body easily and interact with intracellular metabolism [13]. Furthermore, the safety evaluation of nanoparticles products in broiler chickens is still very limited. Thereby, this study investigated the probable effects of brown seaweed extract nanoparticles on liver enzymes of broiler chickens.

2 Materials and Methods

2.1 Birds and Management

One hundred and ninety-two mixed sex broiler chickens were obtained from a commercial hatchery. Upon arrival, the birds were reared in an open-sided house using rice husk as floor material. On day 11, the birds were distributed into 24 pens representing six treatments with four replicates of eight chicks each.

2.2 Experimental Design

A completely randomized design with six treatments and four replicates was employed in this study. The drinking water of broiler chickens were treated with no additive (negative control), zinc bacitracin (0.25 g/L; positive control), brown seaweed extracts (2.50 or 5.00 g/L), or brown seaweed extracts nanoparticles (25 or 50 mL/L). The experimental treatment was lasted from day 11 up to day 42.

2.3 Liver Enzymes Examination

At the end of the experiment, one bird per replicate pen was chosen. Blood was collected from jugular vein and the serum was separated. Serum concentration of aspartate aminotransferase, alanine aminotransferase, and aspartate aminotransferase:alanine aminotransferase ratio were then examined. These variables were biochemical marker for hepatocellular injury thus observed to evaluate the safety of drinking water additives.

2.4 Statistical Analysis

Data were analyzed statistically using analysis of variance with \( P < 0.05 \) was considered as significant. Means in the variable with significant effect were separated using Duncan’s test. Analyzed data were reported as means ± standard deviation. All statistical analyses were proceed using IBM SPSS Statistics 22.
3 Results and Discussion

The effects of drinking water inclusion with zinc bacitracin, brown seaweed extract, and brown seaweed extract nanoparticles on serum aspartate aminotransferase, alanine aminotransferase, and aspartate aminotransferase:alanine aminotransferase ratio of broiler chickens is presented in Table 1. The use of zinc bacitracin in drinking water elevated ($P < 0.05$) serum aspartate aminotransferase concentration, when compared to that of negative control. The increment of serum aspartate aminotransferase concentration in the chicks treated with zinc bacitracin was almost 1.5 times to that of negative control. On the other hand, both brown seaweed extract and brown seaweed extract nanoparticles did not alter aspartate aminotransferase compared to that of negative control. Drinking water additives showed a negligible effect on serum alanine aminotransferase concentration of broiler chickens. In the case of aspartate aminotransferase:alanine aminotransferase ratio, no substantial alteration was observed on all drinking water treatments.

Serum concentration of aspartate aminotransferase, alanine aminotransferase, and aspartate aminotransferase:alanine aminotransferase ratio are indicators of hepatocyte damage induced by drugs metabolism in the liver [14]. In current study, the use of AGP increased serum aspartate aminotransferase concentration of broiler chickens. In agreement with this finding, Haque et al. [15] also reported that the use of ciproflox and renamycin as AGP in broiler chicken diets elevated serum aspartate aminotransferase concentration. Similarly, Lee et al. [16] also observed that aspartate aminotransferase concentration of broiler chickens was increased due to the use of enramycin as AGP. In another study, Erinle et al. [17] also found that the use of bacitracin methylene disalicylate as AGP tended to increase serum aspartate aminotransferase concentration in broiler chickens. It could be stated that the detoxification of antibiotics in the liver induced hepatocyte damage thus releasing aspartate aminotransferase to the circulatory system. This finding provided indication that the use of AGP impaired the liver health of broiler chickens.

The utilization of natural additives rich in bioactive compounds are currently received great attention as AGP alternatives [18–23]. Brown seaweed is one of the potential

<table>
<thead>
<tr>
<th>Treatments</th>
<th>AST</th>
<th>ALT</th>
<th>AST:ALT ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>193.00 ± 17.91$^a$</td>
<td>13.25 ± 0.50</td>
<td>14.56 ± 1.05</td>
</tr>
<tr>
<td>ZB (0.25 g/L)</td>
<td>283.00 ± 18.06$^a$</td>
<td>14.00 ± 0.82</td>
<td>20.27 ± 1.85</td>
</tr>
<tr>
<td>BSE (2.5 g/L)</td>
<td>215.50 ± 61.16$^a$</td>
<td>14.00 ± 0.82</td>
<td>15.59 ± 4.99</td>
</tr>
<tr>
<td>BSE (5 g/L)</td>
<td>217.75 ± 18.84$^{ab}$</td>
<td>13.25 ± 1.26</td>
<td>16.57 ± 2.29</td>
</tr>
<tr>
<td>BSEN (25 mL/L)</td>
<td>230.25 ± 33.93$^{ab}$</td>
<td>14.75 ± 1.50</td>
<td>15.79 ± 3.12</td>
</tr>
<tr>
<td>BSEN (50 mL/L)</td>
<td>236.25 ± 44.51$^b$</td>
<td>13.75 ± 0.96</td>
<td>17.32 ± 3.96</td>
</tr>
</tbody>
</table>

$^a$ uncommon superscripts indicate significant different ($P < 0.05$).
resources which could be used as a natural antibacterial agent [24]. The main bioactive substance in brown seaweed extract was phenolic compounds [25, 26]. Nanoparticles technology could be employed to improve the antibacterial efficacy of brown seaweed extract [27]. In this study, the evaluation was focus on safety aspect of brown seaweed extract and brown seaweed extract nanoparticles. Results showed that both brown seaweed extract and brown seaweed extract nanoparticles did not alter serum aspartate aminotransferase concentration. This result probably because brown seaweed extract and brown seaweed extract nanoparticles were natural products so that they did not possess any harmful effect on the health of broiler chickens. In line with this finding, Erinle et al. [17] observed that the use of grape pomace which rich in phenolic compounds as AGP substitute did not alter serum aspartate aminotransferase concentration in broiler chickens. In a study by Adegoke et al. [28] the use of turmeric and cayenne pepper as source of dietary phenolic compounds also had no adverse effect on serum aspartate aminotransferase concentration of broiler chickens.

4 Conclusions

It could be concluded that brown seaweed extract nanoparticles could be considered as a safe drinking water additive for broiler chickens.

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References


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