KEMAMPUAN *TOXIN BINDER* BERBAHAN *BENTONITE*, *YEAST CELL WALL*, *CURCUMIN*, DAN *CINNAMON* TERHADAP PENGIKATAN SERTA PENURUNAN TOKSISITAS AFLATOKSIN B_1 PADA BROILER

INTISARI

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Penelitian ini bertujuan mengetahui kemampuan *toxin binder* berbahan *bentonite*, *yeast cell wall*, *curcumin*, dan *cinnamon* terhadap pengikatan serta penurunan toksisitas aflatoxin B_1 (AFB_1) pada broiler. Pengujian daya ikat dilakukan secara *in vitro* dengan rancangan acak lengkap pola searah yang terdiri dari 4 perlakuan *toxin binder* dengan 3 ulangan yaitu P1=*bentonite* 100%, P2=*yeast cell wall* 100%, P3=*bentonite* 50% + *yeast cell wall* 50%, dan P4=*bentonite* 47,5% + *yeast cell wall* 47,5% + *curcumin* 3% + *cinnamon* 2 %. Penelitian secara *in vivo* dilakukan dengan menggunakan 288 *day old chick* (DOC) broiler jantan yang dibagi menjadi 6 perlakuan, setiap perlakuan terdiri dari 6 ulangan dengan 8 ekor broiler per ulangan. Hasil uji *in vitro* menunjukkan bahwa *bentonite* signifikan memiliki daya ikat AFB_1 tertinggi (92,96%). Kombinasi *bentonite*, *yeast cell wall*, *curcumin*, dan *cinnamon* menghasilkan daya ikat tinggi (86,52%) sedikit lebih rendah dari *bentonite*, tetapi tetap efektif menurunkan toksisitas AFB_1. Pakan terkontaminasi AFB_1 positif kontrol (PC) menurunkan ADG dan meningkatkan FCR ($P<0,05$) dibandingkan pakan kontrol tanpa AFB_1 (P0), dengan penambahan *toxin binder* mampu memperbaiki peningkatan ADG dan menurunkan FCR ($P<0,05$) selama pemeliharaan broiler 21 hari. Paparan AFB_1 berpengaruh terhadap penurunan ureum (P0=2,56 mg/dL; PC=1,28 mg/dL) dan BUN (P0=1,18 mg/dL; PC=0,6 mg/dL), tetapi secara konsisten *toxin binder* mengandung *curcumin* dan *cinnamon* memiliki rataan ureum, BUN lebih tinggi, begitu juga terjadi peningkatan trigliserida (54,88 mg/dL tanpa AFB_1; 40,22 mg/dL terpapar AFB_1) dibandingkan tanpa penambahan *curcumin* dan *cinnamon* (44,30 mg/dL tanpa AFB_1; 29,58 mg/dL terpapar AFB_1), hal ini dimungkinkan adanya efek antioksidan berpengaruh terhadap fungsi kerja hati. AFB_1 menurunkan rasio panjang vili : kedalaman kripta VH/CD (P0=8,93; PC=6,20) pada usus jejenum ($P<0,05$), sedangkan *toxin binder* signifikan meningkatkan VH/CD (7,85 dan 7,99). Paparan AFB_1 menyebabkan penurunan ekspresi gen CLDN1 (P0=1,17; PC=0,84) dan ZO1 (P0=1,31; PC=0,83), tetapi terjadi peningkatan JAM2 (P0=1,22; PC=1,63). Penambahan *toxin binder* mampu memperbaiki integritas *tight junction* yang ditunjukkan pada peningkatan nilai CLDN1, ZO1 ($P=0,000$). Pakan terpapar AFB_1 signifikan meningkatkan sitokin pro-inflamasi TNFα (P0=0,98; PC=1,27), IL18 (P0=1,05; PC=1,32), serta anti-inflamasi IL10 (P0=0,83; PC=2,58), IL13 (P0=1,06; PC=1,60). Penambahan *toxin binder* membalikkan respon sitokin melalui penurunan TNFα, IL18, IL10 ($P=0,000$), sedangkan IL13 sebaliknya pada kombinasi *bentonite* dan *yeast cell wall*. Penambahan *curcumin* dan *cinnamon* belum menunjukkan pengaruh signifikan terhadap respons sitokin, namun berpotensi memberikan efek protektif melalui aktivitas antioksidan. Berdasarkan hasil penelitian, kombinasi *bentonite* dan *yeast cell wall* dengan daya ikat sekitar 85% merupakan toxin binder paling efektif dalam mencegah dampak negatif toksisitas AFB_1 pada broiler.

Kata kunci : *Toxin binder, Bentonite*, *Yeast cell wall*, *Curcumin*, *Cinnamon*.

THE ABILITY OF TOXIN BINDER BASED ON BENTONITE, YEAST CELL WALL, CURCUMIN, AND CINNAMON TO BIND AND REDUCE AFLATOXIN B_1 TOXICITY IN BROILERS

ABSTRACT

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This study aimed to assess the efficacy of toxin binders composed of bentonite, yeast cell wall, curcumin, and cinnamon in binding and mitigating the toxicity of aflatoxin B_1 (AFB_1) in broilers. The in vitro binding assay was conducted using a completely randomized design consisting of four treatments with three replicates: P1 = 100% bentonite, P2 = 100% yeast cell wall, P3 = 50% bentonite + 50% yeast cell wall, and P4 = 47,5% bentonite + 47,5% yeast cell wall + 3% curcumin + 2% cinnamon. The in vivo trial involved 288 male day-old broiler chicks distributed into six dietary treatments, each comprising six replicates with eight birds per replicate. The in vitro results demonstrated that bentonite exhibited the highest AFB_1 binding capacity (92,96%). The combination of bentonite, yeast cell wall, curcumin, and cinnamon achieved a similarly high binding capacity (86,52%), slightly lower than bentonite alone, yet still effective in reducing AFB_1 toxicity. AFB_1 contaminated feed (positive control, PC) significantly reduced average daily gain (ADG) and increased feed conversion ratio (FCR) ($P < 0,05$) relative to the non-contaminated control (P0). Supplementation with toxin binders markedly improved ADG and decreased FCR ($P < 0,05$) throughout the 21 days rearing period. AFB_1 exposure decreased serum urea (P0 = 2.56 mg/dL; PC = 1,28 mg/dL) and blood urea nitrogen (BUN) (P0 = 1,18 mg/dL; PC = 0,6 mg/dL), However, toxin binders containing curcumin and cinnamon consistently showed higher average urea, BUN, and triglyceride levels (54.88 mg/dL without AFB_1; 40.22 mg/dL with AFB_1 exposure) compared to treatments without curcumin and cinnamon (44.30 mg/dL without AFB_1; 29.58 mg/dL with AFB_1 exposure). This may be attributed to the antioxidant effects of curcumin and cinnamon, which could influence liver function. AFB_1 exposure reduced the jejunal villus height-to-crypt depth (VH/CD) ratio (P0 = 8,93; PC = 6,20) ($P < 0,05$), while toxin binder supplementation significantly improved VH/CD ratios (7.85 and 7.99). At the molecular level, AFB_1 downregulated CLDN1 (P0 = 1,17; PC = 0,84) and ZO1 (P0 = 1,31; PC = 0,83) expression and upregulated JAM2 (P0 = 1,22; PC = 1,63). Toxin binder inclusion improved tight junction integrity, as evidenced by increased CLDN1 and ZO1 expression (P=0,000). Dietary AFB_1 significantly elevated pro-inflammatory cytokines TNF-α (P0 = 0,98; PC = 1,27) and IL-18 (P0 = 1,05; PC = 1,32), and anti-inflammatory cytokines IL-10 (P0 = 0,83; PC = 2,58) and IL-13 (P0 = 1,06; PC = 1,60). Toxin binder supplementation modulated the cytokine profile by reducing TNF-α, IL-18, and IL-10 (P=0,000), whereas IL-13 increased specifically in the bentonite, yeast cell wall combination. Although curcumin and cinnamon did not exert a significant effect on cytokine responses, their antioxidant activities may contribute to a protective physiological role. Overall, the combination of bentonite and yeast cell wall, with an AFB_1-binding capacity of approximately 85%, was identified as the most effective toxin binder for mitigating the detrimental effects of AFB_1 toxicity in broilers.

Key word: Toxin binder, Bentonite, Yeast cell wall, Curcumin, Cinnamon.