

EFFECTS OF CARBONACEOUS ADDITIVE ON DIOXIN ACCUMULATION IN BROILER CHICKEN

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Abstract

Effects of carbonaceous feed additive ("Food Saver") in suppression of dioxin accumulation and biological effects in chicken were investigated in the present study. There were no abnormal histopathological findings in tissues between treated with feed additive and control group. However, some biochemical parameters (NEFA and TG) in blood plasma were significantly different between dioxin + feed additive and only dioxin fed groups. Dioxin accumulations in abdominal fat and pectoral muscle were clearly difference between chickens fed with feed additive and non-additive. Control of dioxin accumulation in chicken was highly effective compared to previous studies with test animals (rat and yellowtail fish). This result indicated that animal feed with carbonaceous additive, "Food Saver", was one of the effective ways to reducing health risk of dioxin in animal and human.

Introduction

Human intake of dioxins is suggested to be mostly come from their foodstuff. Fish consumption is the main dioxin exposure route in Japanese including peoples in many Asian countries; where as meat and animal products are the main dioxin exposure route in most of western inhabitants.^{1,2} Therefore, it is an important issue to control dioxins in foodstuff to reduce dioxin related health risk in human.³ Iwakiri et al. (2005, 2006) has been reported that carbonaceous materials could be an effective dioxin accumulation suppressant in rat and cultured fish.^{4,5} Recently, dioxin contamination incidents in domestic animals were reported in EU and USA. Therefore, in the present study was carried out to ensure the effects of carbonaceous materials as a feed additive to control dioxins accumulation in broiler chicken.

Materials and Methods

Animals and treatment

Twenty four "chunky-type" day-1 male broiler chicks (~45 g) were randomly divided in to 4 groups. Chicks were given 4 different feeds with or without "Food Saver" (Miura industry Co., Ltd.) carbonaceous materials and adjusted dioxin dosage made from PCDD/DFs standard solution (Wellington Laboratories Inc.). The feed types were: 1). Feed with dioxin addition, 2) Feed with dioxin + Food Saver addition (0.5% W/W), 3) Normal feed (Nihon Nosan, Japan) and 4) Feed with Food Saver addition (0.5% W/W). Groups 3) and 4) were assigned to see the influence of the dioxin suppressant "Food Saver" in chicken. The final dioxin concentrations in dioxin added feeds were 470 pg/g and 525 pg/g in chick and adult feed, respectively. Chickens were fed for 8 weeks, 4 weeks each with chick feed followed by adult feed, and body weight was measured every 3-days.

Analysis

At the end of the experiment, blood was collected for biochemical analysis. Then birds were euthanized and pectoral muscle and abdominal fat were collected for dioxin analysis. All biological samples (blood and organs) were stored at -20 C° until instrumental analysis. The following tissues were fixed in 10% phosphate-buffered formalin and processed for histological examination: liver, kidney, spleen, heart, lung, thymus, testis, bursa of fabricius, and brain. This experiment followed the guidelines for animal experiments of the National Institute of Animal Health, Tsukuba, Japan.

The method for dioxins analysis was mentioned elsewhere.⁶ Briefly, samples were extracted with alkyl digestion and hexane. Then samples were purified through a multi-layer silica gel column and fractionated by an active carbon dispersion silica gel column. The quantification was carried out by a HRGC/HRMS.

Results and Discussion

Biochemical changes

End of the experiment, no significant difference in body weight and abnormalities of histopathology were recognized in chickens between suppressant addition group (Group 4) and non-addition group (Group 3). However, in the plasma biochemical parameters, non-esterified fatty acids (NEFA) seem to be increased with decreasing of triglyceride (TG) in the suppressant addition group (Group 4) (Fig.1). It can be assumed that carbonaceous material added to feed may restrain part of fat absorption into the chicken body. As a result triglyceride level may decrease in the body and, consequently free fatty acid may discharges to cover up the lacked TG levels in the body. This tendency was significantly recognized in chickens fed with dioxins in Group 1 and 2. There could be some effects to the fat accumulation / metabolism in chicken which is resulted from dioxin intake. However, by addition of dioxin suppressant to feed with dioxins showed similar results to non dioxin fed chickens implying that this suppressant may improve some of deleterious effects of dioxin exposure.

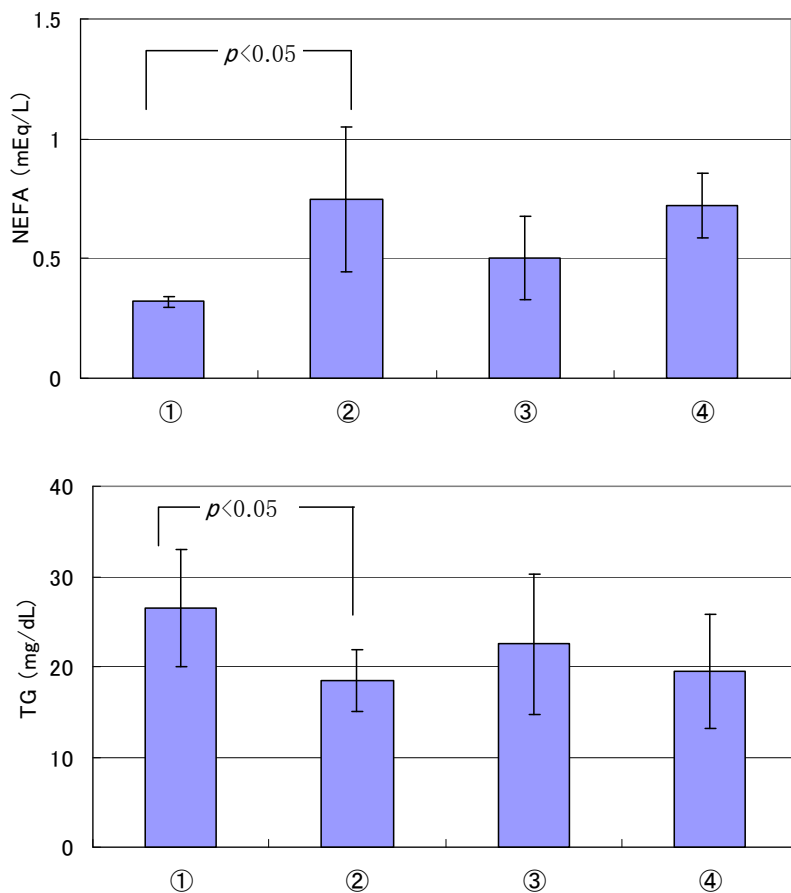


Fig.1 NEFA and TG concentrations in test chicken serum.

- 1) Feed with dioxins
- 2) Feed with dioxin and "Food saver"
- 3) Control feed (no dioxins and "Food saver")
- 4) Feed with "Food saver"

Suppression effects of dioxin accumulation

The effect of with/without suppressant "Food Saver" on dioxin accumulation was shown in Fig 2. The dioxin accumulation in chicken was calculated by the ratio of total dioxin burden in muscle and fat to dioxin intake via feed (feed wt x dioxin concentration) at the end of experiment. The accumulation of dioxin reduced greatly (less than 1%) in the chicken fed with "Food Saver" compared to chicken fed without "Food Saver". This result showed that control of dioxin accumulation in chicken with "Food Saver" was similar to previous studies in rat and cultured yellowtail.^{4,5} In addition, dioxin accumulation in liver in chicken fed with "Food Saver" was lower similar to previous studies (data not showing). Hence, dioxin-like toxic effects in the chicken liver could also be fewer.

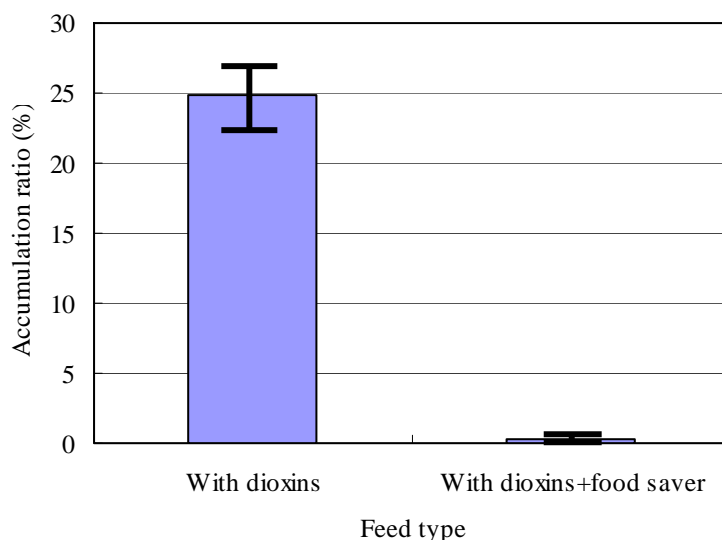


Fig 2. Accumulation ratio of dioxins in chicken fed with and without "Food Saver"

When compared to previous studies with rat and yellowtail fish, the effect of adding "Food Saver" suppressant for dioxin control in chicken was much effective.^{4,5} Better mixing between suppressant and dioxins in feed in the gizzard could be suggested as a possible reason for the current observation in chicken.

These results suggested that "Food Saver" originated from carbonaceous raw materials have clearly reduced dioxin accumulation in the chicken body. It was also seen that there was some influences about internal fat accumulation at the same time. Therefore, this dioxin suppressant may reduce the dioxin accumulation and dioxin-related health risk in chicken. Thus, human health risk by dioxin intake from chicken could also be able to reduce.

References

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