

## Effects of Cecectomy on Nitrogen Utilization and Nitrogen Excretion in Chickens Fed a Low Protein Diet Supplied with Urea

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**ABSTRACT:** The effects of cecectomy on nitrogen utilization and nitrogen excretion were examined in single comb white leghorn (SCWL) cockerels fed a 5% protein diet supplied with urea. The cecectomy tended to increase nitrogen balance and nitrogen utilization and significantly decreased uric acid excretion ( $p < 0.01$ ). Urea and ammonia excretion tended to be about 60% increased and decreased by cecectomy in SCWL cockerels, respectively, but blood ammonia, urea and uric acid concentrations

were not affected. The results are in good agreement with those obtained previously in cecum-ligated chickens. It is concluded that the improvement of nitrogen utilization and decreases in urinary uric acid excretion in cecectomized chickens do not result from the modification of cecal fermentation.

(**Key Words:** Chicken, Ceacum, Cecectomy, Nitrogen Balance, Nitrogen Utilization)

### INTRODUCTION

It has been reported that cecum-ligation in chickens fed a 5% protein diet supplied with urea tends to increase nitrogen balance and to decrease uric acid excretion (Son et al., 1996a).

The current observations of the increase in volume of cecal contents in many of the ligated cecum with time indicated that some microbial activity must have continued, it is possible that nutrients could have entered the cecal lumen from the blood (Poppema and Duke, 1992). And it assumed that possible change in fermentation by the cecum-ligation, and consequently an improvement in nitrogen utilization and decreases in uric acid excretion (Son et al., 1996a). The present study was carried out to examine whether cecectomy (detaching of ceca) gives similar effects as cecum-ligation in chickens fed a 5% protein diet supplied with urea.

### MATERIALS AND METHODS

Six-month-old Single Comb White Leghorn (SCWL) cockerels, weighing  $2.15 \pm 0.08$  (mean $\pm$ SEM) kg body weight of 12 birds, were used in this study. The birds

were individually housed in metabolism cages in a light-controlled room (14L-10D). Control chickens were sham-operated in the same manner as in the cecectomized chickens except cutting of cecum. Surgery for the cecectomy was made according to the method of Green et al. (1987). Prior to surgery birds were fasted for 12 h and anaesthetized with sodium pentobarbital (25 mg/kg BW) via the wing vein. The ceca were ligated with a surgical silk suture (No. 4, Hashimoto Co., Tokyo) as near its origin as possible, thereafter cut and removed. Powdered Sulfisomidinum (Iwaki Pharmaceutical Co., Tokyo) was put in the abdominal cavity of the chicken, and abdominal muscular layer and skin were sutured. One month after the operation, the birds were used for experiments. Post-mortem inspections were done on all the cecectomized chickens to ascertain the absence of cecum.

A 5% protein semi-purified diet, which contained egg albumen as a sole source of protein, was prepared as described previously (Karasawa et al., 1973). Experimental birds were fed 35 g of the diet per kg body weight per day in the morning (08:30) for 7 d and intubated into the crop with 10 ml of 6% urea solution (in distilled water) per kg body weight per day after they consumed 5 g of the diet. The diet offered was consumed within 45 min in all cases. Thus both daily nitrogen intake of the 5% protein diet and of urea were 280 mg per kg body weight.

A mixture of feces and urine was collected for the last

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2 d of experimental period, using polyethylene bag attached to the cloaca. The collected excreta were immediately sprayed with 5N HCl and dried in an electric oven with forced aeration at 55°C.

Nitrogenous compounds were extracted from a given amount of the excreta in 0.5% lithium carbonate solution for determinations. Total nitrogen in excreta was determined by a Kjeldahl method, uric acid in excreta by an enzymatic spectrophotometric method (Pudelkiewicz et al., 1968), urea in excreta by an urease method and ammonia in excreta by colorimetric methods (McNabb and McNabb, 1975).

The significance of differences between means were determined by t-test (Snedecor and Cochran, 1967).

## RESULTS AND DISCUSSION

Table 1 shows changes in nitrogen balance and nitrogen utilization (N balance/N intake) in control and cecectomized chickens when the daily intake of nitrogen was 280 mg of protein nitrogen plus 280 mg of urea nitrogen per kg of body weight. Total nitrogen excretion tended to be decreased by cecectomy, and consequently nitrogen balance and utilization tended to be increased by the treatment, since nitrogen intake was similar in the control and cecectomized birds. This response agrees well with our previous results which were observed in cecum-ligated chickens fed a 5% protein diet, 5% protein diet plus urea or 10% protein diet (Son et al., 1996a; Son et al., 1996b).

Effects of cecectomy on excretion of nitrogenous compounds are shown in table 1. The cecectomy significantly decreased uric acid excretion by 82 mg nitrogen ( $p < 0.01$ ), which contributed to a decrease in total nitrogen excretion. These findings suggest that uric acid synthesis in chickens is affected by the back-flow of urine and the entry of ingesta into the ceca, and by

exclusion from cecal fermentation, which is in good agreement with those obtained previously in cecum ligated chickens.

Urea and ammonia excretion tended to be about 60% increased and decreased by cecectomy in SCWL cockerels, respectively. Some dietary urea can be utilized for growth of chicks, such as when crystalline amino acid diets low in nonessential nitrogen or diets containing low concentrations of intact protein are fed (Featherston et al., 1962; Lee and Blair, 1972; Davis and Martindale, 1973). It may be inferred that the nitrogen recycling through the ceca is involved in the utilization of dietary urea by the chicken. Karasawa (1989) had proposed a mechanism for the utilization of dietary urea, wherein the absorbed dietary urea is excreted in the urine, carried back into the ceca along with urine by means of antiperistalsis and hydrolyzed there to produce ammonia by cecal microorganisms. Therefore, cecectomy tended to increase urea excretion at the except of ammonia excretion. However the present experiment indicates that about 60% of dietary urea is not recovered in excreta even in the cecectomized chickens where the entry of dietary urea along with urine into the ceca, which is known to be a major site for urease activity in chicken body (Karasawa et al., 1994). Liver, kidney and other intestinal contents such as colorectum were also reported to have appreciable activities of urease (Karasawa et al., 1994). It is possible, therefore, that dietary urea is utilized in the cecectomized chicken without passing through the cecum.

No effects of the cecectomy was also observed on ammonia, urea and uric acid concentrations in blood 6 h after feeding on the last day of experimental period.

The present study suggests that cecectomy improves nitrogen utilization by a decrease in urinary uric acid excretion in chickens fed a low protein diet supplied with urea.

**Table 1.** Effects of cecectomy on nitrogen excretion and utilization, and concentrations of blood nitrogenous compounds in chickens fed a 5% protein diet supplied with urea

	N-Intake <sup>3)</sup>	N-Excretion			N-balance <sup>1)</sup>	N-Utilization <sup>2)</sup>	Blood (mg/100ml)			
		Urea	Ammonia	Uric acid			Total	Ammonia	Urea	Uric acid
		mg/kg BW/d				%				
Control	560.0	70 ± 14	95 ± 8	159 ± 11	427 ± 20	427 ± 20	24 ± 2	70 ± 10	63 ± 7	4 ± 1
Cecectomy	560.0	114 ± 23	56 ± 12	77 ± 6**	385 ± 20	385 ± 20	31 ± 3	80 ± 10	60 ± 6	4 ± 1

Values are means ± SEM of 6 chickens.

\*\* Significantly different from control at  $p < 0.01$ .

<sup>1)</sup> (nitrogen intake) - (nitrogen excretion).

<sup>2)</sup> (nitrogen balance)/(nitrogen utilization).

<sup>3)</sup> The daily intake of nitrogen was 280 mg of protein nitrogen plus 280 mg of urea nitrogen per kg of body weight.

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