INFLUENCE OF CECECTOMY AND DIETARY ANTIBIOTICS ON THE FATE OF INGESTED INTACT GLUCOSINOLATES IN POULTRY

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Introduction

In balance trials with poultry the recovery of intact glucosinolates (IG) in excreta was shown to be low (Freig et al. 1987). Decomposition of IG both in the GI tract of the birds and during the collection of excreta was shown to be a factor in the low recovery of IG (Slominski et al. 1987). Cecectomized hens and dietary antibiotics were used in the current experiments to obtain further information on the absorption of IG.

Materials and Methods

Balance trials were conducted with normal intact hens and cecectomized hens (Payne et al. 1970) with and without dietary antibiotics (100 mg/kg diet) to study the influence of hindgut fermentation on the recovery of intact glucosinolates. Colostomized roosters (Paulson 1969) were also used to estimate the urinary excretion of free thiocyanate ion (SCN) and IG in poultry fed canola meal. In all studies excreta was collected within 1 hr of voiding and was immersed directly into liquid nitrogen to minimize hydrolysis of IG during the collection. Excreta samples were later freeze-dried prior to analysis for IG (Slominski and Campbell 1987), SCN (Sirvestava and Hill 1975) and chromium (Williams et al. 1967) as an internal marker.

Results and Discussion

A higher recovery of IG in the excreta of cecectomized hens as compared to intact hens was noted (Table 1) and these data confirm the previous suggestion (Slominski et al. 1987) that cecal bacteria are the major source of IG hydrolytic activity in the GI tract of poultry. It cannot be determined, however, whether the balance data with cecectomized hens represents absorption from the small intestine or decomposition in the colon, cloaca and excreta. Evidence of the absorption of IG was indicated by the presence of IG in the urine of colostomized roosters. The total urinary excretion, however, was low being less than 1% of ingested IG which is similar to previous reported results from this laboratory (Freig et al. 1987).

Glucosinolate recovery was increased by the addition of antibiotics to the diet but the extent of the effect was dependent on the antibiotic used (Figure 1). Chlorotetracycline and lincomycin proved to be the most effective of the antibiotics studied. Data

presented in Table 2 shows a differential response between aliphatic and aromatic IG regarding absorption and/or decomposition of IG as influenced by antibiotic feeding. The excretion of SCN is also given in Table 2. Antibiotics and particularly chlorotetracycline had a more marked influence on aromatic IG than on aliphatic IG. In this regard, the absorption and/or decomposition of aromatic IG was reduced from 0.92 mmol (50% of intake) for controls to 0.15 mmol (8% of intake) for the chlorotetracycline-fed hens in comparison to a change in aliphatic IG from 1.53 mmol (60% of intake) to 0.81 mmol (33% of intake). The excretion of SCN markedly exceeded the intake of SCN for all treatment groups although the effect was less marked for the chlorotetracycline-fed hens. The data indicated that with the exception of the no-antibiotic treatment, the additional excretion of SCN over intake could not be accounted for by assuming complete decomposition of SCN-releasing glucosinolates (aromatic IG). The biotransformation of absorbed aliphatic IG and subsequent excretion of SCN via the kidney could represent a source of the excess SCN. In this regard the urinary excretion of SCN by colostomized roosters fed canola meal exceeded intake (0.15 vs 0.09 mmol).

The improved recovery of IG in excreta with antibiotic supplementation is further evidence of the significance of intestinal microflora in the decomposition of IG in the GI tract of poultry. The fact that chlorotetracycline supplementation caused a marked improvement in IG recovery in intact hens but little or no response in cecectomized hens (Figure 2) adds credence to the suggestion that the non-recovered IG in cecectomized hens is as a consequence of absorption of IG from the small intestine rather than decomposition of IG in the colon, cloaca and excreta. Further study in this area is needed to substantiate the extent of absorption of IG in poultry

Summary and Conclusions

Several experiments involving the use of cecectomized hens and dietary antibiotics as a means of controlling hindgut fermentation were conducted to determine the absorption of IG in poultry. In addition, balance studies were conducted with colostomized roosters to determine the role of the kidney in the excretion of SCN by poultry. The recovery of IG in excreta was low for intact (control) hens but was increased in cecectomized or antibiotic-fed hens. The data indicate that no more than 15% of total IG was absorbed and that the apparent absorption was greater for aliphatic IG than for aromatic IG (glucosinalbin and indoles). Thiocyanate ion excretion was high in the urine of colostomized roosters fed canola meal and exceeded intake in antibiotic-fed, cecectomized hens. The biotransformation of absorbed aliphatic IG was indicated as a possible source of the excess SCN.

Acknowledgements

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Table 1. Intact glucosinolate (IG) balance in intact and cecectomized hens fed canola meal

Group	IG intake mmol/7 days	IG excretion mmol/7 days	IG excretion % of intake
+ Ceca	3.62±0.25a[1]	1.24±0.19b	33.6±3.7b
- Ceca	3.39±0.24a	2.74±0.33a	80.8±5.7a

[1]Mean ±SE. Means within a column not followed by the same letter are significantly different ($P<0.05$).

Table 2. Intact glucosinolate (IG) and thiocyanate ion (SCN) balance in intact laying hens fed canola meal and various antibiotics (mmol/7 days)

Added antibiotic	Aliphatic IG[1]			Aromatic IG[2]			SCN		
	Intake	Excretion	Absorption or decomposition	Intake	Excretion	Absorption or decomposition	Intake	Excretion	Excretion minus intake
None	2.55a[3] ±0.06	1.02b ±0.04	1.53a ±0.06	1.86a ±0.04	0.94c ±0.37	0.92a ±0.05	0.39a ±0.01	1.37a ±0.08	0.97a ±0.09
Streptomycin	2.50a ±0.10	1.10b ±0.09	1.39a ±0.15	1.82 ±0.07	1.03bc ±0.10	0.79a ±0.14	0.38a ±0.02	1.31a ±0.09	0.93a ±0.09
Lincomycin	2.37a ±0.15	1.44a ±0.11	0.94b ±0.10	1.71a ±0.10	1.33ab ±0.12	0.38 ±0.12	0.37b ±0.02	1.06ab ±0.09	0.70ab ±0.08
Chlortetracycline	2.46a ±0.06	1.65a ±0.07	0.81b ±0.12	1.79a ±0.04	1.64a ±0.04	0.15b ±0.04	0.38a ±0.01	0.86b ±0.06	0.49b ±0.06

[1]Includes 3-butenyl, 4-pentenyl, 2-OH-3-butenyl and 2-OH-4-pentenyl glucosinolates.

[2]Includes 4-OH-benzyl, 3-indolylmethyl and 4-OH-3-indolylmethyl glucosinolates.

[3]Mean ±SE. Means in the same column not followed by the same letter are significantly different ($P<0.01$).

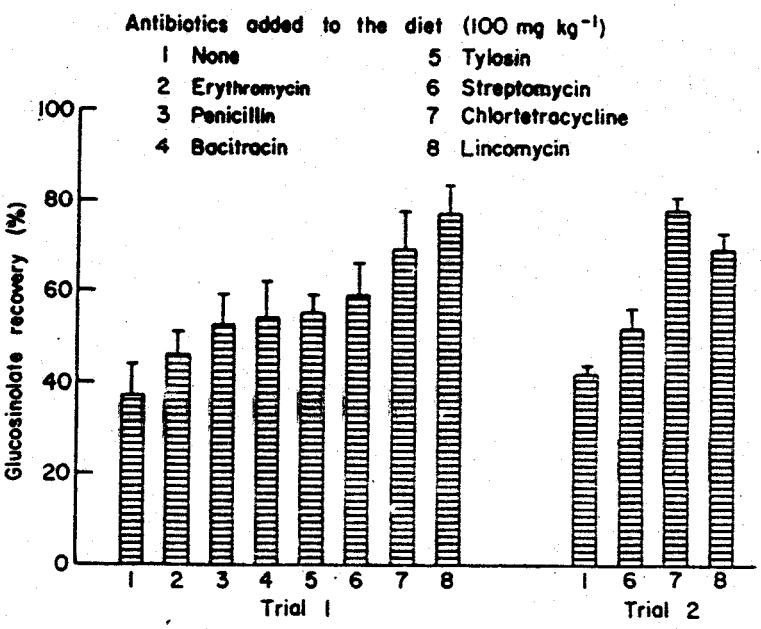

Figure 1. Effect of dietary antibiotics on the recovery of intact glucosinolates in the excreta of intact laying hens fed canola meal.

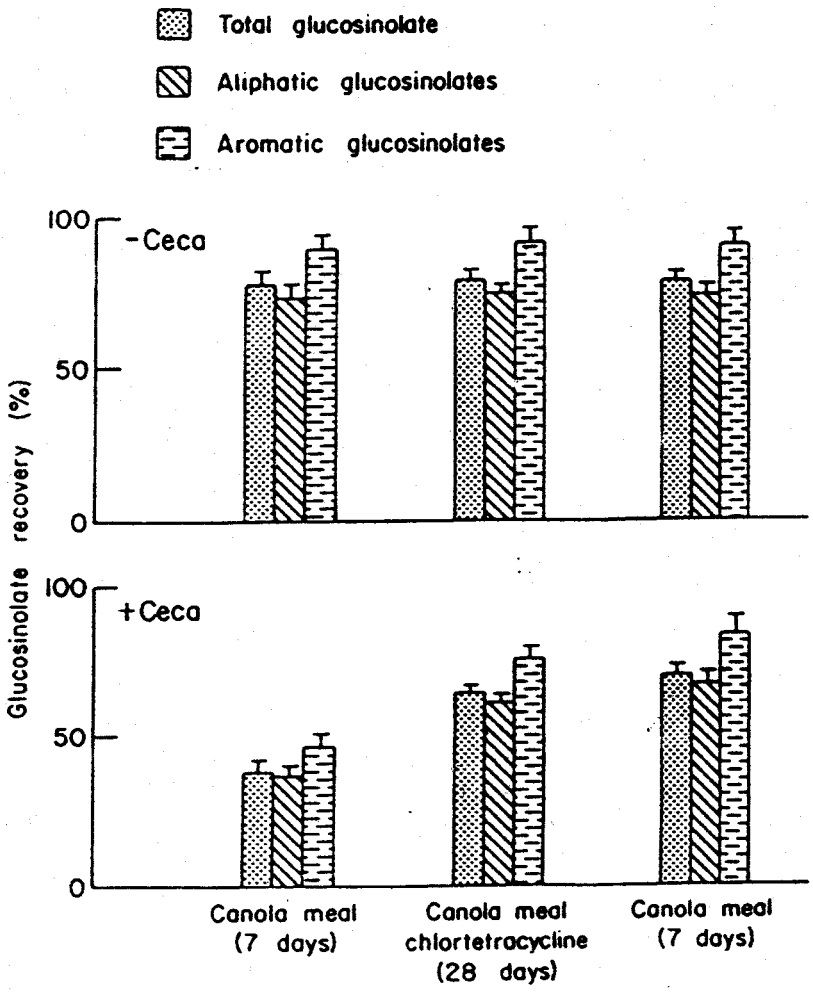

Figure 2. Effect of chlortetracycline (100 mg kg^{-1}) on the recovery of aliphatic and aromatic intact glucosinolates in excreta of cecectomized and intact laying hens fed canola meal.