Effect of ammoniation of canola meal on the fishy odor and trimethylamine contents of eggs produced by brown-egg layers.

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When rapeseed meal (RSM) of low glucosinolate- or high glucosinolate- type is included in the ration of brown-egg layers, some of the birds produce eggs with a fishy odor (Hobson-Frohock et al.,1973; Clandinin et al., 1974). Sinapine, was identified as the precursor of the trimethylamine (TMA), the compound responsible for the fishy odor (Hobson-Frohock et al., 1977; Clandinin et al., 1977). Goh et al., (1979a) found that laying rations containing 0.1% or more of sinapine caused the laying of eggs with a fishy odor. No fishy eggs were produced when sinapine was hydrolysed under alkaline conditions to sinapic acid and choline prior to its inclusion in the ration (Goh et al., 1979b). The effect of treating low-glucosinolate RSM (canola meal) with ammonia on its sinapine content was recently investigated by Goh et al., (1982). They found that sparging canola meal (CM) with 5% W/W ammonia and 5% W/W steam during desolventization caused hydrolysis of 65% of the sinapine in the meal. The total glucosinolate and potential 5-vinyl-2-oxazolidinethione contents of this meal were decreased 17 and 35%, respectively.

The objective of the study described, herein, was to investigate the effect of anhydrous or hydrous ammonia treatment of CM on the fishy odor and TMA contents of eggs from brown-egg layers fed rations containing the ammoniated meals.

MATERIALS AND METHODS

Four CMs produced from *Brassica Campestris* cv Candle seed at the POS Pilot Plant Corporation, Saskatoon, Saskatchewan were used in this study. Two of the meals were prepared by sparging during desolventization with or without anhydrous ammonia (5% W/W ammonia) and two of the meals were produced by sparging with or without hydrous ammonia (5% W/W ammonia, 5% W/W steam). The proximate composition, sinapine, total glucosinolate and potential oxazolidinethione contents of the meals were reported earlier (Goh et al., 1982).

Fifty brown-egg layers (Rhode Island Red), which were found to lay eggs with a fishy odor when fed a ration containing 10% of CM were housed in floor pens (5 birds per pen) equipped with trap-nests. The birds were fed a soybean meal (SBM)-wheat based laying ration until they no longer produced eggs with a fishy odor. Two pens of the birds were continued on the same ration while two pens were fed each of the four treated-CM-containing rations (Table 1). The rations were isonitrogenous and isoenergetic. Feed and water were

supplied ad libitum. During the fourth week on ration treatment eggs were collected from each bird for fishy odor evaluation and TMA determination. Evaluation for fishy odor was performed as previously described (Goh et al., 1979a). The contents of three eggs collected from each bird were pooled, homogenized and analyzed for TMA (Goh, 1978).

Two of the layers did not produce any eggs during the collection period, hence, unequal numbers of observations per treatment resulted. The data on fishy odor scores and TMA contents were analysed statistically by least square analysis of variance (Harvey,1975). Differences among treatment means were compared by Duncan's multiple range test (Steel and Torrie, 1960) at the 0.05 level of probability.

RESULTS AND DISCUSSION

The amount of sinapine (expressed as sinapine bisulfate) in the various rations, the mean TMA contents in the homogenized eggs and the mean fishy odor scores of eggs are presented in Table 2. Statistical analysis of the TMA data showed that the TMA contents of eggs produced by layers fed the rations containing 10% of CM sparged with ammonia in the absence or presence of steam were lower than their respective CM controls (Ration 3 vs 2 and Ration 5 vs 4). The TMA contents of the eggs from the birds fed these rations paralled the decrease in sinapine contents of the rations resulting from the different sparging treatments to which the meals were subjected. Likewise the mean fishy odor scores of the eggs from the birds fed the rations containing the ammoniated meals were better than those of their respective CM controls. Only the ration containing meal ammoniated in the presence of steam (Ration 5) and the ration containing no CM (Ration 1) produced eggs that had no fishy odor. However, it should be pointed out that the average TMA content of the eggs from the ration containing CM sparged with ammonia in the presence of steam (0.76 ug/g egg) was close to the level (0.8 ug/g egg) claimed by Griffiths et al., (1979) to be detectable in eggs by organolipic evaluation. Furthermore, when one takes into account the variation in TMA content in eggs from a specific fishy egg layer or in eggs from different fishy egg layers fed the same CM-containing ration, one has to conclude, that either the ammonia-steam sparging would have to be continued for a longer period of time to bring about more complete hydrolysis of the sinapine in the meal than occurred in the meal used in this study, or, the percentage of CM used in the laying ration would have to be reduced below the level recommended for white-egg layers (10%) in order to make the ration suitable for brown-egg layers.

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REFERENCES

CLANDININ, D.R., HAWRYSH, Z., HOWELL, J., HANSON, J.A., CHRISTIAN, R.G. and MILNE, G.R. 1974. Problems associated with the feeding of rations containing rapeseed meal to laying chickens. Proc. 4th Int. Rapeseed Conf., pp. 463-477.

CLANDININ, D. R., ROBBLEE, A.R., GOH, Y. K., DARLINGTON, K. and MILNE, G. R. 1977. Use of rapeseed meal in rations for laying chickens. Proc. of a symposium on rapeseed oil, meal and by-product utilization, Vancouver, B.C.,Rapeseed Association of Canada. pp. 177-190.

GOH, Y.K. 1978. Problems associated with rapeseed meal. Ph.D. thesis. University of Alberta, Edmonton, Alberta.

GOH, Y.K., CLANDININ, D.R., ROBBLEE, A.R. and DARLINGTON, K. 1979a. The effect of level of sinapine in laying rations on the incidence of fishy odor in eggs from brown-shelled egg layers. Can. J. Anim. Sci. 59: 313-315.

GOH, Y.K., MUELLER, M.M., CLANDININ, D.R. and ROBBLEE, A.R. 1979b. The effect of choline and sinapine bisulfate in a laying ration on the incidence of fishy odor in eggs from brown-shelled egg layers. Can. J. Anim. Sci. 59: 545-549.

GOH, Y.K., SHIRES, A., ROBBLEE, A.R. and CLANDININ, D.R. 1982. Effect of ammoniation of rapeseed meal on the sinapine content of the meal. Brit. Poult. Sci. 23: 121-128.

GRIFFITHS, N.M., LAND, D.G. and HOBSON-FROHOCK, A. 1979. Trimethylamine and egg taint. Br. Poult. Sci. 20: 555-558.

HARVEY, W.R.. 1975. Least square analysis of data with unequal subclass numbers. Agriculture Research Service, H-4, USDA, Washington, D.C.

HOBSON-FROHOCK, A., LAND, D.G., GRIFFITHS, N. and CURTIS, R.F. 1973. Egg taint: association with trimethylamine, Nature, 204: 304-305.

HOBSON-FROHOCK, A., FENWICK, G.R., HEANEY, R.K., LAND, D.G. and CURTIS, R.F. 1977. Rapeseed meal and egg taint: association with sinapine. Brit. Poult. Sci., 18: 539-541.

STEEL, R.D.G. and TORRIE, J.H. 1960. Principles and procedures of statistics. McGraw-Hill Co., New York.

Table 1. Composition of experimental rations

	Rations[1]				
	1	2	3	4	5
Ground wheat	72.18	66.78	66.78	66.78	66.78
Stabilised fat	1.00	2.80	2.80	2.80	2.80
Dehydrated alfalfa meal	2.00	2.00	2.00	2.00	2.00
Soybean meal (47.5% crude protein)	14.00	7.60	7.60	7.60	7.60
CM[2] + heat	-	10.00	-	-	-
CM + heat + NH_3	-	-	10.00	-	-
CM + steam	-	-	-	10.00	-
CM + steam + NH_3	-	-	-	-	10.00
Ground limestone	8.00	8.00	8.00	8.00	8.00
Dicalcium phosphate	1.40	1.40	1.40	1.40	1.40
Iodised salt	0.35	0.35	0.35	0.35	0.35
Micronutrients[3]	1.07	1.07	1.07	1.07	1.07

[1]The rations were formulated to contain 16.4% crude protein and 11.17 MJ/kg.

[2]The canola meals (CM) were produced from canola seed at the POS Pilot Plant Corporation, Saskatoon, Saskatchewan.

[3]The micronutrients supplied per kg ration: vitamin A, 6000 IU; vitamin D, 1200 ICU; vitamin E, 5 IU; riboflavin, 4 mg; calcium pantothenate, 6 mg; niacin, 15 mg; vitamin B_{12}, 10ug; choline chloride, 100 mg; biotin, 0.1 mg; $MnSO_4$, 0.4 g; ZnO, 0.1 g; and DL-methionine, 0.5 g.

Table 2. The trimethylamine (TMA) content and fishy odor score of eggs produced by brown-egg layers fed rations containing canola meal (CM) sparged with ammonia

	Rations				
	1	2	3	4	5
Treatment	control	CM + heat	CM + heat + NH_3	CM + steam	CM+steam+NH_3
Sinapine (% in ration)[1]	-	.156	0.083	.146	0.055
TMA (ug/g egg)[2]	0.03^{a}	2.42^{c}	1.33^{b}	2.55^{c}	0.76^{ab}
± SEM	0.284	0.284	0.284	0.317	0.284
Fishy odor score[3]	0.00^{a}	1.58^{c}	0.44^{ab}	0.60^{b}	0.00^{a}
± SEM	-	0.131	0.131	0.147	-
Percent of eggs scored as fishy[4]	0	95	44	60	0

[1] Expressed as sinapine bisulfate.

[2] The egg samples for TMA analysis were obtained by pooling the last three eggs produced by individual birds during the fourth week on ration treatment. Mean of two replicate groups (5 birds per group).

[3] Fishy odor was scored on a scale from 0 to 4; 0 (normal), 4 (very fishy).

[4] Not analysed statistically.