

Hydrothermally treated rapeseed meal does not increase the incidence of tainted eggs in brown layers.

R. WILTENBURG *, C. GERRIS, P. DE BOT, M. UBBINK

CCL Research, P.O. Box 107, 5460 AC Veghel, the Netherlands

*Corresponding author: ria.wiltenburg@ccl.nl

Rapeseed meal (RSM) is an interesting raw material for poultry feed, but in most brown egg laying strains a small percentage of the birds is sensitive for producing tainted eggs due to the presence of sinapine in the rapeseed meal.

In this project, RSM was hydrothermally treated to reduce the sinapine content of the RSM.

The hydrothermally treated rapeseed meal (HT-RSM) was fed to brown layers at 0 (negative control), 5, 10 and 15% of the diet; the positive control group was fed 15% untreated RSM from the same batch.

The experiment ran from 18 weeks until 44 weeks of age. Data were collected on technical performance and at 26 and 36 weeks of age, eggs were evaluated by a trained panel on egg taint.

Results of the test on egg taint show, that the positive control group had significant ($p < 0,001$) more tainted eggs than any of the other treatments. At 26 weeks, there were no differences in number of tainted eggs between the negative control and any of the treatments with HT-RSM, but at 36 weeks the inclusion of HT-RSM reduced the incidence of tainted eggs compared to the negative control.

Results of this experiment show that by hydrothermal treatment of rapeseed meal, it is possible to feed RSM to brown layers, without increasing the incidence of tainted eggs.

Keywords: rapeseed meal, hydrothermal treatment, brown layers, tainted eggs

Introduction

Egg taint is caused by the presence of trimethylamine (TMA) above 0,8 ppm in the egg (Griffiths et al, 1979). Sinapine is the choline ester of sinapinic acid. In the caeca of birds, TMA is released by the microbial breakdown of choline, which is readily formed from sinapine (March and MacMillan, 1979). In normal hens, the TMA is rapidly metabolised into TMA-oxide, which is odourless and tasteless (Pearson et al, 1979). Some brown layers do have an impaired ability to transform TMA into TMA-oxide. This impaired ability is strongly inherited (Bolton et al, 1976).

In this project, rapeseed meal was treated, based on the principle of hydrothermal treatment to reduce the sinapine content of the rapeseed meal (Farahmand and Lucht, 2002; Tayaranian, 1991).

The hydrothermally treated rapeseed meal was fed to brown layers to test the effect on the incidence and severity of egg taint and on technical performance. This paper will only give the results of the effect of the hydrothermally treated rapeseed meal on egg taint.

Materials and methods

The rapeseed meal (RSM) was hydrothermally treated in 2 batches by a combination of temperature, pressure, time and a catalyst ($\text{Ca}(\text{OH})_2$) to reduce the sinapine content. The RSM was analysed before and after treatment. Phase 1 diets were produced with the 1st batch of the hydrothermally treated rapeseed meal (HT-RSM); phase 2 diets with the 2nd batch.

2304 Hyline brown laying hens were placed in the experimental housing at 17 weeks of age. The experimental housing consisted of 1 room with 6 blocks of 3-tier cage housing → total 36 rows. Each row had 16 cages of 4 hens each → 64 hens per row = experimental unit. The room had no day light. Lighting schedule, temperature and daily management were according to standard practise.

From 17 till 18 weeks of age, hens received a commercial prelay diet; at 18 weeks of age, hens were switched the experimental diets. The experimental arrangement comprised 5 dietary treatments with 8 replicates for treatment 1 to 4 and 4 replicates for treatment 5. All treatments consisted of a phase 1 diet (18 – 32 weeks of age) and a phase 2 diet (32 - 44 weeks of age).

Treatment 1 acted as negative control (diet without RSM); treatment 2, 3 and 4 contained respectively 5%, 10% and 15% HT-RSM and treatment 5 acted as positive control and contained 15% RSM from the same batch. All diets were offered as mash and were fed ad libitum until 32 weeks of age. From 32 to 44 weeks of age, mild feeding restriction was applied to realise a minimal body weight gain. Feed composition and calculated nutrients are given in table 1.

Table 1: composition and calculated nutrients of the experimental diets.

Raw materials	Tr 1: neg control = 0% RSM		Tr 2: 5% HT-RSM		Tr 3: 10% HT-RSM		Tr 4: 15% HT-RSM		Tr 5: pos control = 15% RSM	
	ph 1	ph 2	ph 1	ph 2	ph 1	ph 2	ph 1	ph 2	ph 1	ph 2
HT-RSM ^{*)}			5,0	5,0	10,0	10,0	15,0	15,0		
RSM ^{*)}									15,0	15,0
Corn	25,0	25,0	25,0	25,0	25,0	25,0	25,0	25,0	25,0	25,0
Wheat	35,0	36,6	35,0	35,0	35,0	33,2	34,5	33,9	32,6	33,3
Soyabean meal	13,5	10,4	11,8	7,2	10,2	5,4	7,1	2,8	8,0	5,5
Sunflower meal	5,9	7,0	3,1	7,0		5,5		2,8		
Peas	4,0	4,0	4,0	4,0	4,0	4,0	4,0	4,0	4,0	4,0
Corn gluten feed	2,5	2,5	2,4	2,1	2,5	2,5	1,0	2,5	1,0	2,5
Fat	2,7	2,6	2,7	2,9	2,5	3,2	2,8	2,9	3,3	3,1
Limestone	8,8	9,4	8,5	9,1	8,2	8,7	7,9	8,5	8,6	9,2
Premix, minerals etc.	2,6	2,5	2,5	2,7	2,6	2,5	2,7	2,6	2,5	2,4
Nutrients (gr/kg)										
Crude protein	163	152	162	152	162	155	160	153	161	152
Crude fat	50	49	50	53	49	55	51	53	56	55
Crude fiber	33	38	33	43	33	45	37	45	37	39
ME _{lay} (kcal/kg)	2825	2800	2825	2800	2825	2800	2825	2800	2825	2800
dig lys pl	6,6	6,1	6,6	6,1	6,6	6,1	6,6	6,1	6,6	6,1
dig m+c pl	5,9	5,9	5,8	5,8	5,9	5,8	5,9	5,8	6	5,8
Ca	38	41	39	41	39	41	39	41	39	41
dig P	3,0	2,7	3,0	2,7	3,0	2,7	3,0	2,7	3,0	2,7
Na	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4

^{*)} HT-RSM = hydrothermally treated rapeseed meal ^{*)} RSM = standard rapeseed meal

At 26 and 36 weeks of age, in 5 sessions a full day production with a maximum of 60 eggs per replicate was evaluated by a trained panel for egg taint. The eggs were split into egg white and yolk and per egg the yolk was collected in a closed cup. Each yolk was independently tested for TMA by smelling by 4 panel members and classified as normal, doubtful, light taint or strong taint. The average classification per egg was used for further analysis.

The distribution over the taint classes per treatment were analyses according to the model of McCullagh using the statistical software package Genstat 8.2.

Also per replicate, an index for egg taint was calculated according the following formula:

$$\text{egg taint index (ETI)} = (\text{nr normal eggs} * 0 + \text{nr doubtful eggs} * 1 + \text{nr light taint eggs} * 4 + \text{nr strong taint eggs} * 7) / (\text{total nr eggs} * 7) * 1000$$

The ETI was analysed by the GLM-procedure from software package SAS v8 according the model:

$$Y = \mu + S_i + T_j + e_{ijk}$$

in which: S_i = effect of session

T_j = effect of treatment

e_{ijk} = residual error

Results and discussion

The hydrothermal treatment of the RSM was effective in reducing the amount of sinapine; over 90% of the sinapine was broken down by the hydrothermal treatment. But not only the sinapine content was reduced, also some amino acids like cystin and lysine were broken down. In table 2, the analysed values for the HT-RSM and the untreated RSM of both batches are given. In the calculation of the experimental diets with HT-RSM, the loss of amino acids and increase in Ca-content was taken into account. Therefore the composition of the positive control with 15% untreated RSM was little different from the diet of treatment 4 with 15% HT-RSM.

Table 2: analysed values of the untreated and hydrothermal treated rapeseed meal.

analysed (gr/kg)	batch 1		batch 2	
	RSM ^{#)}	HT-RSM ^{*)}	RSM	HT-RSM
crude ash	67	101	68	106
crude fiber	127	128	121	126
crude protein	335	337	329	345
crude fat	31	31	32	34
moisture	123	84	118	41
Ca	7,8	25,6	8,1	27,6
sinapine (mg/kg)	7170	522	7590	490
lysine	18,6	14,6	18,7	14,9
cystin	8,3	5,0	8,1	4,5
methionin	7,0	7,0	7,3	7,6

^{*)} HT-RSM = hydrothermally treated rapeseed meal ^{#)} RSM = standard rapeseed meal

In table 3, the percentage of eggs per classification, treatment and period is given and the p-value for the distribution over the classes. The results show, that also in the negative control group tainted eggs were detected, which confirms practical experiences that RSM is not the only cause for tainted eggs. At 26 weeks of age the distribution over the classes from the treatments with HT-RSM was not different from the negative control. The positive control was significant different from all other treatments. It may be concluded, that the hens were sensitive for producing tainted eggs and that the use of HT-RSM did not increase the incidence of tainted eggs.

However, at 36 weeks of age the treatments with 10% and 15% HT-RSM had a significant different distribution over the classes compared to the negative control with a higher percentage normal eggs and lower percentage strong tainted eggs. Compared to the positive control, all treatments with HT-RSM had a significant different distribution; for the negative control there was only a tendency. These results indicate that the use of HT-RSM does reduce the incidence of tainted eggs even compared to a negative control group without any RSM in the diet.

Table 3: classification of the eggs per treatment as evaluated by a trained panel and p-value for distribution over the classes.

Treatment	% of eggs per egg taint classification				p-value model vs neg control	p-value model vs pos control
	normal	doubtful	light taint	strong taint		
26 weeks of age						
neg control; 0% RSM ^{#)}	85,8%	8,5%	3,1%	2,5%		<0,001
5% HT-RSM ^{*)}	85,8%	8,6%	4,0%	1,7%	0,947	<0,001
10% HT-RSM	83,5%	10,9%	4,2%	1,5%	0,364	<0,001
15% HT-RSM	84,3%	12,1%	2,5%	1,0%	0,686	<0,001
pos control; 15% RSM	70,7%	15,1%	4,2%	10,0%	<0,001	
36 weeks of age						
neg control; 0% RSM	87,0%	4,1%	5,8%	3,2%		0,090
5% HT-RSM	90,5%	3,2%	3,8%	2,5%	0,076	0,001
10% HT-RSM	93,2%	4,0%	1,9%	0,9%	0,001	<0,001
15% HT-RSM	92,5%	6,0%	1,5%	0,0%	0,005	<0,001
pos control; 15% RSM	82,8%	2,5%	5,0%	9,7%	0,090	

^{*)} HT-RSM = hydrothermally treated rapeseed meal ^{#)} RSM = standard rapeseed meal

In practise, a strong tainted egg will be detected by almost everyone; a light tainted egg is estimated to be detected by ca. 50% of the people and a doubtful egg will only in rare cases be classified as abnormal. Therefore in the calculation of the ETI, the weighing of a strong tainted egg is much stronger (7) than a light tainted egg (4) or doubtful egg (1).

In table 4, the results of the statistical analysis for the ETI are given per age. At both ages, the ETI for the positive control is significantly higher than any other treatment, which confirms that the higher incidence of strong tainted eggs is due to the use of RSM.

At 26 weeks of age, the ETI is not different for the negative control and the treatments with HT-RSM. At 36 weeks of age, the ETI reduces with the inclusion rate of HT-RSM, mainly caused by the lower percentage of strong tainted eggs by higher inclusion of HT-RSM.

The incidence of tainted eggs is related to the microbial activity in the caeca in combination with the presence of TMA-precursors like choline. The hydrothermal treatment of RSM is not expected to breakdown the choline-part from the sinapine itself, as choline is a rather stable molecule. Free choline from the diet is absorbed in the small intestine and therefore not subjected to microbial breakdown in the caeca, unless there is a big oversupplementation. Therefore, differences in the level of choline from the raw material are not likely to be the explanation for the lower ETI by higher inclusion of HT-RSM.

Table 4: results of the test on egg taint index at 26 and 36 weeks of age as evaluated by a trained panel.

Treatment	Neg control: 0% RSM ^{#)}	5% HT- RSM ^{*)}	10% HT- RSM	15% HT- RSM	Pos control: 15% RSM	p-value for treatment
ETI ^{§)} at 26 wks of age	57 ^a	49 ^a	51 ^a	39 ^a	149 ^b	< 0,0001
ETI at 36 wks of age	71 ^a	56 ^{ab}	27 ^{bc}	15 ^c	127 ^d	< 0,0001

^{*)} HT-RSM = hydrothermally treated rapeseed meal ^{#)} RSM = standard rapeseed meal ^{§)} ETI = egg taint index.

^{abcde}: different superscript within the same row means significantly different (p < 0,05)

References

- BOLTON, W., CARTER, T.C. and MORLEY-JONES, R. (1976) The hen's egg: genetics of taints in eggs from hens on rapeseed meal. *British Poultry Science* **17**: 313-320.
- FARAHMAND, H. and LUCHT, H.W. (2002) Customised hydrothermal treatment of ingredients. Proceedings 5th International Kahl-Symposium; p 17.1 – 17.12.
- GRIFFITHS, N.M., LAND D.G. and HOBSON-FROHOCK, A (1979) Trimethylamine and egg taint. *British Poultry Science* **20**: 555-558.
- MARCH, B.E. and MACMILLAN, C. (1979) Trimethylamine production in the caeca and small intestine as a cause of fishy taints in egg. *Poultry Science* **58**: 93-98.
- TAYARANIAN, H.R. (1991) Entwicklung eines technischen Verfahrens zur Reduktion von unerwünschten Stoffen (Sinapin und Glucosinolate) in Rapssaat und Rapssaatprodukten der 00-Qualität. PhD-thesis from the Christian-Albrechts University, Kiel, Germany.