《Research Note》

A Long Term Feeding Trial of Excess Tryptophan in Laying Pullets

Iwao TASAKI, Koshi ASAKURA and Michiko KOMIYA

Laboratory of Animal Nutrition, Faculty of Agriculture, Nagoya University, Nagoya 464

The effect of tryptophan deficiency and excess on the laying performance of White Leghorn pullets was reported previously¹⁾. The result showed that even in a short term experiment (25 days) the pullets responded to the slight deficiency of tryptophan (90% of the requirement) and laying performance (egg production rate and egg weight) reduced remarkably. On the contrary, even when the pullets received a very large dose of tryptophan (655% of the requirement) no ill-effect on the laying performance was observed. Since the previous experiment had been conducted only for a short period, a long term feeding experiment was carried out to examine whether excess tryptophan showed any ill-effect.

Materials and Methods

A total of 24 White Leghorn pullets of 8.5 months of age, weighing about 1.7 kg, were divided into 2 groups. All birds were carefully selected so that they had shown more than 90% of egg production rate. The birds were placed in metabolism cages and diets were provided individually. The duration of the experiment was 24 weeks, from February 3rd through July 24th. Egg production was recorded every day, feed intake was measured every week and body weight was checked every 4 weeks. One of the groups was given a commercial laying ration (CP 15.5%) as a control and another group was provided the same diet supplemented with 0.5% L-tryptophan. The birds were allowed to eat diet and drink water ad libitum. The composition of the control diet was not informed, however, it had been proven that with this diet the birds could produce eggs normally. Amino acid composition of the control diet was measured and it was shown that all amino acids met the requirements. Since tryptophan content of the control diet was 0.16%, that of the tryptophan supplemented diet was estimated to be 0.66%.

Since egg albumen contains a fairly large amount of lysozyme and the lysozyme contains a remarkable amount of tryptophan, being about 10%, eggs laid from the start to the end of the experiment were collected periodically, and albumen weight, protein and tryptophan contents of albumen were measured in order to examine the effect of excess tryptophan given to the birds.

Amino acid composition of the diet was determined by the method of BLACKBURN²⁾ using an ion-exchange chromatography (JEOL Model JLC-6AH) after acid hydrolysis of the samples. Tryptophan in the diet and egg albumen was determined by the method of SPIES and CHAMBERS³⁾ after alkaline hydrolysis of the samples.

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Table 1. Performance of layers

Week	0—4	4—8	8—12	12—16	16—20	20—24	0—24
Body weight gain, g							
Cont	0.04	0.04	0.04	—0.07	0.07	0.05	0.17
Trp	0.04	0.03	0.03	—0.07	0.07	0.03	0.13
SEM	.01	.01	.01	.02	.02	.01	.02
Number of eggs							
Cont	26.3	26.1	25.2	23.3	23.6	23.2	147.6
Trp	25.9	25.9	23.6	22.9	22.4	24.6	144.8
SEM	.5	.5	.6	.7	.9	.7	2.9
Egg production rate, %							
Cont	93.8	93.1	89.9	83.3	84.2	82.7	87.9
Trp	92.6	92.5	87.7	81.7	79.8	87.9	86.2
SEM	1.7	1.8	2.1	2.3	3.1	2.3	1.8
Egg weight, g							
Cont	55.5	56.2	57.3	56.4	56.7	55.3	56.3
Trp	54.4	54.5	53.3	55.3	54.8	55.1	55.4
SEM	.8	.9	1.6	.9	.9	1.1	.9
Egg production, g/day							
Cont	52.0	52.4	51.6	47.0	47.7	45.8	49.5
Trp	50.1	50.5	46.8	45.1	44.0	48.4	47.7
SEM	1.1	1.3	2.0	1.3	1.9	1.5	1.1
Feed intake, g/day							
Cont	101	114	112	100	106	110	106
Trp	94	108	111	96	103	102	102
SEM	9	2	2	4	3	3	2

Mean of 12 birds. Cont: Control group, Trp: Tryptophan supplemented group.

Results and Discussion

Performance of layers such as body weight change, feed intake, egg production rate and egg weight are given in Table 1. Since grouping of the birds was made according only to the egg production rate, the average initial body weight was somewhat different between groups, being 1.73 kg in the control group and 1.66 kg in the tryptophan supplemented group. The final body weight (24 weeks after the experiment started) was 1.83 and 1.70 kg in the control and tryptophan supplemented groups, respectively. There were not so much differences in body weight change between groups as shown in Table 1. During 12–16 week period the birds of both groups lost their body weight. This period was in May and such body weight losses sometimes occur in this season because of decreased feed intake due to a stress caused by hot and humid conditions. Feed intake was not so much different between groups, however, the tryptophan supplemented group always consumed less feed than the control group. A part of this difference might be due to the difference in body weight. According to our estimation, however, both groups consumed enough feed to meet the requirement.

Table 2. Egg weight, albumen weight, and protein and tryptophan contents of albumen

Week	0	1	3	4	8	12	16	20	24	Ave
<u>Egg weight, g</u>										
Cont	53.7	55.3	55.2	57.3	57.9	57.9	55.4	59.2	54.8	56.2
Trp	55.0	53.9	54.4	55.2	56.0	55.8	54.1	54.9	53.5	54.7
SEM	1.8	.8	.9	.9	1.0	1.0	1.4	1.2	1.3	1.0
<u>Albumen weight, g</u>										
Cont	32.1	32.7	31.7	32.7	32.9	32.8	31.8	34.2	31.8	32.5
Trp	32.1	31.3	31.8	31.9	32.4	32.0	32.2	31.9	30.8	31.8
SEM	1.0	.7	.7	.8	.8	.8	.9	.8	.9	.8
<u>Albumen weight/egg weight, %</u>										
Cont	59.8	59.0	57.4	57.3	57.0	56.5	57.3	57.8	57.9	57.8
Trp	58.5	57.9	58.5	57.8	57.9	57.3	58.9	58.1	57.5	58.0
SEM	.7	.7	.5	.6	.6	.7	.7	.6	.6	.6
<u>Protein content (N$\times$6.25) of albumen, %</u>										
Cont	10.0	8.9	10.6	10.1	8.8	10.4	9.9	9.8	9.7	9.8
Trp	8.9	10.7	10.2	10.2	9.1	10.2	10.2	9.9	10.0	9.8
SEM	.2	.3	.1	.2	.2	.1	.2	.2	.2	.2
<u>Tryptophan content of albumen, mg/100 g</u>										
Cont	175	173	187	189	159	213	176	177	200	183
Trp	169	172	192	190	166	209	175	183	203	183
SEM	5	4	4	5	3	4	6	7	6	6
<u>Tryptophan/protein of albumen, %</u>										
Cont	1.75	1.93	1.77	1.84	1.81	2.05	1.78	1.81	2.07	1.86
Trp	1.94	1.86	1.78	1.85	1.84	2.05	1.72	1.85	2.12	1.88
SEM	.08	.07	.03	.03	.04	.04	.05	.06	.08	.05

Mean of 12 eggs. Cont: Control group, Trp: Tryptophan supplemented group.

Number of eggs laid, or egg production rate was quite comparable between groups, and egg weight was also not different between groups. Reflecting these, the daily egg production was 49.5 and 47.7 g in the control and tryptophan supplemented groups, respectively, and feed required for egg production (grams of feed/gram of egg produced) was calculated to be 2.14 g/g in both groups. Again no difference was found.

Protein and tryptophan contents of egg albumen are shown in Table 2. Egg weight and albumen weight of the sample eggs were not different between groups and albumen was estimated to be 57–60% of the eggs. Although nitrogen content of egg albumen was reported to be 12–13%⁴⁾, the index of 6.25 instead of 7.69–8.33 was used for calculation of crude protein content. The crude protein content of albumen varied from 8.9% to 10.7%, and the difference between groups was sometimes significant. However, no special relation was observed, and average value was shown to be 9.8% in both groups. Tryptophan content of albumen also varied time to time, being 159–213 mg/100 g, but no difference was observed between groups. The ratio of tryptophan to protein of albumen also varied in seasons, but again no difference was found between groups.

In conclusion, feeding of excess amount of tryptophan did not show any ill-effect on the

performance of laying hens even when excess tryptophan was given for a long period (24 weeks). The amount of tryptophan given to the birds in this experiment was quite unusual, and the amount or rate of absorbed tryptophan and the complete fate of absorbed tryptophan in the body remain to be studied.

Summary

A long term (24 weeks) feeding experiment was conducted using 8.5-month-old White Leghorn pullets receiving a large dose of tryptophan. Each group consisted of 12 birds, and initial body weight was 1.66 and 1.73 kg, and average egg production rate before experiment was 92.6% and 93.5% in experimental and control groups, respectively. A commercial laying ration was used as a control diet, which contained 15.5% of crude protein and adequate amounts of amino acids (tryptophan 0.16%) for layers. An experimental diet was formulated by supplementing the control diet with 0.5% of L-tryptophan, and the total tryptophan content of this diet was 0.66%. Several parameters, such as body weight change, feed intake, egg production rate, egg weight, albumen weight, protein/albumen ratio, tryptophan content of albumen, were measured to compare the normal and excess dosages of tryptophan. The result indicates that a large dose of tryptophan to the laying hens did not show any ill-effect even in a long period of feeding.

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産卵鶏に対する過剰トリプトファンの長期給与試験

田先威和夫・朝倉幸孜・小宮美智子

名古屋大学 農学部 名古屋市 464

8.5か月齢の白色レグホーン若雌を用い、大量のトリプトファンを24週間にわたり給与し、その影響を調査した。対照区、試験区とも各12羽ずつ用い、前者にはCP 15.5%の市販産卵用飼料を与え、後者には市販飼料にL-トリプトファンを0.5%添加給与した。なお市販飼料のトリプトファン含量を測定した結果は0.16%であったので、試験飼料のそれは0.66%となり、これは要求量の65%に相当する。試験前の平均産卵率は、試験区で92.6%、対照区で93.5%であり、開始時体重はそ

れぞれ1.66 kgおよび1.73 kgであった。

24週間にわたり体重の変化、飼料摂取量、産卵率、卵重、卵白重、卵白中のトリプトファン含量などを測定比較したが、いずれも期間によるばらつきはあるものの、両区間には全く差が認められなかった。以上の結果より、かなり多量のトリプトファンを長期間にわたって産卵鶏に給与しても産卵に悪影響を与えることはないと考えられた。

(家禽会誌, 22, 23~26, 1985)