THE INFLUENCE OF VITAMINS IN THE FEED OF LAYING HENS ON THE QUALITY OF THE CHICKENS [1])

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INTRODUCTION

In general the egg-production is chosen as a criterion for the vitamin-requirement of laying hens.

The smallest quantity of a vitamin necessary to keep the egg-production on a maximal level gives the requirement.

However, there are authors who go farther and take the hatchability as a criterion instead of the egg-production.

Of both methods the literature gives many examples (7).

Only a few investigators went on and compared the "quality" of the young chickens with the "quantity" of the vitamins supplied to the hens (1, 7, 9).

As it is well known, that the diet of the hens influences the condition of the eggs and the chickens hatched from these eggs (4), it is rather amazing that in all the extended literature concerning poultry-nutrition, one can find so little of recent date about the relation between the diet of the hen and the quality of the resulting chickens as far as the vitamins A and D are concerned. Probably this is caused by the fact that these differences in quality seldom brought about clearly correlated disasters in practice and older tests gave already a general impression.

In scientific research these differences are obvious – but that does not mean that one always takes them into account.

With the determination of the requirement of growing chickens for vitamins this reserve is often overlooked (8).

These reserves are also highly important in the biological determination of the vitamins.

One has to take a depletion period before every test.

Though BOLIN c.s. (2) suggests, that the duration of this period is fixed (with vitamin A), it is our experience, that there is always some variation.

In addition to the "pre-period" noticeable differences arise during the main-period in the control-depletion-group.

The mortality due to vitamin-shortage is in the one given test much higher (quicker) than in the other one.

These differences observed during our biological vitamin D_3-standardisations led us to the following experiment.

ORGANISATION OF THE EXPERIMENT

The object of our experiment was to find out whether various, though not much from the normal deviating, quantities of vitamin A and vitamin D_3 added to a normal ration of laying hens, would influence the production and hatchability of the eggs and the quality of the chickens.

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As this last point was most important, also in view of our routine vitamin A and vitamin D standardisations, we thought to carry out this experiment with the breed of North Holland Blues present at our poultry-farm of "Boekesteyn" and not to be dependent upon a special laying breed.

The 74 laying hens, used in this experiment, were normally housed, devided into two groups, and controlled on production by means of individual trap-nesting during 25 weeks.

At the same time the amount of kilograms of eggs per group per week was noted.

In order to exclude an influence of the used males on the results of the experiment, these animals were changed regularly for the groups I and II.

The composition of the rations is given in table 1.

For experiment-technical reasons the all-mash feeding method was chosen.

Table 1 Composition of the test diets.

Group	I	II
Cornmeal	28.0425	28.0275
Oatmeal	23	as I
Barleymeal	24.5	„
Wheat-bran	8	„
Soybean oil meal	4	„
Sesame oil cakemeal	3	„
Sunflowerseed oil cakemeal	3	„
Fishmeal	3	„
Tankage, 64% protein	2	„
Minerals for chickens	1.3	„
Vitamin AD_3 prep. [1]	0.0075	0.0225
Vitamin B prep. [2]	0.150	0.150
	100.–	100.–

[1] The mineral stable "Dohyfral Extra" A + D_3 25/5 from N.V. Philips Roxane was used, which contained per gram: 25.000 I.U. vitamin A and 5.000 I.U. vitamin D_3.
So ration I contained 1875 I.U. vitamin A and 375 I.U. vitamin D_3 added by the preparation, and ration II contained 5625 I.U. vitamin A and 1125 I.U. vitamin D_3 per kg.

[2] The vitamin B preparation contained per gram 1.5 mg riboflavin, 2.5 mg Ca-d-pantothenate and 1.0 mg vitamin K_3.

Results

From the obtained data the egg-production percentage per group $\left(\frac{\text{number of eggs}}{\text{number of animals}} \times 100\,\%\right)$ per month was calculated.

This proved to be the same for both groups as well as the quantity of egg-kilograms.

Also the total production per group calculated over the total test period, did not differ essentially for the two groups.

These results gave ideal circumstances for the second and third part of our experiment.

Variations in egg-production could not have influenced the egg-"quality" in this case and therefore not the hatchability nor the quality of the chickens.

On 7 dates during the experiment the eggs of the experimental groups of hens were put into the incubator.

From group I in total 1143 and group II 1087 eggs.

For the eggs of group I the fertilization percentage was 64, for group II 68.

For the fertilized eggs of group I the result was 81 % chickens and for group II 82 %.

The fertilization seems to be promoted by the addition of extra vitamins. However, the difference is not mathematically significant.

In order to observe the quality of the chickens 162 I-chickens (chickens originating from hens fed with ration I) and 141 II-chickens (from hens with ration II) were devided over 3 groups, and placed in batteries.

The groups I-C and II-C received a vitamin – A – free diet, used at our department for the bio-assay of vitamin A, from which also vitamin D was omitted.

The groups I-A and II-A received the same ration as I-C and II-C, however enriched with 5625 I.U. vitamin A per kg.

The groups I-D and II-D received the same ration as I-C and II-C though enriched with 1125 I.U. vitamin D_3 per kg.

The results of the experiment are given in table 2 and show some interesting aspects.

Table 2 Mean weights (g) on the various dates.

Date	21/9	28/9	5/10	12/10	19/10	26/10	31/10/56
Males:							
Group I-C	38.1	67	105	116	115		
„ I-A	37.6	65	105	147	178	204	234 ± 9
„ I-D	38.1	63	106	131	159		
„ II-C	35.3	60	99	126	145		
„ II-A	35.0	64	110	160	212	255	287 ± 12
„ II-D	35.0	64	106	138	161		
Females:							
Group I-C	37.5	65	98	112	116		
„ I-A	38.1	66	107	146	177	191	198 ± 10
„ I-D	37.5	65	105	132	140		
„ II-C	35.3	62	103	128	140		
„ II-A	35.5	62	103	148	193	223	243 ± 9
„ II-D	35.7	64	106	132	140		
Mean value of males and females:							
Group I-C	37.8	66	102	114	116		
„ I-A	37.8	66	106	146	178	198	216
„ I-D	37.8	64	106	132	150		
„ II-C	35.3	61	101	127	142		
„ II-A	35.2	63	106	154	202	239	265
„ II-D	35.4	64	106	135	150		

In the first place the starting weight of the I-chickens appears to be higher than that of the II-chicks. This difference is highly significant. (P = 0.001).

The mean starting weight of all for this test used I-♂-chickens was 37.9 ± 0.4 g, that of all II-♂-chicks 35.1 ± 0.4 g and for all I-♀-chicks 37.7 ± 0.4 g, for all II-♀-chickens 35.5 ± 0.4 g.

However, at an age of 14 days there is no longer a difference between the I- and II-chickens; but the control groups I and II-C begin to stay behind with regard to the groups I-A and I-D and to II-A and II-D.

A fortnight later (19/10) the picture is clearer. The control group I-C is markedly lighter than the vitamin A-receiving group I-A and the vitamin D-receiving group I-D.

With the II-groups we see the same symptom.

The value of vitamin A as well as that of vitamin D is evident, while vitamin A in this ration appears to be more important than vitamin D.

Are there differences in reaction between I and II-chickens?

In comparing controlgroup I-C with controlgroup II-C we notice that the latter grew better than the former.

Also with the presence of vitamin A the II-A group grows better than the group I-A. So the better growth of the II-chickens with respect to the I-chickens cannot be caused by vitamin A and therefore, in view of the different vitamin A-D_3 doses to the hens, must be owing to vitamin D_3.

We find the affirmation of this in the fact that animals who got sufficient vitamin D_3 in the ration, the groups I-D and II-D grew *as quickly.*

The growth figures led to the conclusion, that though the vitamin A in this ration was most important for the growth, there was a difference between the chickens of group I and II, concerning the vitamin D_3 "reserve".

In table 3 we give the mortality in the groups.

Table 3 Mortality in percentages.

After .... week(s)	1	2	3	4	5	6
Group I-C	–	–	28	72	96	100
„ I-A	2	2	4	7	9	9
„ I-D	–	2	11	43	93	98
„ II-C	2	2	13	64	98	100
„ II-A	–	–	–	–	2	2
„ II-D	–	–	9	47	94	100

It shows that after 3 weeks there was a remarkable deathrate in the groups C and D not receiving vitamin A.

At that the mortality in the I-groups is a bit larger than in the II-groups.

After 5 weeks nearly the complete groups C and D are dead. However, the groups I-A and II-A with vitamin A are rather completely in tact.

The mortality in the I-A group is larger than in the II-A group.

Though not so clearly as from the weight-list also here appears the better resistance of the II-chickens.

Discussions

By studying these results, the following question arises :

Why have the differences in vitamin D-supply to the hens been noticeable in the chickens and the differences in vitamin A-supply not ?

In the first place one can point to the fact that the breeding ration in itself contains already vitamin A activity (pro-vitamin) and no vitamin D.

This causes that a raised dose of vitamin AD_3-preparation to ration II will have had a relatively smaller effect for vitamin A than for vitamin D.

To illustrate another possibility of the deminishing effect of dose-raising of the preparation on the vitamin content of the eggs, we want to refer to Cruickshank (4), who noted that the transfer of vitamin D of the hen to the egg-yolk is far less limited than the transfer of vitamin A.

She ascribes this fact to the buffer function of the liver, which seems to possess a greater capacity to store vitamin A than vitamin D.

Very recent research (3, 5) points also to the limited storage of vitamin D in the liver.

Finally we want to remark, that we chose a vitamin A-free diet for the chickens, which especially affects the vitamin A position of these animals.

An experiment with a rachitogenic diet seems very attractive, but gives the limitation that such a diet is not pro-vitamin A-free.

Conclusion

The raising of the vitamin A and D_3-content in breeding rations, which under our experiment conditions already made a maximal egg-production possible, seemed to influence the "quality" of the chickens resulting from these eggs.

With special vitamin A and/or vitamin D_3-poor rations we could prove, that the raised vitamin A and D_3 supply to the hens resulted in this experiment in a better vitamin D_3 position of the chickens from these hens.

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