A growth depression caused by added vitamin B_6 in a practical broiler ration and the effect thereon of procaine penicillin

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Summary

Two preliminary experiments were carried out on a laboratory scale. In each experiment 180 broilers placed on batteries were fed rations with and without added vitamin B_6 . In both experiments the growth of the animals that were given vitamin B_6 was slightly retarded compared with that of the controls without added vitamin. In one experiment the number of backward birds was significantly greater in the groups with added vitamin B_6 .

These experiments were repeated on a practical scale with 2×1750 animals. The effect of adding procaine penicillin to both rations was also studied. A growth depression caused by the added vitamin B_6 was found in both experiments when the chickens were 6 weeks old. This growth inhibition was significant (P < 0,05) when the results of the two experiments were considered together. In the presence of 7 ppm procaine penicillin, vitamin B_6 did not cause a significant inhibition of the growth.

1. Introduction

The vitamin B₆-(pyridoxine) requirements of young chicks are quite well known. HOGAN *et al.* (1941) roughly estimated that between 3 and 5 mg vitamin B₆ is required per kg of ration. BRIGGS *et al.* (1942) found the requirement for optimum growth to be 2,75—3 mg synthetic vitamin B₆ per kg feed. KRATZER *et al.* (1947), however, reported a value of approx. 2 mg/kg. Recent experiments by FULLER and KIFER (1959) and FULLER and DUNAHOO (1959) demonstrated the need of 3,3 mg B₆/kg of ration for maximum growth and feed conversion. The recommended allowance given by the N.R.C. is approx. 3,0 mg vitamin B₆ per kg of the ration.

Experiments with practical rations consisting mainly of corn and soybean meal (FULLER and KIFER, 1959) provided some evidence, however, that a microbiologically determined value of 5,7 mg B_6/kg is still rather low for such rations. Here the problem arises to what extent natural vitamin B_6 may be utilized by the animal.

Since the discovery of the growth-stimulating effect of low dosages of antibioticas given to pigs and chicks, much work has been done about the relation between antibiotics and the B-vitamin supply of the animals. Although many contradictory results were obtained, it has been established that under certain circumstances the addition of antibiotics may lower certain vitamin B-requirements (vide e.g. COMBS, 1956; LUCKEY, 1959).

With chicks it has never been definitely established that the vitamin B6-requirement

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is reduced by antibiotics. But KUCHINSKAS and DU VIGNEAUD (1957) and KUCHINSKAS *et al.* (1957) demonstrated that L-penicillamine greatly increased the vitamin B_6 -requirement of rats. It was found that L-penicillamine strongly increased the rate of excretion of vitamin B_6 .

In the present paper a case of growth depression of chickens by added vitamin B_6 is described. Moreover, it is demonstrated that this effect was counteracted by adding 7 ppm procaine penicillin to the ration.

2. Experimental

2.1. Designs

Battery *experiments* No. 1 and No. 2 were carried out with 180 chicks each. In both experiments two testgroups of 90 animals were formed each consisting of 6 replicates of 15 animals housed in cages placed on the batteries in such a manner that the effect of location was eliminated.

Practical *experiments* No. 3 and No. 4 were done on our experimental farm with about 1750 chickens each. The animals were kept in floor pens. In each experiment 4 treatments were tested; per treatment 4 pens with 105—111 chicks were used (2 pens with males and 2 with females). The treatments were distributed at random over the 32 available pens.

2.2. Rations

The rations were fed as a mash. The composition of the different rations used are given in TABLE 1.

The amounts of vitamin B_6 in the basal rations cannot be calculated accurately: the data given in the literature for the vitamin B_6 -contents of the different ingredients vary considerably and often they have not been determined correctly (SNELL and KEEVIL, 1954). Using the data of SNELL and KEEVIL (1954) the vitamin B_6 contents of the rations were estimated. The values which varied from 4,2 to 4,9 mg B_6/kg are almost certainly lower than the true values because no figures were available for some of the ingredients (sunflower-seed oil meal, sesame oil meal, meat meal).

As stated earlier, the vitamin B_6 -requirement of young chickens is about 3 mg/kg feed, but in some rations it might be higher. It may be assumed that the rations used in these experiments supplied sufficient vitamin B_6 to meet the requirement.

No extra vitamin B_6 was added to the rations for the control groups. To the test rations 1,8 mg vitamin B_6 per kg corresponding with about 60 % of the requirement for synthetic vitamin was added. The total vitamin B_6 -content of the test rations was hence 6,0—6,7 mg/kg, most certainly a very liberal amount.

In *experiments* 3 and 4, 7 ppm stabilised procaine penicillin was added both to the test- and the control rations.

2.3. Animals

In all experiments the tests were started with one-day old Cornirock \times Sussex chickens. *Experiments* 1 and 2 were done only with males; in *experiments* 3 and 4, 2 pens with male birds and 2 pens with females were used for each treatment. The experiments were terminated when the chickens had reached the age of 9 weeks.

2.4. Methods

All animals were weighed individually. In *experiments* 1 and 2 the weights were recorded at 8 weeks; in *experiments* 3 and 4 at 6 and 9 weeks.

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	Starting ration (0-6 weeks)			Growing ration (6––9 weeks)		
	<i>exp</i> . 1 and 2	exp. 3	exp. 4	<i>exp</i> . 1 and 2	exp. 3	exp. 4
Fat (stabilized animal grease)		8			8	_
Corn	35	31	35	34,5	24	35
Barley	9	5,5	9	8,5	8,5	8,5
Wheat	5	5	5	10		10
Oats	7	9	7	7	24	6,5
Milocorn	15		15	15	-	15
Soybean oil meal	7,5	9	7,5	5	7,5	5
Wheat bran		5	_		6	
Sunflower-seed oil meal	5	2	—	5	1,5	
Sesame oil meal	-	2	5	—-	1,5	5
Alfalfa meal (18 % crude prot.)	2,5	3	2,5	2,5	3	2,5
Herring meal (70 % " ")	7	9	7	5	4,5	5
Meat meal (60 % ,, ,,)	2	2	2	2	2,5	2
Whey powder	-	3	_		3	_
Carrot meal		1				_
$CaHPO_4 \cdot 2H_2O$		0,5	—	0,5	1	0,5
Minerals for chickens	2	2	2	2	2	2
Vit. B premix	3	3	3	3	3	3
Vit. AD ₃ premix	0,12	0,12	0,12	0,1	0,1	0,1
	100,12	100,12	100,12	100,1	100,1	100,1
Crude protein (%) ¹	20,6	20,1	19,6	17,6	18,1	17,7
Productive energy (cal/kg) 1	2230	2055	2017	2160	2065	2065
Vitamin B ₆ (mg/kg) 1	4,32	4,89	4,89	4,24	4,47	4,45

TABLE 1. Composition of rations in percentages

¹ Calculated values.

For the calculation of the results the animals whose growth had lagged excessively were selected by means of a recognized statistical technique; their weights were not included in the final calculations.

The feed conversion was determined as the ratio of the total amount (in kg) of feed consumed by a group of chickens to the total weight (in kg) of the chickens in that group. No correction was applied for the starting weight of the group or for birds that had died during the test.

3. Results

3.1. General

The course of *experiments* 1 and 2 was satisfactory; the percentages of dead birds were 4 and 1,5 respectively. The course of *exp.* 3 was also normal; 6% of the birds died during the experiment. In *exp.* 4, the percentage of dead birds was high (20%) as a result of coccidiosis and sulpha-poisoning.

Experiments 1 and 2

The average weights per cage and per group are given in TABLE 2. Two values are listed for each entry: uncorrected and corrected for those animals whose growth had lagged excessively.

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	Without added vit. B ₆				With added vit. B ₆			
	cage av.		group av.		cage av.		group av.	
	uncor- rected	cor- rected	uncor- rected	cor- rected	uncor- rected	cor_ rected	uncor- rected	cor- rected
Experiment 1 (12×15 chicks)	1220 1205 1240 1202 1211 1237	1220 1205 1271 1248 1211 1237	1219	1232	1171 1236 1198 1292 1079 1175	1284 1236 1241 1292 1162 1201	1192	1236
Experiment 2 (12×15 chicks)	1199 1159 1254 1196 1248 1237	1219 1159 1254 1254 1247 1262	1216	1233	1223 1230 1190 1096 1193 1257	1223 1230 1190 1126 1230 1257	1198	1209

TABLE 2. Average weights (in grams) at 8 weeks of age (experiments 1 and 2)

The uncorrected averages of groups without added vitamin B_6 were always a little higher than those of the groups that received extra vitamin B_6 . After correcting for the very slow-growing chicks, this difference continued to exist only in *experiment* 2. All these differences are merely numerical; they have no statistical significance.

A significant difference was found in the numbers of chickens with extremely slow growth ("slow birds") in exp. 1: the test group had 9; the control group 3. In exp. 2 this difference had no significance.

Feed conversion in exp. 1 was 2,55 for the test group and 2,51 for the control. In exp. 2 these figures were 2,50 and 2,51 respectively.

These results were indicative of a possible unfavourable effect of the addition of vitamin B_6 to the ration. It appeared that growth and health of the animals might have been adversely affected; this led to a repetition of the experiments on a much larger scale on our experimental farm.

Experiments 3 and 4

The average weights of the animals at ages 6 and 9 weeks are listed in TABLE 3. All entries have been corrected as before for "slow birds".

When columns I and II are compared it may be seen that at 6 weeks in both experiments growth had been inhibited by the addition of vitamin B₆. This inhibition amounted to approx. 4% in *exp*. 3 and approx. 11% in *exp*. 4. The effect of vitamin B₆-addition is significant (P < 0,05) for *experiments* 3 and 4 combined.

At 9 weeks the effect was not found in exp. 3, but in exp. 4 the growth inhibition still amounted to approx. 5%. However, when considering both experiments combined the difference between test groups and controls is no longer significant.

The results of adding vitamin B_6 to rations containing 7 ppm procaine penicillin may be seen in columns III and IV.

At 6 weeks an inhibition of the growth was only found in *exp.* 4; considering *exp.* 3 and 4 combined shows that the effect of vitamin B_6 -addition was not significant. Also at 9 weeks there were no significant differences between the groups with and without added vitamin B_6 .

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		No procain	e penicillin		With 7 ppm procaine penicillin			
	1 without added B_6		2 with added B_6		$\frac{3}{3}$ without added B_6		4 with added B_6	
	pen av.	group av.	pen av.	group av.	pen av.	group av.	pen av.	group av.
6 weeks; Exp. 3	656		613		605		655	
16×105 chicks	697		656		620		644	
	766	726	779	700	785	695	774	714
	784		750		771		784	
6 weeks; Exp. 4	524		506		533		507	
16×111 chicks	520		500		535		478	
	558	544	474	489	533	542	538	521
	575		476		568		560	
9 weeks; Exp. 3	1122		1165		1168		1150	
· •	1087		1104		1121		1139	
	1333	1216	1362	1227	1375	1256	1369	1232
	1320		1275		1360		1270	
9 weeks; Exp. 4	902		888		927		922	
<i>,</i>	915		915		908		905	
	990	944	880	898	978	966	973	942
	968		908		1052		969	

TABLE 3. Average weights (in grams) at 6 and 9 weeks of age (experiments 3 and 4)

Feed conversion at 9 weeks is given in TABLE 4. Experiment 4 tends to show some agreement with the results of the growth tests; the same may be said of the averages given in TABLE 4. There were no important differences between the percentages of dead chickens in the various groups of those experiments.

TABLE 4. Feed conversion (kg feed/kg live-weight) at 9 weeks (experiments 3 and 4)

	No procain	e penicillin	With 7 ppm procaine pen.		
-	without added B ₆	with added B ₆	without added B ₆	with added B₆	
Experiment 3 Experiment 4	3,42 3,48	3,35 3,73	3,21 3,33	3,36 3,43	
Average	3,45	3,54	3,27	3,40	

It appears to be justified to conclude that adding 1,8 mg vitamin B_6 per kg to the ration caused a retardation of the growth of the chickens at 6 weeks. In the presence of 7 ppm procaine penicillin no significant effect of the addition of vitamin B_6 was found.

An explanation for the latter observation cannot yet be given; in this connection, the findings of KUCHINSKAS and DU VIGNEAUD (1957) and of KUCHINSKAS *et al.* (1957) who demonstrated that L-penicillamine increased the vitamin B_6 excretion by rats might be useful.

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