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N O V E M B E R 2 0 0 1

Vitamin Requirements For Broiler Production

Need of Vitamin supplements

Poultry require supplemental dietary Vitamins since common feed ingredients used in poultry production do not provide adequate quantities to meet minimum requirements. Vitamins are essential nutrients involved in over 30 metabolic reactions in cellular metabolism and critical to the efficiency of the Krebs/ Citric acid cycle. Vitamins represent only about 2 % of complete feed cost, however vitamins are involved in 100 % of metabolic functions (5). Vitamins are considered critical to both growth and health. Vitamins are organic compounds, present in most feedstuffs in minute amounts, essential for normal metabolism. The absence of adequate vitamins may cause a specific deficiency disease (4).

Vitamin requirements of Broilers

The vitamin requirement of poultry is usually affected by several factors such as age, body size, breed/strain, diet composition, diseases, endogenous or exogenous toxins, environment, feather coverage, feed form, feed intake, housing pattern, management conditions, minerals –vitamin bioavailability, other nutrient concentration, physiological condition, sex, stress, water intake etc.

Information available on mineral and vitamin

Role of Vitamins

Vitamins	Role Of Vitamins	Deficiency Sympyoms
Fat soluble Vitamins		
Vit. A.	• Maintaining Integrity of the epithelial linings. • Increases spermatogenesis in cocks and improve fertility and hatchability of eggs.	• Night blindness, ataxia, weakness and low hatchability.
Vit. D	• Functions in Calcium Homeostasis.	• Rickets, thin shell eggs, reduced growth, weakness, and ataxia.
Vit. E	• Act as a biological antioxidant. • Important role in the metabolism of nucleic acid and sulphur amino acid.	• Encephalomalacia, Exudative diathesis, Muscular dystrophy. • Reduced fertility/ hatchability.
Vit. K	• Essential for clotting mechanism of blood.	• Excess bleeding, anemia, egg spots.
Water Soluble Vitamins		
Vit. B_1/ Thiamine	• Regulates Carbohydrate Metabolism. • Protects Gastro Intestinal tract. • Optimizes Energy Utilization.	• Anorexia, weakness, unthriftiness, retraction of head (Star gazing).
Vit. B_2/ Riboflavin	• Affects Protein fat and Nucleic acid Metabolism. • Maintains nerve functions and production of ATP from ADP	• Curled toe paralysis, slow growth, low fertility/ hatchability.
Vit. B_3/ Nicotinamide/ Vit.PP	• It is a part of two coenzymes, which are involved in Carbohydrate, protein and fat metabolism.	• Enlargements of hock joint, anorexia, poor growth and feathering, inflamed mucous membranes
Pantothenic acid/Calcium D-Pantothenate	• It is an important coenzyme concerned with reversible acetylation reaction in the metabolism of carbohydrate fats and proteins.	• Poor growth, increased mortality, severe dermatitis, poor egg production and hatchability.
Vit. B_6/ Pyridoxine	• Plays central Role in Protein metabolism, • Contributes in Mineral, Fat and Carbohydrate metabolism	• Anorexia, poor growth, tremors, convulsions.
Vit. B_{12}/ Cynacoba-lamin	• Essential for Blood Formation • Promotes growth	• Anemia, reduced growth and performance, high mortality and reduced hatchability
Biotin /Vit.H	• As a component of various enzymes found in animal and in bacteria.	• Leg problems, dermatitis and poor hatchability
Folic Acid	• Influence maturation of erythrocytes	• Macrocytic anemia, slipped tendons, poor growth and feathering and poor hatchability.
Choline	• Synthesis of acetylcholine for nerves and creatinine phosphates. • Fat metabolism.	Perosis of hock joints
Vit. C/ Ascorbic acid	• Involved in tissue repairs • Influence on chicken immune functions. • Least toxic natural antioxidant • Reduce egg weight and increase shell thickness	• Decreased immunity

requirements of poultry gathered abroad is mostly concerned with those birds reared in temperate zones. Contrary to the above, little work has been carried out in this area for chickens managed in the tropical climate like India. Considering the growth of Indian poultry industry, several workers have attempted to determine the requirements of minerals and vitamins for chickens in India. The comparative recommended levels of Vitamins as per BIS (1992) and NRC (1994) are detailed in table 1.

The vitamin levels recommended by NRC or BIS , however are rarely followed in the Industry as these levels are the levels required to prevent deficiency symptoms whereas the industry is concerned with vitamin levels that are the most efficient in production. It is observed that the Industry uses Vitamin levels that are significantly higher than BIS or NRC recommendations.

Table1 : NRC (1994) ; BIS (1992) and Leeson & Summers Recommendations (Starter Rations) (Values per Kg of Feed)

Vitamins	NRC 1994	BIS 1992	Leeson and Summers Recommen-dations	Mean Values
Vitamin A (I.U)	1500	6000	6500	4666
Vitamin D3 (I.U)	200	600	3000	1266
Vitamin E (mg)	10	20	30	20
Vitamin K3 (mg)	0.5	NR	2.0	1.3
Vitamin B1 (mg)	1.8	2.0	4.0	2.6
Vitamin B2 (mg)	3.6	5.0	5.5	4.7
Calcium D-Pantothenate (mg)	10	12	14	12
Vitamin B6 (mg)	3.5	NR	4.0	2.5
Vitamin B12 (mg)	0.010	0.008	0.013	0.010
Nicotinamide (mg)	35	40	40	38.33
Folic acid (mg)	0.55	NR	1.00	0.775
Biotin (mg)	0.15	0.10	0.20	0.15
Choline chloride (mg)	1300	1400	800	1166

NR- not recommended

Table 2:Recommendations by different Breeders for Broilers. (Starter Rations) (Values Per Kg of feed)

Vitamins	Cobb 100	Cobb 500	Hubbard -Isa	Arbor acres	Ross	Avian	Hybro	Mean values
Vitamin A (I.U)	12000	14000	12500	8800	15000	8820	12500	11946
Vitamin D3 (I.U)	2500	5000	2500	3000	4000	3000	2500	3214
Vitamin E (mg)	20	80	30	30	50	22	25	36.71
Vitamin K3 (mg)	3.00	4.00	2.50	1.65	4.00	1.65	—*	2.8
Vitamin B1 (mg)	3.0	6.0	2.5	1.1	3.0	2.21	1.0	2.69
Vitamin B2 (mg)	8.00	8.00	8.00	6.60	9.00	7.72	5.00	7.47
Calcium D-Pantothenate(mg)	20.00	22.00	15.00	11.00	16.00	12.13	8.00	14.88
Vitamin B6 (mg)	3.00	5.00	3.50	4.40	5.00	2.21	2.00	3.59
Vitamin B12(mg)	0.015	0.020	0.020	0.022	0.016	0.014	0.015	0.017
Nicotinamide (mg)	50.00	85.00	40.00	66.00	45.00	48.51	30.00	52.07
Folic acid (mg)	2.0	2.0	1.0	1.0	2.0	1.0	1.5	1.5
Biotin (mg)	0.15	0.20	0.20	0.20	0.20	0.15	0.10	0.17
Choline chloride (mg)	400	450	600	550	400	660	500	508.57

***** Information not available.

(Data From Techna, France).

Table 3 : Recommendations by different Vitamin manufacturers for Broilers (Values Per Kg of feed)

Vitamins	Roche	BASF	Rhone poulenc	Mean Values
Vitamin A (I.U)	10000-12000	8000-12000	11000-13000	9666-12333
Vitamin D3 (I.U)	2000-4000	2500-4000	3000-4000	2500-4000
Vitamin E (mg)	30-50	30-50	30-150	30-83
Vitamin K3 (mg)	2-4	2-3	3-4	2.3-3.7
Vitamin B1 (mg)	2-3	2-3	2-3	2-3
Vitamin B2 (mg)	5-8	5-7	7-9	5.7-8.0
CalciumD-Pantothenate mg)	10-15	10-12	12-14	10.7-13.7
Vitamin B6 (mg)	4-6	3-5	4-6	3.7-5.7
Vitamin B12 (mg)	0.02-0.03	0.015-0.025	0.020-0.040	0.018-0.032
Nicotinamide (mg)	30-50	30-50	40-50	33.3-50.0
Folic acid (mg)	1.0-1.5	1.0	1.0-2.0	1.0-1.8
Biotin (mg)	0.05-0.10	0.10- 0.15	0.1-0.2	0.083-0.150
Choline chloride (mg)	300-400	300-600	—*	300-500

***** Information not available.

The challenge before any broiler producer is to determine Vitamin values that are efficient. This represents an inclusion level that is adequate for efficient performances whilst allowing a margin of safety. It is opined that excessive use of vitamins is an economic waste as beyond a certain point additional vitamins do not lead to any improvement in performance, whilst adding to the cost.

There appears to be a significant variation in vitamin levels used by different broiler producers worldwide. It is observed that Breeders and Vitamin manufacturers generally recommend inclusion levels of vitamins far higher than what may be justified for economic performance. In this too there appears to be significant differences between the recommendations made by different breeders and Vitamin manufacturers.

The Vitamin recommendations by the Breeders are summarized in Table.2 and a recommendation by different Vitamin manufacturers is summarized in table 3.

It is of relevance to note that higher levels of any one particular Vitamin may interfere with the absorption or availability of other vitamins. For instance :

- Fat-soluble vitamins compete for the absorption sites. High dietary levels of Vitamin A can cause either Vitamin D (7), Vitamin E (1) or Vitamin K (3) deficiency.
- Biotin becomes deficient in the presence of high levels of other B vitamins (7,2).

The poultry industry is supplementing vitamins up to 10 times NRC requirements. (BASF, 1994). Increased vitamin fortification also increases feed cost; hence nutritionists must fortify rations with vitamins in accordance with the following criteria;

- Determine the factors in a grow out operation that impact vitamin supplementation
- Objectives to accomplish appropriate vitamin nutrition fortification with minimum feed cost and
- Determine “safety factor” Vitamin levels required due to unexpected and varied stress factors among locations and or within flocks.

The Vitamin levels used by the US Poultry industry were researched by BASF. These values are indicated in table.4

Comments

- There is a significant variation in levels of vitamins recommended in broiler rations by Breeders, Vitamin manufacturers and Researchers.
- There may be some differences in levels required due to breed variations however in view of the fact that all broilers grow more or less at a similar rate, these huge differences cannot be rationalized.
- In general all Breeders and Vitamin manufacturers recommend higher levels of vitamins than what is recommended by researchers like NRC and BIS. This is probably due to NRC defining vitamin requirements as the minimum vitamin level to prevent clinical symptoms of Vitamin deficiency, however commercial broilers are economic agricultural field production units, where the objective is not to prevent deficiencies but to maximize field performance. Whilst considering the above facts a Safety margin inclusion has to be rationalized

Table 4 : Low 25% ,Average, High 25% and High 5% Vitamin premixes for commercial Broiler Markets (Values Per Kg of feed)

Vitamins	Low 25%[3]	High 25 % [2]	High 5%[4]	Avg[1]
Vitamin A, (IU)	6404	10141	12676	8113
Vitamin D3, (IU)	2039	3036	3858	2568
Vitamin E, (IU)	9.48	23.89	29.86	15.76
Vit. K3 (mg)	0.9	2.82	3.53	1.63
Thiamine (mg)	0.85	2.19	2.74	1.40
Riboflavin mg	5.0	7.71	9.65	6.44
Panthothenic acid (mg)	8.4	12.47	15.59	10.91
Pyridoxine (mg)	0.95	3.72	4.65	2.25
Vitamin B12 (mg)	0.009	0.017	0.021	0.012
Nicotinamide (mg)	26.97	60.34	75.43	43.54
Folic acid (mg)	0.46	1.07	1.33	0.75
Biotin (mg)	0.024	0.126	0.157	0.07

(BASF,KC-9408)

[1] Avg. represents the mean for 62 vitamin values used in the US poultry industry
[2] High 25% represents the mean for the highest 15 vitamin values used in the US poultry industry
[3] Low 25% represents the mean for the lowest 15 vitamin values used in the US poultry industry
[4] High 5% represents the mean for the highest3 of 15 vitamin values used in the US poultry industry.

and justified in economic terms. Breeders tend to recommend higher levels and keep huge and often unnecessary safety margins

- A poultry production company must address itself to levels that are adequate, whilst allowing for a safety margin. Higher Vitamin intake wherein nutritionally unharmful (at levels discussed) do have a significant economic impact.
- In reality there is probably a lot more of vitamin consumption than what is required for efficient production. This leaves a significant gap for broiler producers to adjust vitamin levels in the rations, whilst maintaining productivity.
- In Extremes i.e hot or cold climates or under stress there may be a case for supplementation. However the need for supplementation should be defined and quantified and the supplementation must be provided for this specific need.
- The quality of a premix plays a significant role in determining vitamin levels. If a homogenous mix is used one may manage with lower levels than levels that may be required in non-homogenous premixes where vitamin availability is not uniform.
- In commercial terms it has been observed that a homogenous premix consisting of lower vitamin levels often proves a better performer than non homogenous premixes containing higher levels of vitamins.

Conclusion

There is a lot of information and often conflicting information available on the levels of vitamins required for efficient broiler performance. In India it is observed that vitamin levels used are generally in excess of what is required for efficient, reliable performance. There exists significant room for improvement in efficiencies and broiler producers are encouraged to evaluate different levels of vitamins to achieve greater efficiencies.

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AVITECH
ANIMAL HEALTH PVT. LTD.
Corporate Heights, SCO - 24, Sector - 14, Gurgaon 122001 India
Ph : (0124) 6315044 / 45 / 46 Fax : (0124) 6314680 email : avitech@vsnl.com