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Influence of dietary energy density on feed intake, feed efficiency and weight gain of broilers

Der Einfluß des Energiegehaltes im Futter auf die Futteraufnahme, die Futterverwertung und die Körpergewichtszunahme bei Broilern

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1 Introduction

High environmental temperature as found under tropical conditions is known to have a detrimental effect on feed consumption and growth performance of chickens (BUSHMAN, 1974; VIRK et al., 1978; DALE and FULLER, 1980; COON et al., 1981; HENKEN et al., 1982; BOTTJE and HARRISON, 1985; OSMAN, 1988). Under these conditions, adjustments should be made in dietary concentration in order to insure adequate intake of all nutrients (DAGHIR, 1985; LEESON, 1986).

The effect of the dietary energy level on the performance of broilers has been well documented.
Increasing metabolizable energy (ME) of the diet causes significant decreases in food intake and significant improvement in the efficiency of feed conversion (CHAWLA et al., 1978; ONWUDIKE, 1983; INRA, 1984).
SUMMERS and LEESON (1984) found that increasing dietary energy level also improves the protein efficiency of the diet. OLUMU and OFFIONG (1980) and ONWUDIKE (1983) who conducted studies in Nigeria recommanded for growing broilers an energy level of 3000 kcal ME/kg diet. No more improvement was obtained by increasing the energy content up to 3200 kcal ME/kg diet.

This study was undertaken to investigate the effect of increasing dietary energy concentration, at constant protein level, on feed intake, feed efficiency and live weight gain of broilers raised under the environmental conditions of the savanna zone in Côte d'Ivoire.

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2 Materials and Methods

Some 200 one-day broiler chicks of a modern commercial strain (Vedette) were raised up to 4 weeks of age in a floor pen. Rice hulls were used as litter. During this preexperimental period, the chicks were offered ad-libitum a starter diet containing 21.6% Protein and 2900 kcal (12.14 MJ) ME/kg diet (Tab. 1). This ration was found optimal in a previous experiment (Yo and Tawfik, 1989).

Tab. 1: Composition and nutrients content of the diets used in the experiment.

Ingredients	Starter diet	Experimental diets (2800 kcal/kg)	Experimental diets (3000 kcal(kg)
Corn (%)	48.85	46.60	61.30
Rice polishings (%)	15.00	15.00	13.00
Wheat shorts (%)	4.15	13.50	0.00
Cottonseed meal (%)	8.00	11.00	10.50
Soybean meal (%)	8.00	1.50	0.00
Fish meal (%)	12.60	9.00	12.20
Dicalium phosphate (%)	0.40	0.40	0.00
Provix C3 * (%)	3.00	3.00	3.00
Nutrients content			
Metabolizab. energy (kcal(kg)	2895	2797	2997
Protein (%)	21.60	19.00	18.90
Lysine (%)	1.16	0.93	0.94
Methionine (%)	0.55	0.49	0.51
Methionine + Cystine (%)	0.90	0.80	0.81
Calcium (%)	1.60	1.40	1.40
Available Phosphorus (%)	0.63	0.56	0.54
Cellulose (%)	3.90	4.65	3.58
Cost (F.c.f.a/kg diet)**	78.14	64.17	71.81

* Provix C3 supplied per kg ration:
Phosphorus 1.17 g, Calcium 6.6 g, Vit. A 15.000 IU, Vit. D_3 1980 IU, Vit. E 24 mg, Vit. B_1 0.3 mg, Vit. B_2 4.2 mg, Vit. B_3 12.3 mg, Vit. B_6 0.6 mg, Vit. B_{12} 0.01958 mg, Vit. K_3 3 mg, Niacine 24 mg, Folic acid 0.6 mg,coccidiostat 120 mg, Choline 405 mg, BHT 114 mg and Bacitr. zinc 5.1 mg

** Cost calculation based on prises of ingredients during the period of experiment; 1 DM = 170 F.c.f.a (1988)

Additional heat was provided in the pen during the first week of live. At the end of this period, the chicks were randomly distributed in groups of 50 chicks each and assigned to 4 floor pens. Then, the birds were weighed individually.

During the experimental period (29–49 days), two isonitrogenous diets (19% Protein) containing either 2800 kcal (11.72 MJ) or 3000 kcal (12.56 MJ) ME/kg diet were compared. Formula composition and nutrients contents of the eyperimental diets are given in Tab. 1. The ME levels were calculated using the individual ME values of the ingredients as outlined by Inra (1984). Each diet was fed to two pens of 50 birds (two replicates per treatment). Feed and water were supplied ad-libitum and a total lighting period of 18 h per day was provided. At the end of the experimental period (29–49 days), the birds were weighed individually again. Feed consumption and mortality were recorded for each pen.

Statistical analysis for live weight gain, feed intake and feed efficiency were determined by analysis of variance as outlined in RENNER (1981).

3 Results and Discussion

The results of this study are presented in Tab. 2.

Tab. 2: Effects of ME level on the performance broilers (5 – 7 weeks).

	ME levels		
	2800	3000	F test
Live weight gain (g)* (29 – 49 days)			
Males	913 a	975 a	N.S.
Females	747 a	784 a	N.S.
Mixed sexes	849 a	870 a	N.S.
Feed intake/bird	3084 a	2761 b	$P < 0.01$
Protein intake/bird	586 a	522 b	$P < 0.01$
Feed conversion ratio	3.63 a	3.17 b	$P < 0.05$
Protein efficiency**	1.45 b	1.67 a	$P < 0.01$
Mortality (%)	6	10	
Feed cost per kg live weight gain (Fc.f.a)	235 a	228 a	N.S.

* Any two means on the same line having same letter do not differ significantly ($P > 0.05$)

** Protein efficiency was calculated by dividing the live weight gain by protein intake in the same period.

Increasing the dietary energy level from 2800 to 3000 kcal ME/kg diet did not exert any significant effect on the live weight gain of both male and female chicks during the growing period ($P > 0.05$). Feed consumption, however, decreased significantly with increased dietary energy level ($P < 0.01$). Subsequently, increasing the dietary ME content improved significantly the feed conversion ratio of the birds ($P < 0.05$). These results confirm those reported by GRIFFITHS et al. (1977); GUIRGUIS (1977) and CHAWLA et al. (1978). COON et al. (1981) and SUMMERS and LEESON (1984), however, observed, contrary to these results, a significant improvement in weight gain of female chicks with increased dietary energy density. A similar response was not noted for the males.

The trend of improving feed efficency with increasing dietary energy level is in agreement with previous findings in guinea zones of west africa (OLOMU and OFFIONG, 1980; ONWUDIKE, 1983). These autors observed a significant improvement in feed efficiency with increasing the ME level up to 3000 kcal/kg diet. No further improvement was obtained with higher caloric rations.

Chicks receiving the low caloric ration (2800 kcal/kg) showed the highest feed intake ($P < 0.01$). This suggests that chicks are able to regulate their feed intake so as to meet their energetic requirement from low caloric feed using a chemostatic mechanism of feed-intake control. Similar results have been reported by CHAWLA et al. (1978); AHUJA et al. (1978) and COON et al. (1981).

Since the two diets were isonitrogenous (Tab. 1), the higher feed intake in the low energy group was associated with significantly higher protein intake ($P < 0.01$) and lower protein efficiency ($P < 0.01$). It can be postulated from these data that the protein intake in this group was in excess of the protein requirements and the chicks were probably using the surplus as source of energy (AHUJA et al., 1978; ONWUDIKE, 1983). This may explain why the protein efficiency was lower for this ration. Since the primary function of the dietary protein is to channelize for tissueprotein formation (CHAWLA et al., 1978), the higher protein intake on the low caloric diet may be considered as an unnecessary wastage of protein. CHAWLA et al. (1978) noted that the optimum recommandation is to set at that dietary level of energy where the breakdown of protein as a source of energy is minimum without affecting the growth rate. From these remarks, it appears that the ratio energy/protein must be taken in account by formulating the diets.

The lowest feed cost per kg live weight gain was obtained on the high energy feed; however, the difference between treatments was not statistically significant ($P > 0.05$).

Although no published information on broiler energy requirement in Côte d'Ivoire is now available to compare with the data of this study, the energy level found optimal in this trial (3000 kcal ME/kg diet) can be considered optimal for the savanna region of Côte d'Ivoire. This is in agreement with the recommandation of OLOMU and OFFIONG (1980) for the similar climatic zone of Nigeria.

4 Summary

This experiment was conducted to evaluate the effects of dietary energy level on the feed intake, feed efficiency and weight gain of broilers during the growing period (29–49 days). Two isonitrogenous diets (19% Protein) containing either 2800 kcal (11.72 MJ) or 3000 kcal (12.56 MJ) ME/kg diet were compared.

Increasing dietary energy content from 2800 to 3000 kcal ME did not exert any significant effect on the live weight gain of the chicks ($P > 0.05$). Feed consumption, however decreased significantly with increase in dietary energy level ($P < 0.01$). Subsequently the feed conversion ratio improved with increased ME level ($P < 0.05$). The higher feed intake on the low caloric diet was associated with significantly higher protein intake ($P < 0.01$) and lower protein efficiency ($P < 0.01$). Feed cost per kg gain was not affected by the EM level ($P > 0.05$).

Key words: Broiler chicks, Feeding, Energy requirement, Feed efficiency.

Zusammenfassung

In einem Fütterungsversuch mit Broilern wurde der Einfluß des Energiegehaltes im Futter auf die Futteraufnahme, die Futterverwertung und die Körpergewichtszunahme in der Mastperiode, 29.–49. Tag, untersucht. Zwei Futtermischungen mit 19% Protein und

2800 kcal (11,72 MJ) bzw. 3000 kcal (12,56 MJ) wurden verglichen. Es wurde kein Unterschied zwischen beiden Futtermischungen in der Körpergewichtszunahme festgestellt ($P > 0,05$). Die geringere Futteraufnahme bei dem höheren Energiegehalt im Futter ($P < 0,01$) führte bei gleicher Körperzunahme zur Verbesserung der Futterverwertung ($P < 0,05$). Die höhere Futteraufnahme beim niedrigeren Energiegehalt im Futter korrelierte mit einer höheren Proteinaufnahme ($P < 0,01$) und einer schlechteren Proteinverwertung ($P < 0,01$). Der Energiegehalt im Futter übte keinen Einfluß auf die Futterkosten je kg Körpergewichtszunahme aus.

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