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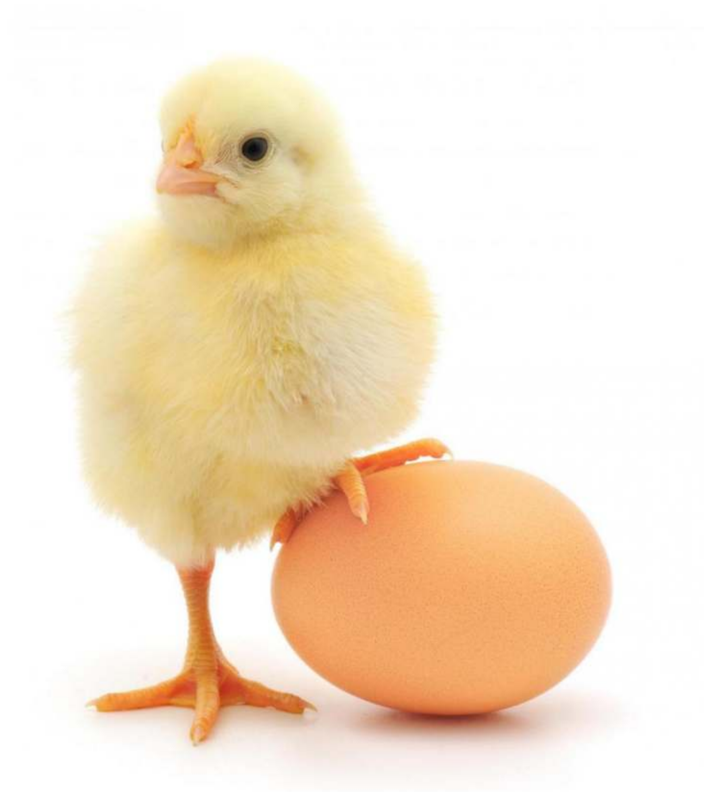

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Effect of Including Some Insects as Feed Supplement on Broilers Reared in Zimbabwe

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Abstract: A trial to test the effect of including some insects as feed supplement on broilers reared in Zimbabwe was conducted. The initial weight of the day old chicks was 48 g they all looked healthy. The feed was provided as mash which the young birds ate normally. On day 12 and 18 when Bursa gomboro vaccine was administered there was no change in feeding frequency. Growth was steady the birds approximately doubling their own weight every 5 days. Throughout the study period day temperatures were between 25 and 35°C Celsius and night temperature were between 15 and 20°C Celsius. Humidity ranged between 65 and 95% the mean being 75%. Rainfall with thunder occurred at least 5 times but did not affect the birds with regards to feeding frequency. The birds that fed on Encosternum delegorguei had a lower mass than the others until slaughter. Those fed on *Macrotermes falciger* had a higher mass until day 25 after which the control group took the lead. There was a significant difference in growth rate between hens and cocks in all the groups (H, I, C) $p>0.05$. Comparison of cocks fed on *Macrotermes falciger, Encosternum delegorguei* and the control showed no significant difference $p>0.05$. Comparison of hens fed on *Macrotermes falciger, Encosternum delegorguei* and the control showed no significant difference $p>0.05$. There was significant difference between feed consumed during the day and that consumed at night among all the three groups $p>0.05$. The sizes of the various body parts were within range for all the groups indicating food utilization by the birds was even and not channeled to one organ. No unusual ill health effects were recorded, the appearance of the birds was normal, internal organs did not show any signs indicating ill health for hens and cocks fed on *Macrotermes falciger*, *Encosternum delegorguei* and the control.

Key words: *Macrotermes*, *Encosternum*, broilers, feed supplement, growth

INTRODUCTION

Rearing chicken on a large scale for meat has been occurring for less than a century. Chicken meat is one of the main sources of readily available animal protein for humans today and as a result there have been efforts to maximize production by selecting breeds that have high efficiency, at the same time developing feed formulas that hasten growth and maturity (Okumura and Emmans, 1990; Saleh *et al.*, 1996; Nyachoti *et al.*, 1996). The current domestic chicken at one time used insects as their main supply of protein and small grains for energy supply. Insects are very abundant in tropical Africa but most of them are not used as food by humans yet they hold a good potential for being used as chicken feed which can then be fed upon by humans thus improving food security (Ene, 1963; Phelps *et al.*, 1975; Ravindran and Blair, 1993; Téguia *et al.*, 2002; Sogbesan and Ugwumba, 2008; Ijaiya and Eko, 2009; van Huis, 2013). Trials to use insect as poultry feed have been done successfully yet in most instances the insects were those not normally consumed by humans and consequently they produced very unfavourable off flavours (Hale, 1973; DeFoliart, 1989; Anand, *et al.*, 2008; Hwangbo, *et al.*, 2009; Haldar, 2012). A change in the diet of broilers has brought new challenges on the physiology of these birds (Moss and Trenholm, 1987; Julian *et al.*, 1992; Leeson and Caston, 1996). Overtime chicken physiological systems developed as adaptations to available food types. As time passed human breeding processes began to select for bird qualities that suited mans tastes and environment than the natural body needs of the chicken. Insects became rare in the menu for chicken feed from 1940 onwards. Soya protein and other types of protein are now the pivotal body building material for the chickens. Such changes to the natural diet usually result in compromised health of the recipient animals (Moss and Trenholm, 1987; Julian *et al.*, 1992; Leeson and Caston, 1996; Téguia, *et al.*, 2002). The food may be nutritious but grossly lacking in palatability and thus lowering the quality of life for the birds. It is estimated that feed amounts to 65% of total cost of production of chicken (North, 1972; Moss and Trenholm, 1987; Esteve-Garcia *et al.*, 1997; Even, 1998; Dube *et al.*, 2009). Feed is

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utilized by the bird for growth and for maintenance. In young birds most feed is used for growth and little is used for maintenance and so efficiency is very good. Over time efficiency deteriorates because the broiler has an ever increasing body mass to maintain (Nyachoti *et al*., 1996; Saleh *et al*., 1996; Leeson and Caston, 1996). Factors influencing feed consumption include among others, breed type, level of exercise, weather (including variations in temperature, wind, humidity and precipitation), the energy and nutritional quality of the feed and how much natural feed supplementation they obtain. Approximately 800 million chickens are found on the African continent. Approximately 80% of these are kept under traditional village production systems by people who are not able to afford expensive feeds (McAinsh *et al*., 2004). The importance of rural poultry in the national economy of developing countries and its role in improving the nutritional status and income of many smallholder farmers has been very significant (Muchadeyi *et al*., 2004). Food palatability is influenced to large extent by our up bringing. Selection of insects to supplement chicken feed must be guided by the target population's perceptions of those insects and availability. *Macrotermes* sp. and Encosternum delegorguei form a large biomass of insects abundantly occurring seasonally in Zimbabwean forests (Dube *et al*., 2013). The aim of this study was to evaluate the effect of including some insects as feed supplement on broiler growth under Zimbabwean conditions.

MATERIALS AND METHODS

Day old Ross broiler chickens were purchased and randomly divided into three groups of 10 each. The first week all the chicks received the starter mash produced by AgriFoods Zimbabwe which was constituted as outlined in Table 1. After one week one group received *Macrotermes falciger* 3% of the total feed mass (Group I) another group received Encosternum delegorguei 3% of the total feed mass (Group H) the third group was the control (Group C) Fig. 6A and 6B. After 21 days the birds were relocated to a new area. Insects were administered until the birds were 42 days. From day 22 the birds regular feed was administered as pellets finisher from AgriFoods Zimbabwe. Insects constituted 3% of the feed. Feed was administered *ad libatum*. Clean water and light were provided all the time. In the event of power outage Solar lighting backup was provided. All the birds were tagged with loose fitting numbered ribbon on the foot so that each individual bird was monitored closely on a daily basis. Every bird was weighed once a day at 5 pm. The feed consumed by each group during the day and that consumed at night were weighed and recorded. Temperature and humidity were monitored. Vaccinations and hygiene were done as recommended by the supplier of the birds (Ross Chicken Bulawayo). ESB was administered to all birds between day 20 and 24 after one of the birds showed poor health in the eyes. The birds were slaughtered on day 45 the carcass, the legs, liver, gizzard, heart, intestines and head were weighed separately. The general condition of the birds was noted all the time. The droppings were monitored for any differences in appearance and texture.

Table 1: Feed used manufactured by AgriFoods Zimbabwe Bulawayo to which 3% by weight of *Macrotermes falciger, Encosternum delegorguei* were added

	B.S. crumbs (%)	B.F. pellets (g/kg)
Crude protein	20	180
Fat	2.9	35
Crude fibre	6	34
Calcium	0.9	9
Phosphorus	0.7	7
Salt	0.4	4

B.S: Broiler Starter B.F: Broiler Finisher

RESULTS

The initial weight of the day old chicks was 48g they all looked health. They were given a glucose energy booster. The feed (Starter mash) was provided as mash and the young birds ate normally. On day 12 and 18 when Bursa gomboro vaccine was administered there was no change in feeding. Growth was steady the birds approximately doubling their own weight every 5 days. Throughout the study period day temperatures were between 25 and 35°C Celsius and night temperature were between 15 and 20°C Celsius. Humidity ranged between 65 and 95% the mean being 75%. rainfall with thunder occurred at least 5 times but did not affect the birds with regards to feeding. The birds fed on Encosternum delegorguei remained with a lower mass until slaughter. The ones fed on *Macrotermes falciger* had a higher mass until day 25 after which the control group were now leading Fig. 1. There was a significant difference in growth rate between hens and cocks in all the groups (H, I, C) $p>0.05$. Comparison of cocks fed on *Macrotermes falciger, Encosternum delegorguei* and the control showed no significant difference $p>0.05$ Fig. 2. Comparison of hens fed on *Macrotermes falciger, Encosternum delegorguei* and the control showed no significant difference $p>0.05$ Fig. 3. There was significant difference between feed consumed during the day and that consumed at night among all the three groups $p>0.05$ Fig. 4 and 5. The sizes of the various body parts were within range for all the groups indicating food utilization by the birds was even not channeled to one organ Table 2. No unusual ill health was recorded, the appearance of the birds was normal, internal organs did not show anything unusual for hens and cocks fed on *Macrotermes falciger, Encosternum delegorguei* and the control.

Table 2: Final average mass (g) of birds fed on *Macrotermes falciger*, Encosternum delegorguei and the control and average weight various parts at slaughter

	Final live mass	Carcass mass	Gizard	Liver	Heart	Head	GIT
Encosternum	2581.3	2156.6	46.4	53.3	12.8	76.1	92.7
Macrotermes	2661.3	2195.2	51.1	59.9	14.1	72	98
Control	2665.6	2200.3	56.2	65.3	15	73	100

Fig. 1(a-b): (A) *Macrotermes falciger* and (B) Encosternum delegorguei used to feed the chickens. These were prepared by local traditional methods

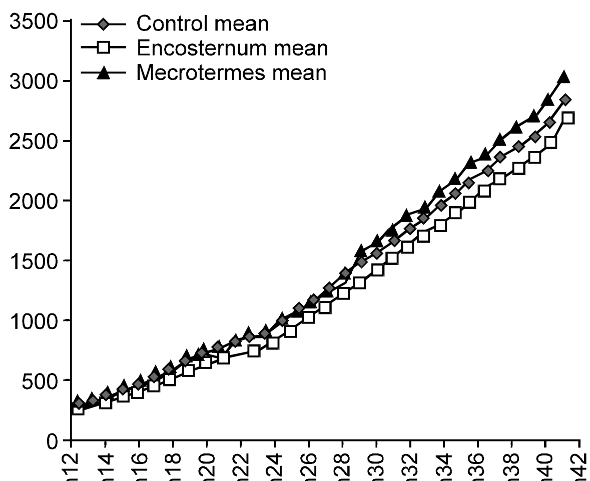

Fig. 2: Graph showing increase in mass(g) in cocks fed with *Macrotermes falciger*, Encosternum delegorguei and the control. One way ANOVA using Graph prism 4 showed no significant difference p>0.05

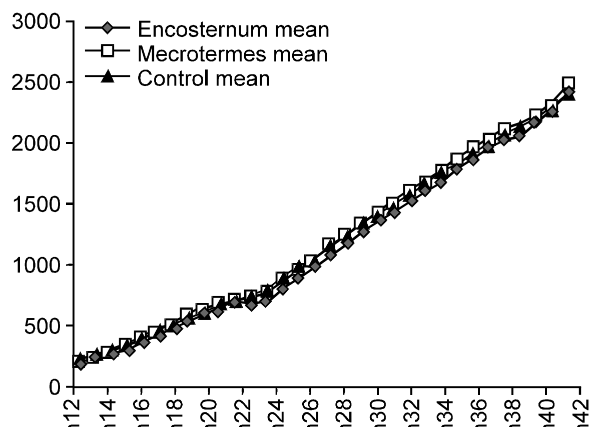

Fig. 3: Graph showing increase in mass (g) in hens fed with *Macrotermes falciger*, Encosternum delegorguei and the control. One way ANOVA using Graph prism 4 showed no significant difference p>0.05

DISCUSSION

That in this study cocks and hens showed differences in growth rate is consistent with other studies done earlier. Within the cocks there is a pecking order where by the dominant birds feed first. This and genetic constitution could account for discrepancies in individual growth rates which is in agreement with previous findings (Hale, 1973; Teguia *et al*., 2002; Anand *et al*., 2008;

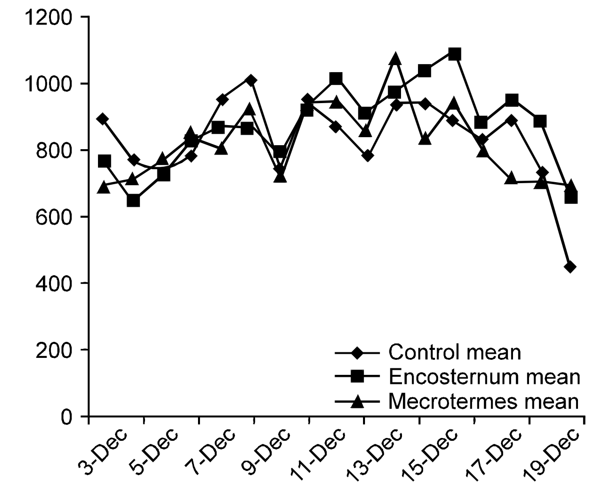

Fig. 4: Graph showing feed intake (g) at night in birds fed with *Macrotermes falciger* Encosternum delegorguei and the control. One way ANOVA using Graph prism 4 showed no significant difference p>0.05

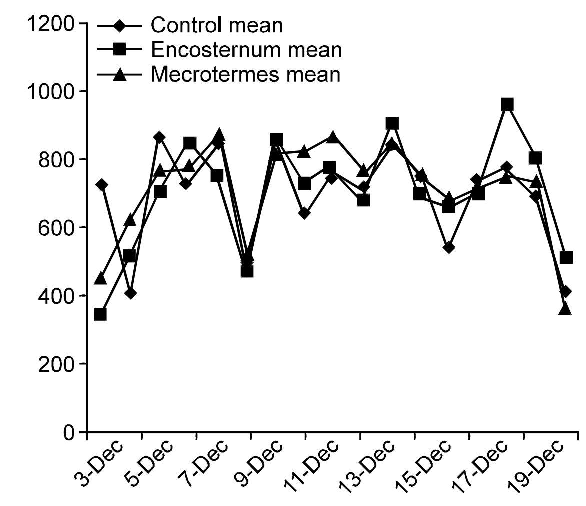

Fig. 5: Graph showing feed intake (g) during the day in birds fed with *Macrotermes falciger* Encosternum delegorguei and the control. One way ANOVA using Graph prism 4 showed no significant difference p>0.05. There was a significant difference between day and night feed intake p>0.05

Haldar, 2012). That no significant difference occurred in hens and cocks fed with *Macrotermes falciger,* Encosternum delegorguei and the control demonstrated that these insects can be used instead of regular commercial feed at lesser expense as previously noted (Hale, 1973; Teguia *et al*., 2002; Anand *et al*., 2008; Haldar, 2012). No unusual ill health was recorded, the appearance of the birds was normal, internal organs did not show anything unusual for hens and cocks fed on *Macrotermes falciger*, *Encosternum delegorguei* and the control this is consistent with studies where the birds were feed with other insects (Ravindran and Blair, 1993; Téguia *et al*., 2002; Sogbesan and Ugwumba, 2008; Ijaiya and Eko, 2009; van Huis, 2013). Our daily masses compared with those of Ross broilers suggesting that insects supplements were reasonably good substitute of commercial prepared feed.

Encosternum delegorguei, is used as food by some segments of the population of South Africa and Zimbabwe. Dried insects constitute of 35% protein, 51% fat, with an energy content of 2600 kJ/100 g. This will be nutritionally beneficial which would account for competitiveness as a supplement. *E. delegorguei* feeds on the sap of the trees *Combretum imberbe*, *Combretum molle*, *Peltophorum africanum*, to a lesser degree on *Dodonaea viscosa* and the grass *Pennisetum clandestinum* which are readily available this will ensure availability of the insects for feed supplements (Teffo *et al*., 2007; Dzerefos *et al*., 2009). *Encosternum delegorguei* are easy to harvest at their overwintering sites and summer oviposition sites such that if used to feed chicken gathering them will not be a challenge (Dube *et al*., 2013). Nutritionally in *M. falciger* the protein and fat composition of wingless wet mass is 21.2 and 22.5%, respectively. The calorific value reported for *M. falciger*, 761 kcal/100 g on an ash-free basis is extremely high and, possibly the highest yet reported for an insect. Their proteins have been used to feed rats with good results (DeFoliart, 1989).

The feed constituted by Agrifoods was appropriate for the growth of the chickens as the expected masses by the suppliers were achieve in the control birds. The feed fortified with supplements of Econsternum and Macrotermes was not significantly different from the commercial feed implying that such could be substituted without adverse effects or loss of potential to grow to desired levels with added advantage that the insects are cheaper. Insects supply proteins from which the chicken can select its own body building blocks (Ravindran and Blair 1993; Téguia *et al*., 2002; Sogbesan and Ugwumba, 2008; Ijaiya and Eko, 2009; van Huis, 2013). The insects have a lot of chitin in their body, this is not digested by the chicken. Chitin would invariably provide roughage needed to aid the digestion in the gizzard. Econsternum and Macrotermes are rich in fat which would aid absorbtion vitamin D and other fat soluble vitamins (Dube *et al*., 2013).

It can be inferred that insect feed supplements can be used instead of the now regular commercial feed.

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