Effect of supplementation on the feed intake and performance of confined and scavenging crossbred growing chickens in Burkina Faso

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Abstracts: An experiment was conducted to evaluate the performance of crossbred growing chickens (Rhode Island Red x indigenous Burkina Faso hens) from 6 to 17 weeks of age, under five feeding / management regimes: 1) CMx(+), confined and given a mixed feed containing cracked maize and cowpea and a vitamin-mineral premix ad-libitum; 2) CS(+), confined and offered ad-libitum a choice of cracked maize and cowpea with the premix; 3) ScS(+), scavenging from 09.00 to 16.00 with the diet in treatment (2) available from 16.00 to 09.00; 4) ScS(-), treatment (3) but without the premix, and 5) ScO, scavenging only, with no supplements provided. Daily dry matter (DM) intake was highest for CS(+) (43.5g), and lowest for CMx(+) (33.6g) ($p < 0.05$), with intermediate intakes for ScS(+) and Sc(-) of 36.7 and 36.2g, respectively. The ratios of intakes of cowpea to maize were 50:50, 21:79, 27:73 and 22:78 for CMx(+), CS(+), ScS(+) and ScS(-), respectively ($p < 0.05$). Dietary concentrations of crude protein (CP) were 15.7, 11.5, 12.3 and 11.6% of DM for CMx(+), CS(+), ScS(+) and ScS(-), respectively. Average daily gains (ADG) were 8.15, 5.24, 6.03, 5.36 and 4.45g for CMx(+), CS(+), ScS(+), ScS(-) and SCO, respectively, and were significantly higher for CMx(+) ($p < 0.05$). Feed conversion ratio was highest for CS(+) and lowest in CMx(+). ADG of the males (6.44g) was significantly ($p < 0.05$) higher than of the females (5.86g). Breast and thigh muscle weights were highest for ScS (+) ($p < 0.05$).

Keywords: Carcase; chickens; performance; scavenging; supplementation

Introduction

In West Africa the dominant village chicken production system is free-range, which is characterised by a low level of inputs (Gueye, 1998). Improving the productivity of this system is one of the challenges that developing countries face: when resources are limited, the priority should be to improve village production using locally available resources.

In Burkina Faso, cereals and legume seeds are given as a supplement to village chickens, according to availability. Provision of free choice diets instead of a complete conventional ration was suggested to have beneficial effects (Pousga *et al*, 2005a). Choice feeding allows birds a greater opportunity to select the nutrients needed for maintenance and production (Siegel *et al.*, 1997), and will also allow village chickens to select the correct proportions of the different supplementary feeds to complement their intake from scavenging. An experiment was carried out on-station in Burkina Faso, to evaluate the effects of supplementing a vitamin-mineral premix and maize and cowpeas, provided either in a mixture or separately, on the performance of confined and semi-scavenging growing crossbred chickens.

Material and methods

The study was carried out on Sapone research station, located around 35 km from Ouagadougou in the Central Region of Burkina Faso. This part of the country is included in the Sudano-Sahelian zone. The experimental birds were crosses between Rhode Island Red cockerels and local breed hens (Noa-Kuiguiga and Noa-Rigre). The resulting eggs were collected for incubation, and after hatching 100 male and 100 female chicks were selected for the experiment.
Experimental treatments :
1) **CMx(+)**, confined and given a mixed feed *ad-libitum* containing cracked maize (50%) and cowpea (50%) and a vitamin-mineral premix (0.2%);
2) **CS(+)**, confined and offered *ad-libitum* a choice of cracked maize and cowpea with the vitamin-mineral premix;
3) **ScS(+)**, scavenging from 09.00 to 16.00 and offered the diet in treatment (2) from 16.00 to 09.00;
4) **ScS(-)**, treatment (3) but without the vitamin-mineral premix, and
5) **ScO**, scavenging only, but housed at night and with no supplements provided.
Drinking water was available for birds on all treatments at all times.

Results and discussion

Effect of supplementation on feed and nutrient intake

In the confined groups, daily DM intake was higher for the choice-feed birds compared to those offered the mixed feed *(Table 1)*. This result is different from other studies (Olver and Malan, 2000; Dana and Ogle, 2002), which showed lower DM intake by choice-fed birds compared to those that received a complete layer mash. This can be explained in our study by the anti-nutritional factors, such as a trypsin inhibitor and tannins, present in the mixed feed due to the high level of inclusion (50%) of cowpea, which would have probably reduced its palatability (Pusztai *et al*., 1992). This negative effect on palatability due to the presence of cowpea was confirmed by the significantly lower intake of cowpea in favour of maize in all the choice-fed groups, although it should be pointed out that a high intake of maize is usually seen when it is given separately (Olver and Malan, 2000; Dana and Ogle, 2002).

Dry matter intake was about 16 % higher for the CS(+) chickens compared to the corresponding scavenging treatment [ScS(+)], which indicates that the scavenging birds were probably getting 16 % of their DM intake from scavenging feed resources (SFR). This proportion is similar to the value found by Minh and Ogle (2005) in a study carried out in Vietnam with crossbred grower chickens, in which it was estimated that around 12% of DM intake came from the SFR. The proportion of the total diet from scavenging varies and is influenced by a number of factors, one of the most important being season (Pousga *et al*, 2005b). The present experiment was carried out during the crop harvesting time (September-November) when it was relatively easy for the scavenging birds to find grains and seeds in the surrounding environment.

None of the choice-fed birds succeeded in meeting their requirements for protein and essential amino acids from the supplements, mainly because of the low intake of cowpea that was offered in order to supply the necessary protein. In the ScS(+) treatment, the CP intake of 12.3% of total DM was below the requirement of commercial pullets from 6 weeks to first egg of 14.5% (INRA, 1986). However, assuming that the requirements of crossbred chickens are lower than of improved pullets and that the intake from scavenging will supply a certain amount of protein, it is likely that choice feeding maize and cowpea should at least meet the CP requirement of scavenging chickens.

Table 1. Effect of supplementation on the dry matter and nutrient intake (% of DM) of confined and scavenging crossbred chickens (LSM ± SEM)

	Treatment*					
Item	CMx(+)	CS(+)	ScS(+)	ScS(-)	SEM	p-value
DM (g / bird / day)	33.6^{c}	43.5^{a}	36.7^{b}	36.2^{b}	0.84	0.00
OM	96.7^{b}	97.0^{a}	96.9^{b}	97.0^{a}	0.004	0.00
CP	15.7^{a}	11.5^{c}	12.3^{b}	11.6^{c}	0.13	0.00
CF	5.04^{a}	4.32^{c}	4.45^{b}	4.33^{c}	0.022	0.00
EE	3.16^{b}	3.88^{a}	3.75^{c}	3.87^{a}	0.022	0.00
NFE	72.9^{c}	77.3^{a}	76.5^{b}	77.2^{a}	0.134	0.00
Ash	3.15^{a}	3.00^{c}	3.03^{b}	3.01^{c}	0.004	0.00
Ca	0.12^{b}	0.15^{ab}	0.19^{a}	0.05^{c}	0.001	0.00
P	0.60^{c}	0.87^{a}	0.82^{b}	0.79^{b}	0.007	0.00
Lysine**	0.75^{a}	0.43^{c}	0.44^{c}	0.49^{b}	0.01	0.00
Methionine**	0.22^{a}	0.18^{c}	0.18^{c}	0.19^{b}	0.001	0.00
Threonine**	0.45^{a}	0.34^{c}	0.35^{c}	0.36^{b}	0.003	0.00
ME (MJ / bird / day)	0.45^{c}	0.64^{a}	0.54^{b}	0.52^{b}	0.01	0.00

(+): With vitamin and mineral premix; (-): Without vitamin and mineral premix
Premix contained the following per 1000 g premix: Vitamins A: 4000 000 IU; D3: 800 000 IU; E: 2 000 mg; K: 800 mg; B1: 600 mg; B2: 2 000 mg; Niacin: 3 600 mg; B6: 1 200 mg; B12: 4 mg; choline chloride: 80 000 mg
Minerals: Dicalcium phosphate (Ca 24.5%; P 17%); Iron 1.8%
[a, b, c] Means with different superscript letters in the same row are significantly different at $p < 0.05$
* CMx(+), confined and given a mixed feed containing cracked maize and cowpea and a vitamin-mineral premix ***ad-libitum***; CS(+), confined and offered ***ad-libitum*** a choice of cracked maize and cowpea, with the premix; ScS(+), scavenging from 09.00 to 16.00 with the CS(+) diet available from 16.00 to 09.00; ScS(-), as ScS(+), but without the premix
** Calculated values

Effect of supplementation on average daily weight gain, feed conversion ratio, mortality and feed costs

Average daily gain was higher in the confined group given the mixed feed compared to the choice fed treatment *(Table 2)*. This can be explained by the lower protein and essential amino acid intakes by the choice fed birds as a result of lower than expected intakes of cowpea. Also ADG was higher for CMx(+) than for the scavenging birds, probably because of their limited access to the supplements. Daily gains were also significantly lower for the birds that were not supplemented (ScO) compared to all other treatment groups, which confirms that scavenging only cannot meet the nutrient requirements for maintenance and tissue growth of crossbred chickens. This result is in agreement with Tegene (1992), who concluded that the feed that the local chickens consumed as a result of scavenging was critically deficient in nutrients and protein. The observation that ADG were only marginally lower for the scavenging treatment without the vitamin-mineral premix than for the treatment with the premix indicates that it is not necessary to provide additional vitamins and minerals to scavenging chickens, at least in the harvesting season. Daily gain and final live weight were higher for males compared to females, which is in good agreement with other studies (Minh and Ogle, 2005; Pedersen, 2002).

Feed conversion ratio (FCR) and feed costs/kg gain (FCS) were lowest when the mixed feed was given to the confined chickens. However, because of the relatively low daily gains, FCS was still around USD 3.3 /kg gain for CMx(+), and values for the other treatments where cowpea and maize were offered were even higher. This leads to the conclusion that it is not economically advantageous to feed untreated cowpea to either confined or scavenging growing chickens. However, the present study was carried out during the crop harvesting period at the end of the rainy season. The quantity of SFR would probably have been lower in the dry season, as was found by Minh and colleagues (2006) and Dessie (1996), when it is possible that supplementing cowpea and maize would have been more advantageous. The higher mortality that was found in scavenging birds was almost entirely due to predators, in particular snakes, rats and birds of prey.

Table IV. Effect of supplementation strategy on average daily weight gain (ADG), feed conversion ratio (FCR) and feed cost / kg gain (FCS) of confined and scavenging crossbred chickens (LSM ± SEM)

	Treatment*						
	CMx(+)	CS(+)	ScS(+)	ScS(-)	ScO	SEM	p-value
Initial weight (g)	310	320	300	305	300	4.40	
Final weight (g)	920[a]	715[b]	750[b]	700[bc]	630[c]	18.49	0.00
Days on experiment	75	75	75	75	75		
ADG (g)	8.15[a]	5.24[b]	6.03[b]	5.36[bd]	4.45[cd]	0.234	0.00
FCR (g feed /g gain)	4.62[a]	8.36[b]	5.27[c]	6.54[c]	-	0.165	0.00
Mortality (%)	0.00[b]	7.50[ab]	20.0[a]	12.0[ab]	22.0[a]	4.87	0.03
FCS (CEFA** / kg weight gain)	1718[c]	2877[a]	1844[c]	2248[b]	-	58.5	0.00

a, b, c, d Means with different superscript letters in the same row are significantly different at $p < 0.05$
* See footnotes, Table I. ScO, scavenging only, no supplements provided
** I USD = 550 CEFA (approx.)

Effect of supplementation and scavenging on the carcass characteristics of male crossbred chickens

Carcass percentage, and thigh weight as a proportion of carcase weight, were higher for ScS(+) males compared to the two confined groups *(Table 3)*. This was probably a result of greater abdominal fat deposition by the confined birds at the expense of muscle (Castellini *et al*., 2002). Among the scavenging treatments, higher breast and thigh muscle proportions were noted for the ScS(+) males compared to the un-supplemented scavenging birds (ScO), probably due to their failure to find sufficient protein from SFR, as was also found by Minh and Ogle (2005). The observation that thigh muscle percentage was generally higher for the scavenging compared to the confined birds can be explained by the scavenging activities, which increase motor activity and have been shown to enhance the development of muscle mass at the expense of fat (Wattanachant *et al*., 2004). It can be concluded that it is not economically advantageous to provide maize, cowpea and vitamin-mineral supplements to crossbred, growing, scavenging chickens in central Burkina Faso, at least during the harvesting season.

Table 3. Effect of supplementation strategy on the carcass characteristics of male crossbred chickens (LSM ± SEM)

	Treatment						
	CMx(+)	CS(+)	ScS(+)	ScS(-)	ScO	SEM	p-value
Live body wt.(g)	1048[a]	735[b]	761[b]	715[b]	600[c]	35.8	0.00
Carcass wt.(% of live wt. at slaughter)	56.8[b]	56.5[b]	65.1[a]	59.6[ab]	53.0[b]	2.07	0.004
Breast wt. (% of carcass wt.)	26.7[ab]	26.0[ab]	31.5[a]	27.0[ab]	25.0[b]	1.95	0.187
Thigh wt. (% of carcass wt.)	30.0[b]	30.6[b]	38.5[a]	35.2[ab]	33.0[ab]	2.08	0.04

a, b, c Means with different superscript letters in the same row are significantly different at $p < 0.05$
* See footnotes Table I

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