Vaccination and scavengable feed resource assessment for village poultry

E. B. Sonaiya, O. A. Olukosi, O. Obi, and K. M. Ajuwon

Introduction

Under the existing production system, the productivity of scavenging chickens is limited by both poor nutrition and health problems. Newcastle disease (ND) has been recognized as the greatest constraint to scavenging chicken production (Aini, 1990). The control of the disease by vaccination is, until recently, ineffective due to the nature of scavenging chicken production system, the epidemiological factors of the disease and heat lability of the vaccine (Spradbrow, 2001). The control of the disease will reduce greatly the mortality suffered by scavenging farmyard chickens and lead to a greater need for supplementation and to greater use of available feed resources.

Scavenging chickens subsist on scavenging with very irregular supplementation. Sonaiya (1995) reported that scavenging chickens in southwestern Nigeria receive less than 35g of grain supplement daily. It is suggested that supplementation of scavenged feed with locally available feed resources will improve the chickens' productivity (Sonaiya, 1995; Roberts, 2000). For effective supplementation, there is need to know the quantity of the available scavengable feed. The concept of scavengable feed resource base (SFRB) is used to determine the quantity of SFRB in an environment (Roberts, 1992). It is a starting point in determining the quantity of feed that is required to supplement.

The objectives of this research were to evaluate: the effect of nutrition and health interventions in productivity of scavenging chickens; and to measure as well as predict the quantity of SFRB in some villages in SW Nigeria.

Materials and Methods

Three on-farm studies were carried out in nine villages in SW Nigeria. Study 1 was carried out in five villages (Aba Coker – V1, Aba Iya Gani – V2, Agbogbo – V3, Agric – V4, and Fasina – V5); while study 2 was in four villages; V1, V2, V3 and V4, all in Ife Central Local Government. The third study was in four villages (Moro, Yakooyo, Ipetumodu 1 and Ipetumodu 2) in the Ife North Local Government. All the nine villages are in Osun State of Nigeria. Study 1 was carried out towards the end of the dry season and ended during the early rains (February – April), study 2 was carried out in the late rainy season and ended in early dry season (September – November), while study 3 was done in the early dry season to the late dry season (November – January). Each of the studies 1 and 2 lasted 12 weeks, while study 3 lasted 8 weeks.

Flock owners who had average of 10-20 birds in their flock and who offered some form of shelter and feed supplement for their chickens were used. The required sample size for each study was determined by the average of the of the sample sizes for estimating the required parameters such as mortality, hatchability and chick survivability, etc. The sample size for required for each parameter was calculated using the formular:

$N = 4pq/L^2$

Where p = estimate of the population variance (i.e. standard deviation of the mean for the parameter)

q = 100 – p

L = Confidence probability level

The sample size determined for studies 1 and 2 was 292 while the sample size for study 3 was determined as 384. However, the number of birds used for the studies was 626, 621 and 438 for studies 1, 2 and 3, respectively. These numbers of birds are 30 flocks and 20 flocks, respectively.

In studies 1 and 2, four different treatments were applied to the birds; vaccination of the birds against ND (treatment 1); feed supplementation with commercial growers' mash (CGM) at 50% of the calculated energy requirement of scavenging chickens (treatment 2); a combination of vaccination and feed supplementation (treatment 3) and a control in which no vaccination or feed supplementation was given (treatment 4). All the birds in all the cooperators' flock in each village were offered the same treatment. The allocation of treatments to villages was done by random selection.

The quantity of CGM (calculated analysis 2230 kcal ME /kg and 180g CP/kg feed) required to supply the recommended daily energy requirement for each type of bird in the flock was calculated to be 46.05g for cocks, 40.94g for hens, 23.56g for growers and 5.08g for chicks. Daily feed requirement for each flock was weighed out separately, wrapped in transparent polythene bag and seven bags for a week were handed to each cooperator for daily feeding. The weekly total feed consumed by each bird was partitioned using the assumption that an adult bird consumed 8 times as much as a chick and 2 times as much as a grower (Obi, 1996).

Weekly visits were made to each village in the 3 studies, during which the birds were individually weighed. In studies 1 and 2, other activities carried out included vaccination of the birds when necessary and collection of feed leftovers.

Conventional vaccines (Hitchner B1 and LaSota) were used. Hitchner B1 was administered to chicks (<1 week old) intra-occularlly, while LaSota was administered to growers (>4 weeks old) and adults through drinking water. In study 2 Hitchner B1 was not used because of the expense of breaking a new vial for every batch of chick hatched. Also, LaSota vaccination for adult birds was followed 5 weeks later by intramuscular Komarof vaccination. Mortality occurring between the weekly visits was noted.

In study 3, in addition to weighing of birds, one-day household leftover (HHL) was collected from 24 randomly selected households at weeks 4 and 8 of the study. The households were given plastic wastebaskets the evening previous to the day when HHL would be collected. For the determination of the proportion of crop content that is HHL, 42 chickens were used. The chickens were caught at different periods of the day between 1100 and 1900 hours. They were caught while still scavenging, and were killed immediately by severing the jugular vein. Each bird was eviscerated, its crop opened up and the materials in the crop were visually identified and physically separated into HHL and the scavenged materials from the environment.

For the prediction of SFRB, the predictors used were HHL, number of crawling insects, number of refuse heaps and the vegetation cover. The number of crawling insects was determined by a modification of Obeng-Ofori (1994) pitfall trap method. Five bottles, (each of them 6cm in diameter both at the top and bottom, 13cm in height and 0.2cm rim thickness arranged diagonally with approximately 30 cm between two bottles) were used in a 1-m^2 area. The bottles were each buried in a hole such that the top was about 1cm below the soil with the soil gently sloping into the bottle. The bottle jars were filled to ¼ capacity with 4% formaldehyde solution and left in place for 24 hours. At the end of the period, the insects trapped were identified and counted. Ten random insect catch samples were done in each of the villages.

Transect mapping of the vegetation zones of each village was done using the method described by Kirsopp-Reed (1994). The map of the vegetation cover was made after approximately 20 walks along the east-west direction of each of the villages. The walks were done for thorough familiarisation with the vegetation zones within the villages. Random quadrants were thrown at different vegetation zones in order to facilitate physical counting of plant stands in each of the zones in the villages.

The number of refuse heaps sighted were counted. The counting was done along the east-west direction.

SFRB was determined on per chicken basis using the formular:

i. $\text{SFRB} = H/P \times n/\text{TNC}$

Where H = Quantity of HHL (kg/household/day)

P = Proportion of the crop content which is HHL

n = Number of household in the village

TNC= Total number of chickens

Both n and TNC were obtained from a census of the household scavenging chickens in the villages.

On the basis of bird unit (BU), SFRB was calculated using the formular:

ii. $\text{SFRB} = H/P \times n/\text{TBU}$

Where TBU = Total number of bird units in the village

Bird units were assigned to chickens in different categories using the method of Sonaiya *et al* (2002) and Olukosi (2001). The bird unit of each class was obtained as a quotient of the class average body weight and the average body weight of the cocks. The bird units assigned to cocks, hens, growers and chicks were 1, 0.8, 0.5 and 0.05, respectively.

All the data on performance were subjected to the analysis of variance using the General Linear Model of SAS. Generation of the prediction equation for SFRB was done by multiple regression analysis. The quantities of SFRB determined by prediction and by measurement were compared using the chi-square analysis. Significance was determined at 5% probability level. All analyses were done using the SAS (1986, 1997) software.

Results

Table 1 shows the effect of the treatments in study 1 and 2 on the reproductive performance of the scavenging hens, the chick survivability to 2 weeks and the total mortality among birds. In study 1, treatments 2 and 3 had higher clutch size ($P \le 0.05$) than treatment 1 and the treatment 4. However, there was no difference ($P > 0.05$) in the average clutch sizes of the hens in all the treatments in study 2. Hatchability was highest for treatment 3 (91.8%) and lowest in the treatment 4 (54%) in study 1. Overall, hatchability was highest in treatment 1 (93%) and lowest in the treatment 4 (76%). Chick survival was highest (93%) in treatment 3 and lowest (76%) in the treatment 4. In study

1, mortality was highest in the treatment 4 (65%) and lowest in treatment 2 (27%). However, in study 2 mortality was highest in treatment 3 (12%) and least in the treatment 4 (2%). Overall, mortality was highest (34.5%) in treatment 3 and lowest (16%) in treatment 1. Figure 1 shows the total mortality of the chickens of different ages during the study period. Chick mortality was the highest in all the treatments (65.9%), this was followed by mortality among the growers (18.6%) and then among the adult birds (15.5%).

The proximate composition of the supplemented CGM used in the two studies was 19.25% crude protein, 15.56% crude fibre, 9.08% oil, 32.84% nitrogen-free extract, 15.37% ash and 1478 kcal ME/kg. The effects of the treatments on the live performance of the scavenging chickens in the studies 1 and 2 are shown in table 2. The increases in body weights gain (BWG) in treatments 1, 2 and 3 were significantly different ($P \leq 0.05$) from each other and higher ($P \leq 0.01$) than for the treatment 4. For both the total BWG and the average daily gain (ADG), the increase over the treatment 4 was 62%, 73% and 87% for treatments 1, 2 and 3, respectively. The total BWG was significantly higher ($P \leq 0.05$) in treatments 2 and 3 than for either the treatments 4 or 1. Figure 2 shows the curve of ADG for the scavenging chickens in studies 1 and 2. The curve of ADG for the birds in treatment 3 had the least slope (0.11) compared with 0.75, 0.48 and 0.20 for treatments 1, 2 and 4, respectively. Table 3 shows that for all the classes of birds, there was a decrease in feed consumption as the study progressed, with the decrease being greater in treatment 3. In treatment 2, the greatest decrease (44.55%) was obtained in growers, while in treatment 3, the greatest decrease (92.13%) was obtained for chicks.

In table 4 is shown the quantities of SFRB available on a daily basis as determined by measurement of HHL for each of the villages in study 3. Moro had the lowest SFRB (6.9 g/chicken/day; 14.2 g/BU/day) while Ipetumodu 2 had the highest (26.9g/chicken/day; 57.3 g/BU/day).

Table 5 shows the predictors of SFRB studied in the villages. Ipetumodu 1 had the highest number of refuse heaps per km (16.4) while Yakooyo had the lowest (6.3). The average number of crawling insects trapped per square meter was significantly higher in Yakooyo (68±46) than Ipetumodu 1 (37±23). The difference in the number of insects trapped was significant ($P \leq 0.05$) only between Yakooyo and Ipetumodu 1. Vegetation cover was not significantly different across the villages. The quantity of household leftovers was highest in Yakooyo (0.18kg/day) and lowest in Moro (0.05kg/day)

Using multiple regression analysis, the prediction equation generated for calculating the SFRB was: SFRB = -65 + 928(HHL) + 0.6 (ENTO) + 2.7 (RH)

Where SFRB = available scavengable feed resource base, kg/family flock/year
HHL = Quantity of household leftover, kg/household/day
ENTO = Number of crawling insects, number/m^2/day
RH = Number of refuse heaps, number /km

The regression coefficient for the equation is statistically significant ($r^2 = 0.99$, $P \leq 0.04$). The standard error of the estimate of the regression coefficient is ±1.1kg/year. Inclusion of vegetation cover in the equation increased the standard error the most.

Table 6 shows the quantities of SFRB determined by the measurement of HHL, calculation and prediction. The average SFRB by measurement was 19.7 g/chicken/day, while it was 19.4 g/chicken/day by prediction. Chi square analysis shows that there was no difference in the two quantities.

Discussion

Chickens given vaccination or supplementation alone grew (62% and 73%, respectively) faster than the chickens in treatment 4 (control). However, combination of vaccination and supplementation improved performance by 86.5%.

In study 1, an outbreak of ND in the treatment 4 caused 57% mortality within the first two weeks of the study alone. The heavy mortality discouraged the participation of the cooperators in the study, such that the treatment was discontinued at the end of the sixth week. The mortality observed in the treatments was not due entirely to ND against which the birds were vaccinated, mortality was also due to predation, accident and other diseases such as fowl pox and respiratory disease. In study 2, predation alone accounted for 77.4% and 81.8% of the mortality in Treatments 1 and 3 respectively. This shows that with the control of ND, other diseases will become important constraints for scavenging chickens production (Adene, 1990).

Nutrition and health interventions improved chick survival which was higher in treatment 3 than in the other treatments, and lowest in the treatment 4. Creep feeding improves the survival of the chicks especially when the creep feed is fortified with protein (Gunaratne *et al*., 1992; Roberts and Senaratne, 1992).

The effects of the supplementation treatments of chickens agrees with the report of Roberts and Senaratne (1992) that providing creep feed (with 15% CP) to scavenging chickens improved growth rate by 75%.

The decrease in feed intake by the supplemented chickens in study 1 might be partly explained by the season. Study 1 began in the late dry season when there was little to scavenge and ended in the early rainy season when scavenged feed is expected to be more plentiful. Chickens prefer the cafeteria choice feeding (Sonaiya, 1995) which the scavenging situation approximates more than no-choice feeding which the supplement of growers' mash represents. On the other hand, a substantial part of the decrease could have been due to morbidity of the chickens, especially in treatment 3 where the body weight gain of the chickens was very low in the latter part of the study as shown in Figure 2. Feed mouldiness due to high air humidity could have reduced the palatability of feed resulting in reduced feed intake.

In order to effectively utilize the supplemented feed, there is need to determine the quantity of the available SFRB, its nutritional value as well as its availability to chickens. The formular of Roberts (1992) estimates SFRB on the basis of the flock unit. However, the flock size varies constantly even within a household. It is better to estimate the availability of SFRB to each chicken. Thus SFRB is better expressed on per chicken basis as in formula (i). However, the weakness of this formula is that it assumes that different classes of chickens have equal access to the SFRB. In reality, there is always a competition among chickens for SFRB, and it can not be assumed that a chick, for example, has equal access to SFRB as a cock. That is why Sonaiya *et al* (2002) suggested the use of bird unit in determining the quantity of SFRB using formula (ii).

Using the bird units, it is assumed that under the same competitive scavenging situation, a cock has access to 1.25 times more of the SFRB than a hen and 20 times more than a chick. Since a cock in this study had access to 43.72g of the SFRB per day, a hen had access to 34.98g, and a chick had access to 2.19g. This approach facilitates the determination of available SFRB to each category of chicken, and helps in determining what quantity of feed to supplement.

It is possible to arrive at the formulars above using the following steps, assuming first of all, that SFRB consists entirely of household leftover (H) and scavenged materials from the environment (E).

Thus, SFRB = H + E ………………………. (1)

Since the component E can not be measured directly, it has to be estimated from the proportion (P) of the crop content that is H. Hence;

$$E = \frac{H(1-P)}{P} \qquad (2)$$

Thus (1) becomes; $SFRB = H + \frac{H(1-P)}{P}$ …………….(3)

Solving (3) by partial fraction gives

SFRB = H/P……………………………(4)

This equation (4) is the same as the left side of Roberts (1992) formular. Hence, equation (4) is sufficient to determine SFRB if it is assumed that household leftover is the major contributor to SFRB.

Because the HHL is not the major contributor to SFRB in all locations, it is necessary to include other factors that could influence the quantity of the SFRB. Only four factors: number of crawling insects, vegetation cover, number of refuse heaps and household leftovers were used in this study. The quantities of SFRB determined by prediction and by measurement of HHL in this study were similar. However, it is necessary to identify more predictors and use them in the estimation. In this study, it was found that inclusion of vegetation cover in the equation decreased the precision of the equation the most. When more predictors are used, it will be possible to eliminate those that contribute little to the precision of the determination and to further refine the equation. The use of prediction equation is an improvement of Roberts (1992) formula and make it unnecessary to sacrifice the chicken to determine the crop content.

It can be concluded from the studies that interventions in both nutrition and health are required to improve the productivity of scavenging chickens. Also, it is necessary to determine the SFRB in a location before determining what quantity of feed supplement to be used. Rather than basing the determination of SFRB on the quantity of household leftover only, other contributors to the SFRB should be factored into the determining equation. Indeed, where there are no households (as in a free range poultry farm), the environmental contribution entirely determines SFRB. Further studies need to be carried out to provide estimates of SFRB under a complete free range. Sonaiya (2000) has called for such studies.

References

Adene, D. F. 1990. An appraisal of the health management problem of rural poultry stock in Nigeria. *In* E. B. Sonaiya, ed. *Rural Poultry in Africa: Proceedings of and International Workshop.* African Network of Rural Poultry Development (ANRPD). November 13-16, 1989, Obafemi Awolowo University, Ile Ife, Nigeria. Pp 89-99

Aini, I., 1990. Control of poultry diseases in Asia by vaccination. *World Poultry Science*

Journal 46:125.

Farrell, D. J. 2000. The energy and protein needs of scavenging chicken. *CD Proc. XXI World's Poultry Congress*: Aug 22-24, Montreal, Canada. Code:**p14.04**.

Gunaratne, S. P., A. D. N. Chandrasiri, W. A. P. M. Hemaltha and J. A. Roberts. 1992. Productivity and nutrition of village chickens in Sri Lanka. *In* P. B. Spradbrow ed. *Newcastle Disease in Village Chickens, Australian Center for International Agricultural Research*, Cambera. Proceeding 39: 144-148.

Kirsopp-Reed, K. 1994. A Review of PRA Methods for Livestock Research and Development. *RRA Notes.* 20:11-36.

Obeng-Ofori, D. 1994. The behaviour of 9 stored product beetles at pitfall trap arenas and their capture in millet. *Entomological Experimentalis et Applicata.* 73:39-50.

Obi, O. O. 1996. The effect of nutrition and health interventions in rural poultry production in Osun State. *Unpublished MSc. thesis.* Obafemi Awolowo University, Ile Ife, Nigeria.

Olukosi, O. A. 2001. A multisystem approach to the determination of the nutritional base Of scavenging family poultry. *Unpublished MPhil. thesis,* Obafemi Awolowo University, Ile Ife, Nigeria.

Roberts, J. A. 1992. The scavenging feed resource base in assessments of the productivity of scavenging chickens. *In* P. B. Spradbrow, ed. *Newcastle disease in village chickens: control with thermostable oral vaccines. Proc. International Workshop* October 6-10 1991. Kuala Lumpur, Malaysia. ACIAR Proc. No. 39: 29-32.

Roberts, J. A. and R. Senaratne. (1992). The successful introduction of hybrid egg laying chickens into a Sri-Lankan village. Proc. XIX World's Poultry Congress, Sept 19-24, 1992. Amsterdam. Vol I:818-821.

Roberts, J. A. 2000. Utilisation of feed resources by small holders in the villages of developing countries . *In* F. Dolberg and P. H. Petersen eds. *Poultry as a tool in poverty eradication and promotion of gender equality. Proc. Workshop organized by The Danish Agricultural and Rural Development Adviser's forum*. Mar. 22-26, 1999. Tune Landboskole, Denmark. Pp. 311-335. www.ihh.kvl.dk/htm/php/tune99/28-Roberts.htm.

Sonaiya, E. B. 1995. Feed Resources for Small-holder Poultry in Nigeria. *World Animal Review*. 1995(1):25-33.

Sonaiya, E. B. 2000. Family poultry and food security: Research requirements in science, Technology and socioeconomics. CD Proc. XXI World's Poultry Congress, August 22-24, Montreal, Canada. Code: s2.305.

Sonaiya, E. B. and Olori, V. E. 1990. Village poultry production in south-western Nigeria. *In* E. B. Sonaiya, ed. *Rural Poultry in Africa: Proceedings of and International Workshop.* African Network of Rural Poultry Development (ANRPD). November 13-16, 1989, Obafemi Awolowo University, Ile Ife, Nigeria. Pp 243-427.

Sonaiya, E. B., J. S. Dazogbo and O. A. Olukosi. (2002). Further assessment of scavengable feed resource base. In: Characteristics and Parameters of Family Poultry Production in Africa. *Results of a FAO/IAEA Coordinated Research Programme on "Assessment of the effectiveness of vaccination strategies against Newcastle disease and Gumboro disease using immunoassay-based technologies for increasing farmyard poultry production in Africa"*. IAEA, Vienna 2002. IAEA-TECDOC- XXXX. ISBN 90-5782-094-3. Pages 193-200.

Spradbrow, P. B. 2001. The epidemiology of Newcastle Disease in village chickens. *In* R. G. Alders and P. B. Spradbrow *eds. SADC Planning Workshop on Newcastle Disease control in Village Chickens. Proc. of an International Workshop.* March 6 –9, 2000. Maputo, Mozambique. ACIAR Proc No 103. Pages 53-55.

Table 1. Effect of vaccination and feed supplementation on mortality of scavenging chickens in southwestern Nigeria, their reproductive performance and survival of their chick

	Treatments			
	1	2	3	4
Total mortality, %				
Study 1	35	27	57	65
Study 2	19	5	12	2
Mean	27	16	35	34
SEM	2.38	2.79	3.99	4.72
Clutch size				
Study 1	6.7^{b}	9.3^{a}	8.8^{a}	6.3^{b}
Study 2	6.8^{a}	6.2^{a}	6.4^{a}	8.8^{a}
Mean	6.7	7.7	7.6	7.5
SEM	0.19	1.05	0.92	0.94
Percent hatchability				
Study 1	82	68	81	66
Study 2	91	84	83	89
Mean	86.5	76	82	77.5
SEM	1.78	2.38	0.84	2.85
Percent chick survivability to 2 weeks				
Study 1	81	77	91	54
Study 2	87	96	95	98
Mean	84	86.5	93	76
SEM	1.46	2.59	1.19	3.94

Treatment 1 – Vaccination only
Treatment 2 - Feed supplementation only
Treatment 3 – Combination of vaccination and feed supplementation
Treatment 4 – No vaccination or feed supplementation
SEM – Standard error of the mean
^{ab} – Means in the same row with different superscripts are significantly different ($P \leq 0.05$)

Table 2. Effect of the treatments on the performance of scavenging chickens in studies 1and 2

	Treatments			
	1	2	3	4
Number of birds				
Study 1	135	195	113	173
Study 2	169	160	154	138
Average daily body weight gain (g/bird/day)				
Study 1	3.75	4.20	4.74	2.07
Study 2	4.14	4.26	4.37	2.81
Mean	3.95	4.23	4.55	2.44
SEM	0.195	0.03	0.185	0.37
Total body weight gain (g/bird)				
Study 1	315	353	398	174
Study 2	348	358	367	236
Mean	332	356	383	205
SEM	3.42	1.33	3.31	4.68

Treatment 1 – Vaccination only
Treatment 2 - Feed supplementation only
Treatment 3 – Combination of vaccination and feed supplementation
Treatment 4 – No vaccination or feed supplementation
SEM – Standard error of the mean

Table 3. Daily feed intake of different classes of birds in study 1

Feed Intake, g/bird/day	Supplementation only			Vaccination + Supplementation		
	Adult	Grower	Chick	Adult	Grower	Chick
Initial feed intake (g/d)	136.3±126.2	25.8±26.2	9.4±7.1	101.1±30.3	23.4±25.9	15.5±13.5
Final feed intake (g/d)	97.0±41.9	14.4±12.3	8.2±4.9	34.7±9.6	2.9±1.2	1.2±0.5
Decrease in feed intake (%)	28.83	44.35	12.18	65.68	87.50	92.13

Table 3. Scavengable feed resource base (SFRB) for poultry flocks in four villages in southwestern Nigeria

Villages	SFRB, g/chicken/day	SFRB, g/BU/day	ME, Kcal/ BU#/day	CP, g/BU/day
Moro	6.9	14.2	42.64	0.97
Yakooyo	23.7	51.2	118.6	4.43
Ipetumodu 1	22.5	52.2	148.1	5.59
Ipetumodu 2	26.9	57.3	166.6	4.93
Average	19.7	43.7	119.0	3.80

#BU – 1 Bird unit, equivalent to 1 cock weighing 1.03 kg.
ME – Metabolizable energy
CP – Crude protein

Table 4. Some predictors of SFRB in four villages in southwestern Nigeria

Villages	Refuse heaps, No/km	Crawling insects, number/m^2/day	Vegetation cover, plant stands/m^2	Household leftover (HHL), kg/household/day
Moro	1.04	52±28[ab]	100±29	0.05
Yakooyo	0.63	68±46[a]	109±40	0.18
Ipetumodu 1	1.64	37±23[b]	98±30	0.12
Ipetumodu 2	0.95	63±24[ab]	115±47	0.11
Average	1.07±0.42	55±14	106±8	0.11±0.05

Table 5. Quantities of SFRB by measurement and prediction in four villages in southwestern Nigeria

Village	*SFRB by prediction	*SFRB by measurement
Moro	6.5	6.9
Yakooyo	23.3	23.7
Ipetumodu 1	22.4	22.5
Ipetumodu 2	26.7	26.9
Average	19.4±8.99	20.0±8.98

*There was no difference in the quantities of SFRB determined by the two methods. The chi square value was 0.067, whereas the value that is required for significance ($P \leq 0.05$) was 0.711
SFRB – Scavengable feed resource base (g SFRB/chicken/day)

Fig. 1. Effect of feed supplementation and vaccination on the mortalities of chickens in different ages in southwestern Nigeria

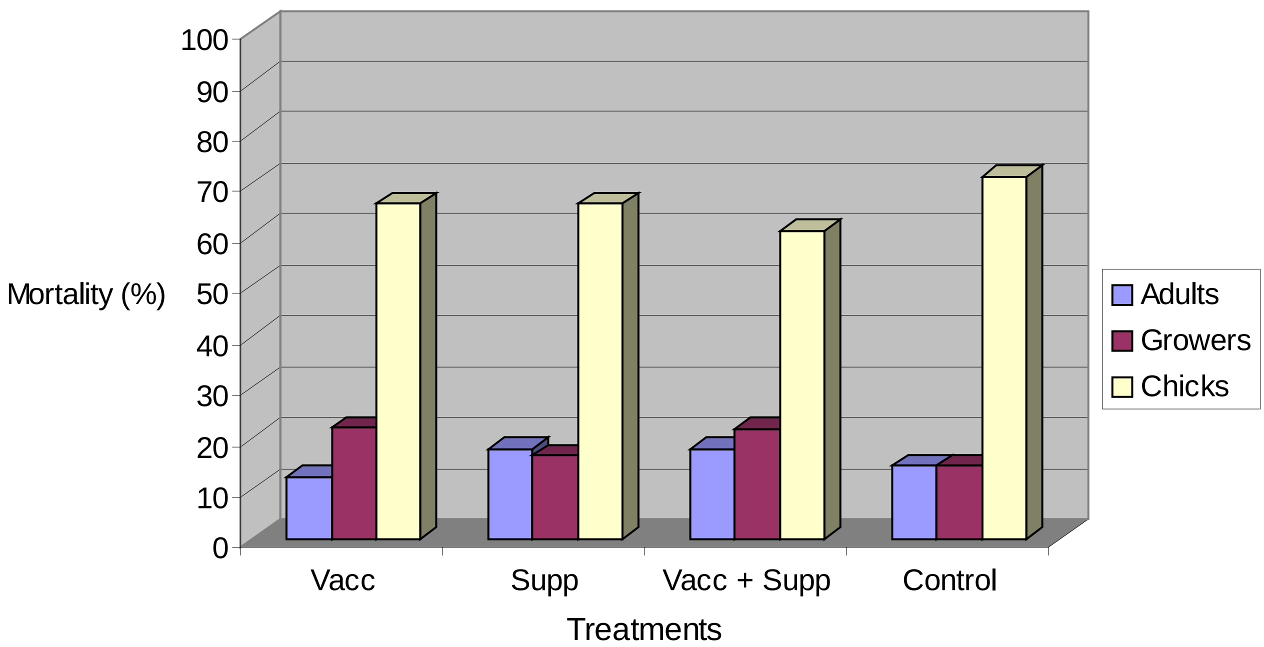

Fig. 2. Effects of vaccination and feed supplementation on the body weight gain of scavenging chickens