Seasonal variation in nutritive value of scavenged feed and effect of supplementation on performance of rural birds

*S K Mutayoba, *A K Katule, **U Minga, ***M M Mtambo and J E Olsen

*Department of Animal Science and Production, P.O. Box 3004, Sokoine University of Agriculture, Morogoro Tanzania **Open University of Tanzania, P.O.Box 2409, Dar-es-Salaam, Tanzania

***Faculty of Veterinary Medicine, Department of Medicine and Health, Sokoine University of Agriculture, Morogoro, Tanzania.

smuta2004@yahoo.co.uk; smuta@suanet.ac.tz

ABSTRACT

The study to evaluate nutritive value of scavenged during the wet and dry season using crop contents from 270 rural birds of different age groups was carried out. Chemical composition for crop contents, feeds and blood component analyses were done. The effect of feed supplementation on performance of rural birds was also assessed. Cereals were formed the largest proportion in the crop in both the dry and wet season. Insects, worms and plant materials were significantly (P<0.001) higher in the wet season while kitchen wastes were significantly (P<0.001) more in the dry season. Season effect was highly significant (P<0.001) on both physical and chemical composition of the scavenged feed. Total DM intake was significantly (P<0.001) higher in the dry season. Supplementation led to increased body weight gain. Gross profit margin was highest in scavenging only birds. Serum analysis showed no significant differences in total protein and glucose levels whereas significant (P<0.001) seasonal differences were observed for plasma albumin, triglycerides, NEFA, calcium and phosphorus levels. From these findings it was concluded that feeds scavenged by rural birds varied with season in availability and quality. It was also noted that supplementation to rural chickens should be done strategically so as to realize both the biological and economical gains.

Key words: Rural chickens, crop contents, season feed composition

INTRODUCTION

Poultry production in developing countries is mainly dominated by the indigenous/local chickens which are kept under the traditional scavenging free range system. Under this system of management birds spend up to 90% of their time during the day scavenging over a radius of 110 up to 175m for food and water. The extent to which this system meets the requirements for maintenance, growth and production depend upon the nature of the land and the foraging materials available to the birds. Most studies on rural birds show that scavenging cannot fully meet the nutritional requirements Mwalusanya et al., (2002) and Sonaiya, (2004). The low productivity observed in rural chickens to some extent is linked to diets which are limited in both quality and quantity. Improvement in productivity of rural chickens due to supplementation has been reported although there is no adequate information about the quantity and type

of nutrients to be supplemented. On the other hand it is not very clear whether supplementing local chickens would be economical due to their low genetic potential. Therefore, the current study was undertaken with the objective of assessing the effect of season on availability and composition of feeds. The effect of feed supplementation on performance of local chickens was also assessed.

MATERIALS AND METHODS

Crop contents obtained from 270 birds of three age groups (i.e. chicks, growers and adults) were used to visually qualify and quantify feed ingredients eaten by the birds. The frequency of occurrence, proportional contribution of each ingredient in the crop and DM intake per bird per day were also determined. Thereafter the feed components were placed on a piece of paper and subsequently proximate analyses were done using the standard procedures (AOAC, 1990).

Blood collection and analysis

Blood samples were collected from birds on the same day with the crop contents. Two tubes were used to collect blood per chicken. The blood was collected into both plain vacutainer tubes with heparin as an anticoagulant and sodium fluoride (Nafl), was added to arrest glycolysis. Blood collection was done by severing the jugular vein from each bird. Centrifuging was done using a Sigma 3E -1 equipment at 3000 rpm for 15 minutes to obtain plasma and sera. The plasma and sera thus obtained were stored at -20° C waiting further analysis. The serum was analyzed for calcium and phosphrus analysis whereas the plasma was analyzed for glucose, albumin, non esterified fatty acids and triglycerides.

Feed Supplementation

The objectives of these studies were to evaluate the effect of feed supplementation on the performance of scavenging local chickens (growth). The study was carried out for a period of 7 months between May and December. The stated period covered both the cold and hot dry season and the short rainy season. The beginning of the study period coincided with the main grain harvesting period while the latter part coincided with a period of food scarcity within the house hold. Locally mixed diet based on locally available feed ingredients maize, soya, cassava leaf meal and eggshells as a mineral source.

Statistical analysis

The collected data for crop contents, ingredient chemical composition, feed supplementation data, blood nutrients and metabolites concentration were analysed using the General Linear Model (GLM) of SAS (2001).

RESULTS

Results on the assessment of the nutritive value of scavenged feeds and effect of supplementation are presented in this section. Significant (P<0.001) variations in gross crop composition between seasons were noted, with the quantities being higher during the dry season. The feed components found in the crops included cereal grains (maize, sorghum, whole rice), kitchen waste, plant materials, seeds, insects and unidentified materials. The percentage of grain was higher in the dry season than the wet season in all age groups. Age differences were significant whereby the adult birds had higher percent

grain than chicks and grower during the dry season. During the wet season the highest proportion of grain was found in the growers. (Table 1). More plant materials were observed in the wet than the dry season. The dominant insects in the wet season were termites, ants and grasshoppers whereas in the dry season the crawling insects were the most common.

The chemical composition of the scavenged feed varied significantly between seasons. With the exception of ME and NFE most components were highest during the wet season and the differences were most noticeable for EE and Ash.

The effect of season on nutrient intake was noted in such that birds of all ages had higher intakes of total feed, CP, calcium, NFE, and ME during the dry than the wet season (Table 3). No significant difference (P>0.05), was observed for EE intake between the seasons. A significant (P<0.001), interaction between season and age was observed for CF, EE, and ash intake. Fibre intake was similar between seasons in the chick and adults but different in the growers. Ash intake was similar in adults between seasons but different in growers and chicks while EE intake was similar between the seasons in the chicks and growers but was different in the adults.

The relationship between intake and requirement during the different season is presented in Figure 1. The deficiency of nutrients in birds of all age groups was high during the wet season. When compared between nutrients, it was noted that minerals were most deficient while deficiency levels were lower for protein. Protein deficiency was highest for adult birds whereas energy deficiency was highest for growers. The deficiency of phosphorus was higher in chicks during both seasons.

The effects of season and age of birds on the plasma nutrient levels is shown in Table 4. An increase in total plasma protein with age was noted but the concentration did not vary significantly between seasons. The plasma glucose levels were significantly influenced by both age and season although slightly lower levels were observed in chicks in the wet season. However NEFA levels did not vary between age groups but were lowest during the dry season whereas the TG levels were high in the dry season. Increases in TG with age were also noted. Plasma albumin concentrations were highest during the dry season. Both plasma Ca and P were influenced by age and season, levels being higher in the dry season and were increasing with age.

Growth was significantly lower for the scavenging only birds, whereas birds on mixed diet had a higher growth rate in period 3. A declining trend was observed in all diets after the 3rd period (figure 2).

Income per body weight gain for birds under the commercial, homemade and scavenging only was Tshs. 2044, 1994, and 1523 respectively. However, when the cost of feed was taken into account the scavenging chickens had significantly (P<0.001) wider net profit margins..

DISCUSSION

The results of the present study are discussed in relation to other findings. The seasonal variations of the physical and chemical composition noted in this study were also reported by Mwalusanya et. al., (2002); Goromella et. Al., (2006) and Aganga et. al., (2003). Feed availability, quality and frequency depend on the period of the year. During the rainy season, the supply of ingredients is more diverse, particularly in animal materials and green forages, while in the dry season, the birds depend mostly on supplemental feed (kitchen waste) and seeds. The high composition of grains in the dry season was due to the fact that this season came soon after the harvest period in the study areas hence there were a lot of spilled grains around which the birds could pick. During the wet rainy season grains are very scarce even for human consumption and therefore no grains can easily be found on the range and even grains from the wild plants will not have ripen during this season.

The high occurrence of plant materials in the wet season were attributed to the abundance of greens and may be the scarcity of other feeds like cereal grains on range during this period. During the dry season most plants shed their seeds to the ground where they remain dormant waiting for rains to geminate. After the onset of rains the seeds germinate and the birds feed on the young shoots unlike the bare land observed in the dry season. The chemical composition of the crop contents were mainly a reflection of the ingredients the birds were eating. However they were slightly different from those reported by Mengesha et al., (2008) probably due to agro ecological variations in which the studies were done, birds normally eat what is around in their surroundings.

The protein quantity of above 16% observed in the wet season feed in the present study exceeds the NRC (1994), recommendation suggesting that provided dry matter intake is within acceptable level protein intake may not be a limiting factor to production in this season. However the protein content in the dry season though adequate for growers may limit performance especially for chicks and layers as it is below the recommended concentration. The high fibre contents observed in the present study may have a negative effect on the digestibility of the scavenged feeds and therefore nutrient availability, especially in the wet season.

The high ash content was probably due to the picking of sand alongside with the feed deliberately to assist in the physical grinding of the raw feeds in the gizzard Dessie and Ogle, (1997). Furthermore during the wet season the high intake of greens with soils attached to them may be the reason for high ash content in this season. The high ash content was not reflected with the levels of calcium and phosphorus a clear indication of the presence of soil and sand particles Momoh et al., (2010).

The differences in crop contents due to age were probably due to the fact that, birds at different age groups have varying requirements hence in most cases they normally select nutrients sources so as to meet their nutrient needs. Findings reported in other studies showed that under cafeteria feeding birds generally tend to select what to consume according to their nutrient requirement. The metabolic comfort/discomfort the bird experiences after consuming the feed, can make the bird like or dislike certain types of feed ingredients. This might explain why chicks tend to go for high protein feeds such as worms and insects which they need for growth and avoid a lot of grains and forages that are not easily digestible, Goromella et. al., (2006).

The findings of this study showed that both triglycerides and NEFA could be used as indicators of the nutritional status of the birds. Triglycerides indicated available energy to the birds mainly from CHO's whereas, NEFA was an indication of fat mobilization so as to meet the energy demands of the bird.

The increase in egg production and body weight with feed supplementation observed in the presented study followed a common phenomenon that increased plane of nutrition leads to better performance. However the limited improvement in performance was a reflection that feeding cannot improve performance of birds beyond their genetic potential. The results suggest that improvement in the productivity of rural chickens is linear up to the point when the bird reaches its genetic potential and not beyond. The rural scavenging chickens have never been selected for high productivity as such even if good feeding management is instituted, they cannot produce beyond their genetic set level Msoffe et. al., (2004). The lower gross margins and net profit

15.4

Total

observed with the commercial and homemade feeds was due to the high feed cost, coupled with somewhat low genetic performance of the birds. Scavenging only chickens fed on wasted scrap foods from the household and whatever found in the environment, were able to produce high quality products from low valued feed ingredients. This may explain why this system is the most popular among the economically disadvantaged people in the world.

41.9

27.5

| Table 1. Gross composition (g) of feed components in the crop at various age groups and seasons | | | | | | | | | |
|---|------|-------|------|--------|------|-------|--|--|--|
| Component | Ch | Chick | | Grower | | Adult | | | |
| | Dry | Wet | Dry | Wet | Dry | Wet | | | |
| Grain | 12.3 | 2.9 | 21.3 | 8.6 | 34.3 | 17.2 | | | |
| Kitchen waste | 0.83 | 0.37 | 2.0 | 0.4 | 2.1 | 1.5 | | | |
| Plant material | 0.4 | 1.3 | 0.9 | 1.3 | 0.7 | 2.1 | | | |
| Seed | 0.7 | 0.6 | 1.1 | 0.8 | 1.8 | 1.5 | | | |
| Insects | 0.4 | 0.6 | 0.8 | 0.9 | 0.9 | 2.1 | | | |
| Worms | 0.4 | 0.4 | 0.6 | 0.6 | 0.6 | 1.2 | | | |
| Unidentified | 0.3 | 1.2 | 1.3 | 0.4 | 1.5 | 2.0 | | | |

| Table 1. Gross composition | (a) of feed | d components in th | e crop at variou | s age groups and | seasons |
|----------------------------|-------------|--------------------|------------------|------------------|---------|
| | (9) | | | | |

Table 2. Effect of age and season on the chemical composition of the scavenged feed (percentage)

7.4

27.9

13.1

| Nutrient | Chicks | | Growers | | Adults | |
|--------------|---------|---------|---------|---------|---------|---------|
| | Dry | Wet | Dry | Wet | Dry | Wet |
| *CP | 12.4 | 17.8 | 12.5 | 17.8 | 12.3 | 17.1 |
| EE | 4.4 | 14.1 | 4.6 | 14.4 | 4.6 | 14.7 |
| CF | 5.5 | 11.1 | 6.4 | 10.3 | 6.0 | 10.8 |
| Ash | 10.4 | 17.8 | 10.5 | 18.2 | 11.3 | 18.3 |
| Ca | 0.5 | 0.6 | 0.7 | 0.8 | 1.5 | 1.2 |
| Р | 0.2 | 0.3 | 0.3 | 0.3 | 0.5 | 0.3 |
| Ca:P | 2.1:1 | 2.3:1 | 2.1: | 2.8:1 | 3.2:1 | 4.6:1 |
| NFE | 59.0 | 36.1 | 57.6 | 33.8 | 56.1 | 35.7 |
| ME (Kcl/kg), | 3279 | 3011 | 3190 | 3053 | 3198 | 3021 |
| ME : CP | 265 : 1 | 170 : 1 | 255 : 1 | 171 : 1 | 260 : 1 | 177 : 1 |

*CP= Crude Protein, EE= Ether Extracts; CF= Crude fibre; Ca= Calcium; P= Phosphorus; NFE= Nitrogen free extracts, ME= Metabolizable energy

| Table 3. | Feed intake and | nutrient intake as | influenced by age | e and season in | scavenging birds |
|----------|-----------------|--------------------|-------------------|-----------------|------------------|
| | | | | | |

| | Chi | cks | Gro | wers | Adı | ults |
|---------------------|------|------|------|------|-------|------|
| Nutrient intake (g) | Dry | Wet | Dry | Wet | Dry | Wet |
| Total feed | 15.4 | 7.4 | 27.9 | 13.1 | 41.9 | 27.5 |
| Protein | 1.9 | 1.3 | 3.5 | 2.3 | 5.1 | 4.7 |
| Ether extract | 0.7 | 1.0 | 1.3 | 1.9 | 2.0 | 4.1 |
| Fibre | 0.9 | 0.8 | 1.8 | 1.3 | 2.5 | 3.0 |
| Ash | 1.6 | 1.3 | 2.9 | 2.3 | 4.7 | 5.0 |
| Calcium | 0.1 | 0.1 | 0.2 | 0.1 | 0.6 | 0.3 |
| Phosphorus | 0.04 | 0.02 | 0.1 | 0.04 | 0.2 | 0.1 |
| NFE | 9.1 | 2.7 | 15.6 | 4.4 | 23.4 | 9.8 |
| ME (kcal/kg) | 46.8 | 19.4 | 83.2 | 28.2 | 135.9 | 80.9 |



Fig 1(a): Percentage deficit of nutrient intake during the dry (DDS) and wet seasons (DWS)

| season | | | | | | | |
|----------------------|--------|------|---------|------|--------|------|--|
| Season/Component | Chicks | | Growers | | Adults | | |
| | Dry | Wet | Dry | Wet | Dry | Wet | |
| Total protein g/l | 33.7 | 33.8 | 36.2 | 36.6 | 49.8 | 49.1 | |
| Glucose mmol/l | 11.4 | 10.8 | 12.4 | 12.1 | 12.1 | 12.6 | |
| Albumin g/l | 10.6 | 11.0 | 12.0 | 11.6 | 6.4 | 5.3 | |
| Triglycerides mmol/l | 2.3 | 1.3 | 2.5 | 1.8 | 5.2 | 2.5 | |
| NEFA mmol/l | 0.7 | 1.2 | 0.7 | 1.3 | 0.7 | 1.1 | |
| Total calcium mmol/l | 1.9 | 1.5 | 3.3 | 2.5 | 5.5 | 0.6 | |
| Inorganic p mmol/l | 0.4 | 0.3 | 0.4 | 0.3 | 0.8 | 0.6 | |

Table 4. Least square means of blood metabolites levels of scavenging chickens summarized by age group and

The effect of supplementation on body weight gain and growth rate is shown in figures 2 and 3.



Fig: 2: Body weight (g) of birds fed different diets

Body weight was consistently lower for the scavenging only birds but was similar for birds supplemented with homemade and commercial diets.



Fig 3. Growth rate g/day of birds fed different diets

CONCLUSION

From the study it can be concluded that there is seasonal variation in the availability of feeds to rural birds. Although supplementation may bring about biological gains economically it is not beneficial. If supplementation is to be done the feedstuffs should be cheap but of high quality.

ACKNOWLEDGEMENTS

The authors would like to thank DANIDA (Danish International Development Agency) for the financial support and the late Francis Kampeni for his tireless effort in doing this work.

REFERENCES

- Aganga, A. A., Tshwenyane, S. O and Molefhe, L (2003) Influence of feed type on egg production of Tswana laying chicken. Int. J. of Poult. Sci. 2: 256-258
- AOAC, (1990). Association of Official Analytical Chemists (AOAC) 1990 Official Analytical Methods, 15th Edition Vol. 1: AOAC. Washington DC
- Dessie, T and Ogle, B. (1997). Effect of Maize (*Zea mays*) and Noug (*Guizotia abyssinica*) cake Supplementation on Egg Production Performance of Local birds under Scavenging conditions in the Central Highlands of Ethiopia. Proceedings of International Network of Family Poultry Development Mbou'r Senegal Dec. 9-13, 1997
- Goromela, E. H., Kwakkel, R P., Verstegen, M. W. A and Katule, A. (2006) Strategies to optimize the use of scavengeable feed resource base by smallholder poultry farmers. Afric. J. of Agric. Res.1: 91-100. http://www.academicjournals.org/AJAR

- Mengesha M., Tamir, B and Dessie, T (2008). Village chicken characteristics and their seasonal production situation in Jamma District, South Wollo, Ethiopia. *Volume 20, Article #128.* Retrieved July 15, 2011, from http://www.lrrd.org/lrrd20/8/meng20128.htm
- Momoh ,O. M., Egahi, J. O., Ogwuche, P. O and Etim, V. E (2010) .Variation in nutrient composition of crop contents of scavenging local chickens in North Central Nigeria. Agric. and Biology Journal of North America. ISSN Print: 2151-7517, ISSN Online: 2151-7525, doi:10.5251/abjna.2010.1.5.912.915. http://www.scihub.org/ABJNA
- Msoffe, P. L. M., Mtambo, M. M. A., Minga, U. M., Olsen, J. E., Juul-Madsen, H. R., Gwakisa, P. S., Mutayoba, S. K and Katule, A. M (2004). Productivity and reproductive performance of the free-range local domestic fowl ecotypes in Tanzania.. *Volume. 16, Art.* #67. Retrieved February 6, 2011, from http://www.lrrd.org/lrrd16/9/msof16067.htm
- Mwalusanya, N.A., Katule, A. K., Mutayoba, S. K., Minga, U. M., Mtambo, M. M. A and Olsen, J. E (2002).
 Nutrient content of crop contents of rural scavenging local chickens in. Tanzania. British Poultry Science 43: 90-95
- NRC, (1994). Nutrient Requirements of Poultry. Washington, DC. National Academy Press.
- SAS, (2001). Users Guide; SAS Institute Inc Version 6 Cary, NC.
- Sonaiya, E. B (2004) Direct assessment of nutrient resources in free range and scavenging systems Regional Report: In World's Poultry Sci. 60: 523-535.