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Effect of restricted feeding on the carcass characteristics of Koekoek chickens

Molapo S.M.[1] and Webb E.C[2]

[1]Department of Animal Science, National University of Lesotho, P.O. Roma 180, Lesotho, South Africa
[2]Department of Animal and Wildlife Sciences, University of Pretoria, Pretoria 0002, South Africa

Abstract

An experiment was conducted to evaluate the impact of feed restriction on carcass characteristics of Koekoek chickens. Two hundred and seventy hens and twenty seven cocks were randomly allocated to four feeding level treatments in a completely randomized design in chickens were full-fed in the rearing and laying phases (AA), chickens were full-fed in the rearing phase and restricted fed during the laying phase (AR), chickens were fed restricted feeding in the rearing phase and full-fed in the laying phase (RA) and chickens were fed restrictedly during the rearing and laying phases (RR). Each treatment had seven replicates (10 animals per replicate) with the exception of RR treatment which had six replicates (10 animals per replicate). Collected data was subjected to SPSS (17.00) package and analyzed by using analysis of variance (ANOVA). In the rearing phase, feed restriction resulted in reduced slaughter weight, dressing weight, skin weight, breast muscle weight, shank width, chest width and heart girth ($P<0.05$). Abdominal fat weight was higher ($P<0.05$) in chickens that were full-fed. At the age of 32 weeks, the effect of compensatory growth was prominent in chickens that that were subjected to RA treatment in a number of carcass traits. It is concluded that full feeding only in the laying phase (RA) would be the appropriate feeding management technique if chickens were to be slaughtered in the laying phase.

Keywords: Koekoek; full-fed; restriction; carcass and abdominal fat

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Introduction

Nutritionally, people eat poultry meat for its high quality protein and its low fat content. Animal protein sources like mutton are very expensive, whereas beef has a limited use due to its high cholesterol contents. Therefore, chicken production may help in reducing the gap between supply and demand of animal protein. Higher amount of fat has become a major concern in poultry industry due to its health hazards and this has forced a significant number of people to shift to lean poultry meat (Attia et al., 1998; Novele et al., 2008). Restricted feeding is one of the management strategies in reducing carcass fat in chickens. The study of Melnychuk et al. (2004) reported a higher fat content in full-fed chickens as opposed to restricted fed chickens at sexual maturity. Chickens raised on restricted feeding during the rearing period and later shifted to normal feeding programme usually have reduced carcass fat and low incidences of leg disorders (McGovern et al., 2000). Some studies showed that feed restriction improves the relative breast muscle percentage of chickens (Renema, 1999; Crounch et al., 2002; Melnychuk et al., 2004). Feed restriction decreases the shank length and width in chickens (Crounch et al., 2002).

Therefore, in a way to reduce the carcass fat and improve the quality of carcass characteristics in Koekoek chickens. this study was conducted to determine the effect of feeding level on the carcass characteristics of Koekoek chickens. The information on carcass characteristics of Koekoek chickens would assist poultry farmers at rural communities to sustainable produce quality and desirable chicken meat at affordable feeding costs.

***Corresponding author:** Molapo S.M., Department of Animal Science, National University of Lesotho, P.O. Roma 180, Lesotho

Materials and Methods

Two hundred and seventy hens and twenty seven cocks of Koekoek chickens were bought at eight weeks of age. Ten hens and one cock were randomly selected and placed in each pen. The chickens were given stress pack in water to combat travelling stress and Lasoda vaccine in water to prevent Newcastle disease. They were fed pullet grower mash from arrival day up to 18 weeks of age, and then fed laying mash from 19 to 32 weeks. Koekoek chickens under restricted feeding were fed 70% of the full feeding. Chickens were offered fresh water without restriction. The experiment was designed as a completely randomized design. Treatments AA, AR and RA were replicated seven (7) times except treatment RR which was replicated six (6) times. Therefore, there were twenty-seven (27) experimental units.

At 18 and 32 weeks of age, one Koekoek chicken per replicate was slaughtered from chickens that were allocated to full-fed in the rearing and laying phases (AA), chickens were full-fed in the rearing phase and restricted fed during the laying phase (AR), chickens were fed restricted feeding in the rearing phase and full-fed in the laying phase (RA) and chickens were fed restrictedly during the rearing and laying phases (RR). Birds were starved for 12 hrs before slaughtering. The slaughtering procedure was followed as outlined by Jones (1984). The slaughter weights for chickens were determined just before slaughtering. Birds were weighed again after plucking. Then birds were eviscerated and dissected. The dead birds were weighed individually. Carcass dressing weight, skin weight and abdominal fat weight were taken using a digital weighing scale. Fat surrounding the gizzard and intestine was considered as abdominal fat. The shank length and heart girth were measured by measuring tape while shank width as well as chest width were measured using Vanier Calliper. Chest width was measured by placing a calliper under the wings, 2.5 cm posterior to the cranial. The chest (heart girth) girth was measured using a tape at the widest point on the breast positioned under the wings and this measurement was taken during exhalation (Renema et al., 2007). The pectoralis major muscle and pectoralis minor muscle (breast muscles) were removed and weighed.

The collected data was entered in a computer Excel Spread Sheet. Collected data was then subjected to SPSS (17.00) package and analyzed with the use of analysis of variance (ANOVA). The arrival weights of birds were used as covariates. The significant levels were based on $P<0.05$ unless otherwise stated.

Results and Discussion

During the rearing phase, birds that were full-fed being AA and AR treatments weighed 1743g and 1697g which were higher compared to birds that were reared under feed restriction (RA and RR treatments) with the slaughter weights of 1339g and 1361g respectively. The results of the current study are in agreement with the findings of Mahmood et al. (2007) who reported that birds kept under restricted feeding programme gained less weights than those kept under *ad libitum* feeding at the age of 5 to 16 weeks. The similar results were also confirmed in a study conducted by Novele et al. (2008) which stipulated that birds that were under restricted feeding gained less weight in comparison with birds that were under full fed treatment. Bochno et al. (2007) reported that birds on restricted feeding from week two until the end of the rearing period had lower ($P<0.05$) weights than those subjected to *ad libitum* feeding.

During the laying phase, birds that were full-fed had heavier ($P<0.05$) slaughter weights than those that were fed restrictedly. The non-significant difference between Koekoek chickens that were in the AA and RA treatments signify the compensatory growth pattern shown by birds that were feed restricted earlier and later shifted to full feeding. The results suggest that birds in the RR group were growing at the constant rate from rearing up to laying phase which might be because of their bodies being acclimatized to the lower level of feeding. The results of the current study are in agreement with the findings of Richards et al. (2003) who pointed out that birds that were on restricted feeding had significantly lower body weights compared to *ad libitum* fed chickens. The same sentiments were shared by Vakali and Akbarogli (2000) in demonstrating higher body weights of broiler chickens that were fed on daily basis compared to the ones that were under the skip a day treatment.

Koekoek chickens that were subjected to full feeding had heavier absolute dressing weights than those that were under restricted feeding during the rearing phase. In support of these results, Saleh et al. (2005) demonstrated that male broilers that were on *ad libitum* feeding were significantly having higher carcass dressing weight compared to feed restricted chickens. The study by Yagoub and Babiker (2008) also indicated similar carcass dressing performance of chickens that were subjected to either *ad libitum* or restricted feeding which is in line with the findings of this study.

During the laying phase, Koekoek chickens that were subjected to full feeding in the laying phase had heavier ($P<0.05$) carcass dressing weights than the ones that were under restricted feeding. The insignificant differences in carcass dressing weights between chickens that were in the AA and RA treatments illustrated that birds that were in the RA treatment were having a compensatory growth. This can be justified by the fact that chickens that were in the RA treatment had carcass dressing weight increase of 44.44%, 73.5% and 57.34% higher than the ones in the AA, AR and RR treatments respectively. Contrary to the findings of the current study, Mahmood et al. (2007)

observed the non-significant differences on the dressing weight between chicken groups that were kept on a feed restriction programme of various durations. The similar dressing percentages between the four treatments implied that the differences (P<0.05) in the dressing weights could simply be attached to slaughter weights differences of chickens subjected to different treatments. In contradiction, Novele et al. (2008) reported that chickens that were on 50% *ad libitum* feeding had lower dressing percentage than those on full feeding. During the growing phase, birds that were full-fed had higher (P<0.05) skin weights than the ones that were under feed restriction. During the laying phase, extended feed restriction hindered the skin weight. These results suggest that in order to have significant differences in skin weights one should practice either full-fed or restricted fed for the entire study.

No information is available in literature on the effect of restricted feeding on relative skin percentage in chickens. The present data probably provide a good estimate of the effects of restricted feeding on the relative skin percentage in Koekoek chickens and would probably be used as a base line study.

There was no difference (P>0.05) on shank length observed between full-fed and restricted fed chickens during the rearing phase. These results implied that the growth of shank lengths was statistically similar (P>0.05) regardless of the significant differences on the slaughter weights of chickens. The results of this study are in agreement with the findings of Pishnamazi et al. (2008) who observed no difference on the shank lengths of birds aged 12 or 16 weeks. Ingram and Hatten (2001) reported that shank length seems to be less sensitive to feed restriction. During the laying phase, Koekoek chickens that were in the RR treatment had shortest shank lengths. The results of the present study are in accordance to those of Renema (1999) and Yu et al. (1992) which indicated that restricted fed birds had significantly shorter shank lengths in comparison with those on *ad libitum* feeding. They also showed that restricted fed birds had shank length of 9.2 cm with 1.9kg body weight in comparison to *ad libitum* fed chickens that had 10.8cm with body weight of 4.2kg.

Koekoek chickens that were under full feeding had thicker (P<0.05) shanks as compared to chickens that were exposed to feed restriction. The results of this study are in agreement with the findings of Crounch et al. (2002) who indicated that the shank circumference was reduced in feed restricted chickens more especially in the rearing stage since chickens that were *ad libitum* fed had higher shank circumferences. This was confirmed by Robinson et al. (2007) who explained that body frame of chickens was hindered once birds were feed restricted. At the age of 32 weeks, Koekoek chickens that were full-fed for the entire study period gained thicker shanks compared to chickens that were in other treatments although they were not statistically (P>0.05) different from chickens that were fed restrictedly for the entire study period. Chickens that were in the RR treatment were not different (P>0.05) from birds that were allocated to AA, AR and RA treatments. Koekoek chickens that were allocated to AR treatment had lowest shank widths though they were not different (P>0.05) from chickens that were subjected to full feeding only during the laying (RA). The heavier (P<0.05) breast muscle weights were obtained in full-fed chickens than in restricted fed ones at the age of 18 weeks. Nonetheless, it was established that chickens that were feed restricted had higher (P<0.05) relative breast muscle weight expressed as a percentage of the body weight. In terms of absolute breast muscle weights, these results are in conformity with the findings of Renema (1999) who reported that feed restriction resulted in a reduction of breast muscle weight because of reduced weight gain. These results were further supported by Robinson et al. (2007) who gave evidence that there would be variability in the breast weight percentage due to diverse feed allocations. During the laying phase, the results pointed out that Koekoek chickens that were allotted to the RA had highest breast muscle weights even though they were not different (P>0.05) from those that were in the AA treatment. This is indicating that birds that were in the RA treatment had the benefit of the compensatory growth since they were able to accumulate 40.36g from week 18 to the 32nd week as opposed to birds in the AA treatment that accumulated 16.93g of breast muscles weight for the same period of time. Chickens that were feed restricted during the laying phase had lower (P<0.05) breast muscle weights compared to their counterparts. This shows that the breast muscle weights of chickens in the AR treatments were developing at a lower rate than the ones that were fed restrictedly during both rearing and laying phases. This can be verified by the fact that chickens in the RR treatment were 10.89g heavier than chickens in AR treatment regardless of the fact that the breast muscle weights of chickens in the AR treatment were already heavier than ones of chickens in RR treatment at the age 18 weeks by almost 18.16%. The findings disclosed that chickens that were feed restricted during the laying phase had higher breast muscles weights in proportion to their body weights. It was also observed that the relative breast muscle performance between Koekoek chickens that were slaughtered at 18 weeks ranged from 4.09% to 5.43% while the performance for chickens slaughtered at 32 weeks was between 4.84% and 5.64%. The differences on the breast muscles relative to body weights at two different ages seemed to remain insignificant despite the fact that breast muscle weights increased from week 18 to 32.

The results obtained from this study are in accordance with the findings of Melnychuk et al. (2004) and Saleh et al. (2005) who observed that full-fed birds had significantly heavier breast weights than feed

Table 1: Carcass characteristics of Koekoek chickens that were subjected to different feeding level treatments

Carcass parameters	AA	AR	RA	RR	S.E
Rearing phase (18 weeks)					
Shank width (mm)	8.864[a]	8.714[a]	8.150[ab]	7.983[b]	0.101
Slaughter weight (g)	1743[a]	1697[a]	1339[b]	1361[b]	2.515
Chest width (mm)	53.500[a]	50.857[a]	45.786[b]	44.167[b]	0.594
Chest girth (mm)	266.00[a]	263.50[a]	249.43[b]	239.58[b]	1.953
Dressing weight (g)	1229[a]	1168[ab]	948.50[b]	940.42[b]	9.603
Dressing %	70.63	69.09	71.04	69.11	0.438
Muscle breast weight (g)	107.71[a]	99.143[a]	87.143[b]	81.167[b]	2.034
Muscle breast %	4.087[a]	4.117[a]	5.433[b]	5.151[b]	0.053
Skin weight (g)	120.429[a]	114.071[a]	83.357[b]	83.50[b]	0.814
Skin %	6.897[a]	6.688[a]	6.243[b]	6.143[b]	0.075
Abdominal fat (g)	63.071[a]	66.071[a]	21.857[b]	22.833[b]	0.884
Abdominal %	3.559[a]	3.882[a]	1.615[b]	1.638[b]	0.053
Laying phase (32 weeks)					
Shank width (mm)	69.643[a]	68.643[ab]	69.571[a]	67.250[b]	0.375
Slaughter weight (g)	12.107[a]	10.886[b]	11.336[b]	11.367[ab]	0.131
Chest width (mm)	65.214[a]	61.429[ab]	63.929[a]	59.333[b]	0.345
Chest girth (mm)	293.286[a]	271.857[b]	290.857[a]	267.75[b]	1.652
Dressing weight (g)	1723[a]	1369[b]	1707[a]	1264[b]	1.42
Dressing %	72.2	72.7	72.0	69.2	0.915
Muscle breast weight (g)	124.64[a]	91.86[b]	127.50[a]	102.75[b]	3.12
Muscle breast %	5.211	4.844	5.452	5.637	0.139
Skin weight (g)	175.143[a]	125.571[b]	159.571[c]	122.00[b]	2.773
Skin %	7.487[a]	6.668[a]	6.842[ab]	6.682[b]	0.121
Abdominal fat (g)	125.071[a]	71.143[b]	104.214[a]	73.833[b]	4.071
Abdominal %	5.300[a]	3.762[b]	4.520[ab]	4.050[b]	0.183

[abc]Means within a row without a common superscript differ significantly (P<0.05); Foot note: AA= full feeding for both rearing phase and laying phase. AR= full feeding for rearing phase and feed restriction for laying phase. RA= Feed restriction for rearing and full feeding for laying phase. RR= Feed restriction for both rearing phase and laying phase. S.E=Standard Error.

restricted birds. This was also confirmed by Renema (1999). Contrary to the results of the current study Crounch et al. (2002) indicated that restricted fed birds would have high breast muscle weights at 30 and 32 weeks. With respect to compensatory growth displayed by chickens that were in the RA treatment these results are not in harmony with the findings of Crounch et al. (2002) who pointed out that chickens would have lower breast muscle weights if they are feed restricted early in their lives. With reference to the breast muscle percentage, the findings of this study are in agreement with the results of Crounch et al. (2002) which demonstrated that restricted fed birds had higher breast muscle percentages. This was also confirmed by the findings of Melnychuk et al. (2004) who stated that feed restricted birds performed better than *ad libitum* fed chickens.

At puberty (18 weeks), the results indicated that feed restriction reduced an average heart girth by 7.65% compared to full feeding. These results are comparable to the results of Pishnamazi et al. (2008) who noted that the heavier breast muscle weights of birds fed *ad libitum* might have contributed to the wider chest girth attained. During the laying phase, there were significant differences in heart girths observed between birds that were full-fed and those that were on restricted feeding. Birds raised under full feeding had wider chest girths than birds raised under restricted feeding. These results gave an implication that chickens with heavy body weights would at the end the day have wider chest girths. These results are in line with the results of Pishnamazi et al. (2008) who stated that birds offered *ad libitum* feeds had larger chest girths than those fed restrictedly. Furthermore, birds that were in the RA treatment had scored wider chest girth than in other treatments because of compensatory growth.

Generally, the chest widths of Koekoek chickens that were subjected to full feeding were 7.2mm higher than the ones of chickens that were exposed to restricted feeding at the age of 18 weeks. During the laying phase, the results showed that there were differences (P<0.05) between full-fed and restricted fed birds. Chickens in the AA treatment had higher chest widths compared to the chest widths of chickens in other treatments though they were not different (P>0.05) from the ones that were subjected to RA and AR treatments. It can be revealed from the findings of this study that in spite of chickens in the AA treatment having the highest chest widths, chickens in the RA treatment had the highest (18.14mm) development of the chest widths from the 18th to 32nd week with chickens in the RR treatment (15.17mm) being second in chest development performance. Koekoek chickens in AR treatment were lowest in chest widths growth as they managed to increase their chest widths by only 10.57 mm for the period of 14 weeks while chickens that were in

AA had an increase of 11.71mm for the same period of time. These results are in line with the results by Pishnamazi et al. (2008) who stated that birds fed *ad libitum* had greater chest widths than birds fed restrictedly.

The abdominal fat content of chickens that were under full feeding was higher ($P<0.05$) as compared to the one of chickens that were subjected to restricted feeding at the age of 18 weeks. The abdominal fat content of chickens that were full-fed was on average 65.39% higher than in feed restricted ones. The relative abdominal fat percentage of Koekoek chickens that were full fed was different ($P<0.05$) from the relative fat percentage of chickens that were under restricted feeding by 56.52%.

Feed restriction reduced the abdominal fat accumulation during the laying phase ($P<0.05$). Koekoek chickens that were in the RA treatment gained more abdominal fat (82.36g) from the age of 18 to 32 weeks in comparison with chickens that were subjected to AA, AR and RR treatments with the abdominal fat gains of 62g, 5.07g and 51g respectively. The results of this study are in agreement with the findings of Novele et al. (2008) which stated that *ad libitum* fed birds developed excessive abdominal fat content than restricted fed birds. In addition, Mahmood et al. (2007) reported that restricted fed birds were found to have lower abdominal fat content at market age than birds fed *ad libitum.* The similar results were also reported by Crounch et al. (2002) and Richards et al. (2002). Renema (1999) confirmed a large difference in the relative fat pad with *ad libitum* fed chickens representing a higher level of fat pad percent of body weight compared to restricted fed chickens. Nikolova et al. (2007) stated that abdominal fat weight in birds fed *ad libitum* increased significantly with the age of chickens and this is in harmony with the results of the current study. Attia et al. (1998) also reiterated that late feed restriction reduces the deposition of fat in chickens as opposed to early feed restriction. Contradictory to the findings of this study, Saleh et al. (2005) reported that either abdominal fat content expressed as absolute or percentage of carcass weight was not affected by feed restriction.

Conclusion

Full feeding in the rearing phase improved the carcass characteristics of Koekoek chickens except for the breast muscle weight, intestine weight, liver weight and gizzard weight when expressed as percentage of the body weight as compared to restricted feeding. Early feed restriction followed by full feeding improved the carcass characteristics during the laying phase. Therefore, it will be more economical for farmers to feed Koekoek chickens without restriction only during the laying phase.

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