Journal of Agriculture and Rural Development in the Tropics and Subtropics
Vol. 116 No. 1 (2015) 27–35

urn:nbn:de:hebis:34-2014082545948 ISSN: 2363-6033 (online); 1612-9830 (print) – website: www.jarts.info

Carcass composition of Venda indigenous scavenging chickens under village management

Thomas Raphulu [a,b,*], Christine Jansen van Rensburg [a], Roelof Johannes Coertze [a]

[a] *Department of Animal and Wildlife Sciences, University of Pretoria, Pretoria 0002, South Africa*
[b] *Department of Agriculture Limpopo, Mara Research Station, Makhado, 0920, South Africa*

Abstract

Four Venda indigenous scavenging (VIS) chickens (one young male and one young female of 10–16 weeks of age, a mature cockerel and a mature hen) were randomly purchased from each of six adjacent rural villages during three different seasons (autumn, winter and spring) to determine the meat yield and carcass chemical composition. A total of 72 chickens were slaughtered and feathers, head, neck, viscera, feet and lungs were removed. The live body weight, dressed carcass weight and also the mass of the breast without wings, thighs and drumsticks were recorded with bones and skin. The muscle tissues of the breast and both legs without tendons and fat were sampled for chemical analysis and were analysed for dry matter, ether extract, crude protein and ash. The carcass weight, dressing %, mass of the breast, mass of the thighs, mass of the drumsticks, breast yield, thighs yield and drumsticks yield of both grower and adult VIS chickens were not influenced by season. The crude protein of the grower chickens breast muscles and fat content of the adult chicken leg muscles differed with season. The meat from VIS chickens provided a constant nutrient (crude protein) supply throughout the year to the rural communities.

Keywords: season, gender, meat yield, chemical composition

1 Introduction

Most poultry in Africa is kept under traditional production systems (Branckaert *et al.*, 2000) where chickens are allowed to roam free and scavenge for food around the household. Scavenging chickens are an efficient waste disposal system converting insects and leftover grains and human foods into valuable protein foods, such as eggs and meat (Minh, 2005). Production costs are generally low as no supplementary feeds and medication are used and the chickens are genetically adapted to harsh environments. Besides being a source of high quality food protein for rural communities (Qureshi, 1990; Wattanachant *et al.*, 2004), indigenous chickens are also kept for religious and cultural purposes (Swatson *et al.*, 2001). It is known that human diets in the rural communities are often deficient in protein, both qualitatively and quantitatively (FAO, 1997). Rural communities keeping scavenging chickens have more access to good quality protein through consumption of meat and eggs from their chickens which may improve their health status, alleviate malnutrition and also improve food security. Smith (1982) reported that poultry meat is low in fat and cholesterol which makes it a healthy food for children and aged adults. However, the meat yield and meat quality of indigenous chickens

* Corresponding author
Email: thomas.raphulu@gmail.com

Published online: May 21, 2015
Open access article licensed under a Creative Commons Attribution International License CC BY-NC-ND
http://creativecommons.org/licenses/by-nc-nd/4.0

in South Africa is not yet fully explored. Van Marle-Köster & Webb (2000) reported 49.6 % crude protein and 28.8 % crude fat in the meat of Lebowa-Venda chickens reared intensively and concluded that carcasses of native chickens had higher crude protein and lower crude fat than broilers. The nutritional status of scavenging chickens under village management varies with season, climatic conditions and locality (Rashid *et al.*, 2004; Goromela *et al.*, 2008; Mekonnen *et al.*, 2010). Diet is one of the factors that determine the chemical composition of poultry meat, particularly fat. There are no reports available on the influence of season on the meat quality of the indigenous scavenging chicken in the Venda area (Limpopo province, South Africa). If the nutritional status of scavenging chickens varies between seasons, the meat quality may also fluctuate throughout the year. Knowledge on the meat quality of the Venda indigenous scavenging (VIS) chickens will assist in developing human nutritional supplementary interventions in the rural communities. The objectives of this study were to determine the meat yield and carcass chemical composition of the VIS chicken and also the influence of season on the meat yield and carcass composition.

2 Materials and methods

The research was approved by the Animal Use and Care Committee of the University of Pretoria (EC008-08). The local traditional leaders granted permission to conduct a study in the communities. The study was conducted at six adjacent rural villages, Tshifudi, Tshidzini, Tshamutshedzi, Tshivhilwi, Tshitereke and Makhuvha. All villages are situated between latitude S22°48' to S22°53' and longitude E30°28' to E30°42' in the Thulamela Municipality, Vhembe District in the Limpopo province of South Africa. Vhembe District is the most northern district of the Limpopo Province and it shares borders with Botswana, Zimbabwe and Mozambique. The villages are in a summer rainfall area, with the highest rainfall and temperatures normally recorded between October and March. The mean maximum temperatures during summer range from 26 to 29 °C, while the minimum temperatures range from 12 to 14 °C between May and August. Winter is usually cold but rarely reaches freezing point. Main crops cultivated in the area are maize, groundnuts and vegetables.

A total of four VIS chickens were randomly purchased from each of the six rural villages included in the study during three different seasons, i.e. autumn (April), winter (July) and spring (October). The four chickens comprised of a young male and a young female (10–16 weeks old), and a mature cock and a mature hen. Each village was regarded as a replicate and thus the study included six replicates for each age class (young and mature), gender (male and female) and season (autumn, winter, spring).

The chickens were killed, weighed and scalded in hot water for 2–3 minutes to facilitate easy plucking. The feathers, head, neck, viscera, feet and lungs were removed. The dressed carcass, breast, thighs and drumsticks were weighed with bones and skin. The wings were removed by a cut through the shoulder joint at the proximal end of humerus. The breast portion was obtained as described by Hudspeth *et al.* (1973). The thigh and drumstick portions were obtained by cutting through the joint between the femur and ilium bone of the pelvic girdle. The drumstick was separated from the thigh by a cut through the joint formed by the femur, fibula and tibia. The dressing percentage was calculated as weight of the carcass (without neck, head, feathers, feet and visceral organs) divided by live bodyweight multiplied by 100, while carcass traits were expressed as absolute mass (in grams) and as the percentages of the carcass weight.

The muscles of the breast and leg (drumsticks and thighs) were removed, freeze dried and grounded using a coffee blender. The muscle tissues of the breast and both legs without tendons and fat were sampled for chemical analysis. Dry matter, ether extract, crude protein and ash in muscles were measured according to the methods described by the AOAC (2000). Moisture content was determined by drying at least 2 g of meat to a constant weight at 105 °C overnight. Ash was determined at 600 °C. The data collected were statistically analysed using the GLM of SAS 9.2 (2010). The following model: $Y_{ijkl} = \mu + S_i + A_j + X_k + (SA)_{ij} + (SX)_{ik} + (AX)_{jk} + E_{ijkl}$, was employed where Y_{ijkl} is an observation for a given variable; μ is the general mean common to all observations; S_i is the effect due to i^{th} season; A_j is the effect due to the j^{th} age class of chicken; X_k is the effect due to the k^{th} effect of the gender of chickens; $(SA)_{ij}$ is the interaction effects between the i^{th} season and j^{th} age; $(SX)_{ik}$ is the effects between the j^{th} age and kth gender class; $(AX)_{jk}$ is the effects between the j^{th} age and k^{th} gender group and E_{ijkl} is the random error. A 5 % significant level was used.

3 Results

The slaughter weight, dressed carcass weight, dressing %, mass and yield of breast, thighs and drumsticks for grower and adult chickens were not influenced by season ($P \geq 0.05$) (Table 1). The slaughter weight of grower chickens showed a decreasing tendency with season with the highest obtained in autumn, while adult chickens showed increasing tendency with season, but it was insignificant ($P \geq 0.05$). The slaughter and carcass weight, dressing %, mass of breast, mass of thighs, mass of drumsticks, breast yield and thighs yield of the VIS chickens differed between age groups ($P < 0.05$). Differences exhibited in terms of the gender on carcass weight, mass of the breast and thigh and breast yield were statistically highly significant ($P < 0.05$).

Carcass chemical composition of the VIS chickens during different seasons (LS Means) is presented in Table 2. The dry matter and moisture content of both breast and leg muscle of both grower and adult, ash content of the grower breast muscle and leg muscle of the adult, crude protein content of the grower breast muscle and fat content of the adult muscle differed between seasons ($P < 0.05$), crude protein content of adult chickens for both breast and leg muscle were not influenced by season ($P \geq 0.05$), only fat content of the leg muscle differed with season ($P < 0.05$). The crude protein content of breast muscle of the grower chickens differed with season ($P < 0.05$).

The influence of age and gender on carcass yield and chemical composition of the VIS chickens is summarised in Table 3. Age had a significant effect on slaughter weight, carcass weight, dressing %, mass of the breast, thighs, drumsticks, drumstick yield, ash, fat and crude protein content of the leg muscle ($P < 0.05$). The leg muscle of the adult chickens had higher levels of fat and crude protein than in grower chickens. In the breast muscle no differences were observed in protein and fat content due to age effect ($P \geq 0.05$).

Table 1: *Meat yield of the Venda indigenous scavenging chickens during different seasons (LS Means)*

Parameters	*Age*	*Season*			*Mean*	*SEM*
		Autumn	*Winter*	*Spring*		
Slaughter weight (g)	Grower	582.58 [1a]	439.50 [1a]	419.75 [1a]	480.61	47.03
	Adult	1530.92 [1b]	1549.75 [1b]	1567.92 [1b]	1549.52	47.03
Carcass weight (g)	Grower	336.06 [1a]	264.17 [1a]	242.83 [1a]	281.02	40.02
	Adult	1001.11 [1b]	918.43 [1b]	1019.53 [1b]	979.69	40.02
Dressing %	Grower	56.46 [1a]	59.45 [1a]	57.26 [1a]	57.73	1.36
	Adult	64.84 [1b]	59.99 [1a]	64.41 [1b]	63.08	1.36
Mass of breast (g)	Grower	68.93 [1a]	52.92 [1a]	47.99 [1a]	56.61	9.41
	Adult	224.78 [1b]	206.35 [1b]	231.67 [1b]	220.94	9.41
Mass of thighs (g)	Grower	57.29 [1a]	44.55 [1a]	42.32 [1a]	48.05	6.82
	Adult	168.81 [1b]	181.16 [1b]	187.24 [1b]	179.07	6.82
Mass of drumsticks (g)	Grower	48.97 [1a]	51.70 [1a]	34.43 [1a]	45.03	6.98
	Adult	143.58 [1b]	158.02 [1b]	152.38 [1b]	151.33	6.98
Breast yield (%)	Grower	20.70 [1a]	19.80 [1a]	19.70 [1a]	20.07	0.42
	Adult	22.36 [1a]	22.65 [1b]	23.07 [1b]	22..69	0.42
Thighs yield (%)	Grower	16.67 [1a]	16.62 [1a]	17.45 [1a]	16.91	3.38
	Adult	16.77 [1b]	31.70 [1a]	18.17 [1a]	22.21	3.38
Drumsticks (%)	Grower	14.16 [1a]	19.77 [1a]	14.20 [1a]	16.04	3.23
	Adult	14.12 [1a]	27.60 [1a]	14.52 [1a]	18.75	3.23

[1,2] Means sharing different superscripts within a row and a factor differ significantly ($p < 0.05$).
[a,b] Means sharing different superscripts within a column and a factor differ significantly ($p < 0.05$).

Table 2: *Carcass chemical composition of the Venda indigenous scavenging chickens during different seasons (LS Means)*

Parameters	*Age*	*Season*			*Mean*	*SEM*
		Autumn	*Winter*	*Spring*		
Breast muscle						
Dry matter (DM) (g/kg)	Grower	326.18 [1a]	262.91 [2a]	237.13 [3a]	275.41	6.48
	Adult	306.95 [1a]	273.20 [2a]	289.97 [2b]	290.04	6.48
Moisture (g/kg)	Grower	673.82 [1a]	737.09 [2a]	762.87 [3a]	724.59	6.48
	Adult	693.05 [1a]	726.80 [2a]	710.86 [1b]	709.96	6.48
Ash (g/kg DM)	Grower	38.03 [1a]	39.01 [1a]	42.20 [2a]	39.75	0.30
	Adult	40.21 [1b]	40.81 [1b]	40.67 [1b]	40.57	0.27
Fat (g/kg DM)	Grower	29.63 [1a]	31.22 [1a]	26.78 [1a]	29.21	2.21
	Adult	33.16 [1a]	23.95 [1a]	23.47 [1a]	26.86	2.03
Crude protein (g/kg DM)	Grower	881.95 [1a]	724.65 [2a]	878.13 [1a]	828.24	24.37
	Adult	892.93 [1a]	894.55 [1b]	889.82 [1a]	892.43	24.37
Leg muscle						
Dry matter (DM) (g/kg)	Grower	288.17 [1a]	265.95 [2a]	262.65 [2a]	270.12	3.06
	Adult	279.77 [1a]	263.38 [2a]	267.20 [2a]	272.26	3.06
Moisture (g/kg)	Grower	711.83 [1a]	734.05 [2a]	737.35 [2a]	727.74	3.06
	Adult	720.23 [1a]	736.62 [1a]	732.80 [2a]	729.88	3.06
Ash (g/kg DM)	Grower	37.99 [1a]	39.79 [1a]	38.94 [1a]	38.91	0.70
	Adult	39.85 [1a]	44.63 [2b]	39.99 [1a]	41.49	0.65
Fat (g/kg DM)	Grower	153.81 [1a]	165.41 [1a]	154.80 [1a]	158.01	7.49
	Adult	147.71 [1a]	106.31 [2b]	112.21 [1b]	122.08	7.25
Crude protein (g/kg DM)	Grower	754.95 [1a]	745.5 [1a]	788.78 [1a]	747.87	7.37
	Adult	775.71 [1a]	797.58 [1b]	743.13 [1b]	787.36	7.37

[1,2,3] Means sharing different superscripts within a row and a factor differ significantly ($p < 0.05$).
[a,b] Means sharing different superscripts within a column and a factor differ significantly ($p < 0.05$).

Male chickens weighed more than females ($P < 0.05$). Males showed higher yields of breast, drumsticks and thighs, whereas females had larger breast yield than males. The gender of the chickens did not influence the chemical composition of the breast and leg muscle ($P \geq 0.05$), but the fat and protein content of the leg muscles differed due to gender. Female chickens deposited more fat and less crude protein than male chickens. The slaughter weight, mass of the thighs, mass of the breast and drumstick yield were significantly higher ($P < 0.05$) for male chickens than female chickens in both the age groups.

4 Discussion

The obtained results do not show any significant variation in the meat yield (slaughter weight, carcass weight, dressing %, mass of breast, mass of thighs, mass of drumsticks, breast yield, thighs yield and drumstick yield) of the grower and adult VIS chickens between seasons. The highest slaughter and carcass weight for the grower and adult VIS were obtained in autumn and spring respectively, but this difference was not statistically significant. The obtained results are inconsistence with the findings by Goromela *et al.* (2007) who reported differences in slaughter and carcass weight due

Table 3: *The influence of age and gender on the carcass yield and carcass chemical composition of the Venda indigenous scavenging chickens*

Parameters	*Age*			*Gender*			*SEM*
	Grower	*Adult*	*P value*	*Female*	*Male*	*P value*	
Slaughter weight (g)	480.61[a]	1549.53[b]	0.0001	888.23[a]	1141.90[b]	0.0003	47.02
Carcass weight (g)	281.02[a]	979.69[b]	0.0001	550.69[a]	710.02[b]	0.0006	40.03
Dressing %	57.73[a]	63.09[b]	0.0074	60.47[a]	60.34[a]	0.9476	1.36
Mass of the breast (g)	56.62[a]	220.94[b]	0.0001	129.42[a]	148.13[a]	0.1652	6.98
Mass of the thighs (g)	48.05[a]	179.07[b]	0.0001	93.21[a]	133.90[b]	0.0001	6.82
Mass of the drumsticks (g)	45.03[a]	151.32[b]	0.0001	79.16[a]	117.21[b]	0.0003	9.41
Breast yield (%)	20.06[a]	22.69[b]	0.0001	22.41[a]	20.34[b]	0.0008	0.41
Drumsticks yield (%)	16.05[a]	18.74[a]	0.5577	15.62[a]	19.17[a]	0.5577	3.38
Thighs yield (%)	16.91[a]	22.22[a]	0.2713	16.74[a]	22.40[a]	0.2713	3.37
Chemical composition							
Breast muscles							
Dry matter (DM) (g/kg)	275.41[a]	290.04[a]	0.1156	281.07[a]	284.37[a]	0.7202	6.48
Moisture (g/kg)	724.59[a]	709.96[a]	0.1156	718.92[a]	715.63[a]	0.7202	6.48
Ash (g/kg DM)	39.75[a]	40.56[b]	0.0500	40.44[a]	39.87[a]	0.1650	0.28
Fat (g/kg DM)	29.21[a]	26.86[a]	0.4379	27.87[a]	28.20[a]	0.9144	2.13
Crude protein (g/kg DM)	828.24[a]	892.43[a]	0.0674	859.28[a]	861.39[a]	0.9513	24.36
Leg muscles							
Dry matter (DM) (g/kg)	272.26[a]	270.1[a]	0.6233	274.19[a]	268.18[b]	0.1709	3.39
Moisture (g/kg)	727.75[a]	729.88[a]	0.6233	725.81[a]	731.81[a]	0.1709	3.06
Ash (g/kg DM)	38.9[a]	41.49[b]	0.0076	39.53[a]	40.87[a]	0.1817	0.68
Fat (g/kg DM)	122.08[a]	158.01[b]	0.0001	154.94[a]	125.15[b]	0.0059	7.37
Crude protein (g/kg DM)	747.87[a]	787.36[b]	0.0004	754.06[a]	781.17[b]	0.0188	12.78

[a,b] Means with different superscripts within a row and a factor differ significantly ($P < 0.05$)

to season, with higher weights recorded during the dry season than the rainy season. The authors of this study attributed these differences to higher intakes of cereals and their by-products spilled on the ground during harvesting, threshing and winnowing activities in the dry season. It could be suggested that differences in nutritional status of the scavenging chickens with seasons as reported by Mekonnen *et al.* (2010); Goromela *et al.* (2008), and Rashid *et al.* (2004) did not influence meat yield of the VIS chickens in the present study.

The mean slaughter weight of 1549 g reported in the present study was higher than the 1238 and 1121 g reported by Goromela *et al.* (2008) and Tadelle (1996), respectively, for adult village chickens during the dry season. Goromela *et al.* (2007) attributed differences in slaughter weight to changes in seasonal conditions, farming activities, land size available for scavenging and village flock size. The overall mean of the carcass weight, dressing %, mass of the breast, mass of the thighs and mass of the drumsticks obtained for growers and adult VIS chickens were 281.02 g, 57.73 %, 56.61 g, 48.05 g, 45.03 g and 979.69 g, 63.08 % 220.94 g, 179.07 g, 151.33 g, respectively. The mean dressing percentage of 63.08 % of adult VIS reported in this study was in conformity with the reports by Goromela *et al.* (2008) (63–64 %), but higher than Pousga *et al.* (2005) reports (60.6 %) for scavenging pullets in Bukina-Faso and lower than reported by Tadelle (1996) (65.6 %) for scavenging chickens. Differences in dressing % could be due to heavier weights of the gastro intestinal tract (GIT) and its contents. Observed dressing % in the present study and from previous studies on scavenging chickens is much lower than dressing % reported for broilers. Poltowicz & Doktor (2011) re-

ported an average dressing % of 68.47 and 69.04 for indoor and free-range broilers, respectively. According to Van Marle-Köster & Webb (2000) the lower dressing % found in native chickens is due to slower growth of the native chickens as compared to broilers.

The proportions of the major carcass portions (breast, drumsticks and thighs) as well as the chemical composition of the muscular tissue are regarded as vital parameters determining broiler meat quality (Holcman *et al.*, 2003). The overall mean of the breast yield, thighs yield and drumsticks yield of growers and adult VIS chickens were 20.07 %, 16.91 %, 16.04 % and 22.69 %, 22.21 % and 18.75 %, respectively. Literature on the major carcass portions of native chickens in rural communities in different seasons is very scarce. Bogosavljević-Bošković *et al.* (2010a) reported 31.69, 13.40 and 16.11 % of the breast, thigh and drumstick in free range broilers, respectively. Nikolova & Pavlovski (2009) observed 20.43, 9.73 and 10.63 % of the breast, thigh and drumstick portions in Cobb 500 broilers. The observed results of this study are in close agreement with Nikolova & Pavlovski (2009) in terms of the breast meat yield. However, the mean thigh and drumstick yield obtained in this study are much higher than found in previous studies (Van Marle-Köster & Webb, 2000; Nikolova & Pavlovski, 2009; Bogosavljević-Bošković *et al.*, 2010a). Castellini *et al.* (2002) found that percentages of breast and thigh meat increased when birds had outdoor access and kept at lower stocking density in free-range production systems. It could be suggested that the well-developed leg muscles in the VIS chickens could be due to their scavenging mode as they have to walk long distances to search for food.

The slaughter and carcass weight, dressing %, mass of breast, mass of thighs, mass of drumsticks, breast yield and thighs yield of the VIS chickens obtained in this study showed significant differences between age groups. Higher values were obtained in adult chickens than grower chickens. Similar findings were observed by Young *et al.* (2001).

Males showed higher carcass weight, mass of breast, drumstick and thigh and less breast yield than female chickens, which agrees with the results of Santos *et al.* (2004) and Rahayu *et al.* (2008). Shahin & Elazeem (2005) did not establish any influence of gender and genotype on the proportions of different carcass parts, when expressed as a percentage of carcass weight. Similar results were obtained in this study with the exception of breast yield. Female chickens showed larger breast yield than male chickens. This was confirmed by Young *et al.* (2001) and Rondelli *et al.* (2003) who reported that female carcass had significant bigger breasts and fillet yield and less thighs and drumstick yield compared to male carcass.

Nutritional status of scavenging chickens can vary with season, climatic conditions and locality (Goromela *et al.*, 2007, 2008; Mekonnen *et al.*, 2010). There are reports that diet is one of the factors that determine the chemical composition of poultry meat, particularly that of the fat and protein content (Leenstra, 1986; Liu *et al.*, 2006). Protein and fat of muscle tissue are important meat quality parameters and contribute substantially to the nutritional characteristics of meat. Rural communities consume meat from adult chickens; it can therefore be concluded that meat quality, particularly protein content of the VIS chickens in the rural communities is similar throughout the year and the differences in nutritional status of scavenging chickens reported in previous studies (Rashid *et al.*, 2004; Goromela *et al.*, 2008; Mekonnen *et al.*, 2010) do not have any effect on the meat quality of the VIS chickens. However nutritional status differences reported showed seasonal effect on the fat content of the leg muscle. The highest fat content of the leg muscle was obtained in autumn, which could be attributed to abundance availability of cereals and by products spilled during harvesting.

It was reported that raw chicken meat has a water content of 60.4 to 75.4 %, a protein content of 17.0 to 23.3 %, a fat content of 1.0 to 17.4 %, and an ash content of 0.7 to 3.6 % (Demby & Cunningham, 1980). Similar results were obtained in this study with the exception of protein content. Protein content observed in this study was higher than reported by other authors (Perreault & Leeson, 1992; Žlender *et al.*, 1995; Van Marle-Köster & Webb, 2000). The higher crude protein values in VIS chickens than in broilers was supported by Van Marle-Köster & Webb (2000); Wattanachant *et al.* (2002), and Meluzzi *et al.* (2009) who reported that the carcasses of indigenous chickens contain higher protein and less fat than that of broilers, emphasising the differences in chemical composition of poultry meat due to genotype. It seems as if meat from VIS chickens is superior to broiler meat as it contained high protein levels. It is likely that the higher carcass protein in the VIS chickens than in broilers and other intensively-kept native chickens could be due to tougher muscles as VIS were slaughtered at older age. Bogosavljević-Bošković *et al.* (2010b) observed protein content increase of breast, thigh and drumstick with age. The results indicate that the meat from the VIS chickens is of economic value to the rural communities and has potential of alleviating malnutrition, poverty and improved food security and health in general.

The leg muscle of the adult chickens had higher levels of fat and crude protein than in grower chickens. In the breast muscle no differences were observed in protein and fat content due to age effect ($P \geq 0.05$). The results conforms with the findings by Wattanachant & Wattanachant (2007) who reported that during growth of the indigenous chickens, moisture content in muscles decreased from 77.8 to 71 %, whereas protein and fat increased from 21.5 to 24 % and 1.35 to 3.90 %. There were no significant differences between the genders on the carcass chemical composition, except for the fat and protein content of the leg muscles. Females deposited more fats than males. The obtained results are in conformity with the findings of Grey *et al.* (1983) who found that gender effect at various ages was significant only for the thigh muscles which had the highest lipid concentration. According to Tůmová & Teimouri (2010) the differences could be attributed to metabolic differences, higher competitiveness among males, different fat accumulation capacity, different nutritional requirements and different hormonal effects in males. Fat plays an important role in the reproduction process, when birds mature the production of egg yolk is influenced by lipid metabolism Rahayu *et al.* (2008). Carcasses of male chickens had higher protein content than that of females. Similar findings were reported by De Marchi *et al.* (2005) and Bogosavljević-Bošković *et al.* (2010b).

It is known that leg muscles have higher fat content and lower protein content than breast muscles (Simeonovová, 1999). Similar observations were made in the present study. According to Díaz *et al.* (2010) the differences in breast and leg muscles could be attributed to the very structure of these organs, with breast muscles being mostly composed of white fibres, as opposed to drumsticks made up of muscles that contain red fibres having different metabolic functions. The observed results suggest that the breast muscle is the leanest meat in the chicken.

5 Conclusion

The slaughter weight, carcass weight, mass of the thigh, mass of the drumstick, breast yield of both grower and adult chickens were not influenced by season. Season had effect on the protein content of the grower chicken breast muscle and fat content of the adult chicken leg muscle. Gender of the VIS chickens influenced slaughter weight, carcass weight, mass of the thigh, mass of the drumstick, breast yield and carcass composition (fat and protein content of the leg muscle). The thigh and drumstick yield of VIS chickens were higher than previously found for broilers, but the meat of the VIS chickens contained less fat and more crude protein than the meat of broilers. The meat from VIS chickens provided a constant nutrient supply throughout the year to rural communities and suggests that the supplementation of protein to human diets in the rural communities might not be necessary if sufficient chicken meat is consumed. Keeping VIS chickens has a potential to solve the problem of malnutrition, improve food security and overall health status of the Venda rural communities.

Acknowledgements

We are grateful to the National Research Foundation (NRF) for financial support of the present study, Farmers and the Limpopo Department of Agriculture officials for their assistance in this study.

References

AOAC (2000). *Official method of analysis (17th ed) Volume I*. Association of Official Analytical Chemists (AOAC), Inc. Maryland, USA.

Bogosavljević-Bošković, S., Mitrovic, S., Djokovic, R., Ladimir Doskovic, V. & Djermanovic, V. (2010a). Chemical composition of chicken meat produced in extensive indoor and free range rearing systems. *African Journal of Biotechnology*, 9 (53), 9069–9075.

Bogosavljević-Bošković, S., Pavlovski, Z., Petrovi, M. D., Doskovi, V. & Simeon, R. (2010b). Broiler meat quality: Proteins and lipids of muscle tissue. *African Journal of Biotechnology*, 9 (54), 9177–9182.

Branckaert, R. D. S., Gaviria, L., Jallade, J. & Seiders, R. W. (2000). Transfer of technology in poultry production for developing countries. FAO Sustainable Development Department, Rome, Italy. URL `http://www.fao.or/sd/cddirect/cdre0054.htm`.

Castellini, C., C., M. & Dal Bosco, A. (2002). Effect of organic production system on broiler carcass and meat quality. *Meat Science*, 60, 219–225.

De Marchi, M., Cassandro, M. E., Lunardi, G., Baldan, G. & Siegel, P. B. (2005). Carcass Characteristics and Qualitative Meat Traits of the Padovana Breed of Chicken. *International Journal of Poultry Science*, 4 (4), 233–238.

Demby, J. H. & Cunningham, F. E. (1980). Factors affecting composition of chicken meat. A literature review. *World's Poultry Science Journal*, 36 (1), 25–37.

Díaz, O., Rodríguez, L., Torres, A. & Cobos, A. (2010). Chemical composition and physico-chemical properties of meat from capons as affected by breed and age.

Spanish Journal of Agricultural Research, 8 (1), 91–99.

FAO (1997). Human nutrition in the developing world. Latham M.C. FAO Food and Nutrition Series No.29.

Goromela, E. H., Kwakkel, R. P., Verstegen, M. W. A. & Katule, A. M. (2007). Identification, characterization and composition of scavengeable feed resources for rural poultry production in Central Tanzania. *African Journal of Agricultural Research*, 2 (8), 380–393.

Goromela, E. H., Kwakkel, R. P., Verstegen, M. W. A. & Katule, A. M. (2008). Effect of season and farming system on the quantity and nutritional quality of scavengeable feed resources and performance of village poultry in central Tanzania. *Journal of Cell and Animal Biology*, 2 (3), 63–71.

Grey, T. C., Robinson, D., Jones, J. M., Stock, S. W. & Thomas, N. L. (1983). Effect of age and sex on the composition of muscle and skin from a commercial broiler strain. *British Poultry Science*, 24 (2), 219–231.

Holcman, A., Vadnjal, R., Žlender, B. & Stibiji, V. (2003). Chemical composition of chicken meat from free range and extensive indoor rearing. *Archiv für Geflügelkunde*, 67 (3), 120–124.

Hudspeth, J. P., Lyon, C. E., Lyon, B. G. & Mercuri, L. J. (1973). Weights of broiler parts as related to carcass weights and type of cut. *Food Science*, 38 (1), 145–150.

Leenstra, F. R. (1986). Effect of age, sex, genotype and environment of fat deposition in broiler chickens - A review. *World's Poultry Science Journal*, 42, 12–25.

Liu, Y. L., Song, G. L., Yi, G. F., Hou, Y. Q., Huang, J. W., Vázquez-Añón, M. & D., K. C. (2006). Effect of supplementing 2-hydroxy-4-(methylthio) butanoic acid and DL-methionine in corn-soybean-cottonseed meal diets on growth performance and carcass quality of broilers. *Asian-Australasian Journal of Animal Sciences*, 19 (8), 1197–1205.

Mekonnen, H., Kelay, B. & Berhan, T. (2010). Assessment of the nutritional status of indigenous scavenging chickens in Ada'a district, Ethiopia. *Tropical Animal Health and Production*, 42, 123–130.

Meluzzi, A., Sirri, F., Castellini, C., Roncarati, A., Melotti, P. & Franchini, A. (2009). Influence of genotype and feeding on chemical composition of organic chicken meat. *Italian Journal of Animal Science*, 8 (2s), 766–768.

Minh, D. V. (2005). *Effect of supplementation, breed, season and location on feed intake and performance of scavenging chickens in Vietnam*. Ph.D. thesis Swedish University of Agricultural Sciences, Uppsala. ISBN 91-576-6900-7.

Nikolova, N. & Pavlovski, Z. (2009). Major carcass parts of broiler chicken From different genotype, sex, age and Nutrition system. *Biotechnology in Animal Husbandry*, 25 (5-6), 1045–154.

Perreault, N. & Leeson, S. (1992). Age-related carcass composition changes in male broiler chickens. *Canadian Journal of Animal Science*, 72 (4), 919–929.

Poltowicz, K. & Doktor, J. (2011). Animal Effect of free-range raising on performance, carcass attributes and meat quality of broiler chickens. *Science Papers and Reports*, 29 (2), 139–149.

Pousga, S., Boly, H., Lindeberg, J. E. & Ogle, B. (2005). Scavenging pullets in Burkina Faso: effect of season, location and breed on feed and nutrient intake. *Tropical Animal Health and Production*, 37, 623–634.

Qureshi, M. S. (1990). *Annual Progress Report 1989–1990*. Poultry Development Centre, Poultry Research Institute (PRI), Rawalpindi, Punjab. Pp 295.

Rahayu, H. S. I., Zulkifli, I., Vidyadaran, M. K., Alimon, A. R. & Babjee, S. A. (2008). Carcass Variables and Chemical Composition of Commercial Broiler Chickens and the Red Jungle Fowl. *Asian-Australasian Journal of Animal Sciences*, 21 (9), 1376–1382.

Rashid, M., Roy, B. C. & Asaduzzaman, V. (2004). Chemical composition of crop contents of local scavenging chickens. *Pakistan Journal of Nutrition*, 3, 26–28.

Rondelli, S., Martinez, O. & Garcia, P. T. (2003). Sex effect on productive parameters, carcass and body fat composition of two commercial broilers lines. *Revista Brasileira de Ciência Avícola*, 5 (3), 169–173.

Santos, A. L., Sakomura, E. R., Freitas, E. R., Barbosa, N. A. A., Mendonca, M. O. & Arrilho, E. N. V. M. (2004). Carcass yield and meat quality of three strains of broiler chicken. Proceeding. XXII World Poultry Congress, WPSA Turkish Branch, Jun 8-13, Istanbul, Turkey.

SAS (2010). SAS® Statistics Users Guide, Statistical Analysis System, 5th edition, 9.2 version. SAS Institute Inc., Carry, NC.

Shahin, K. A. & Elazeem, F. A. (2005). Effects of breed, sex and diet and their interactions on carcass composition and tissue weight distribution of broiler chickens. *Archiv Tierzucht, Dummerstorf (Archives Animal Breeding)*, 48 (6), 612–626.

Simeonovová, J. (1999). *Technology of Poultry, Eggs and other Minor Animal products*. MZLU, Brno. (in Czech) p. 247.

Smith, P. (1982). *The chicken Book*. North Point Press, Passim. Pp 16–22.

Swatson, H. K., Nsahlai, I. V. & Byebwa, B. K. (2001). The status of smallholder poultry production in the Alfred District of KZN (South Africa): Priorities for intervention. In *The Proceedings of the Association of Institutions for Tropical Veterinary Medicine. 10th International conference on "livestock, community and environment", 20–23rd August 2001* (pp. 143–149). AITVM, Copenhagen, Denmark.

Tadelle, D. (1996). *Studies on village poultry production systems in the Central Highlands of Ethiopia*. Master's thesis Swedish University of Agricultural Sciences, Uppsala, Sweden.

Tůmová, E. & Teimouri, A. (2010). Fat Deposition in the broiler chicken: a review. *Scientia Agriculturae Bohemica*, 41 (2), 121–128.

Van Marle-Köster, E. & Webb, E. C. (2000). Carcass characteristics of South African native chicken lines. *South African Journal of Animal Science*, 30 (1), 53–56.

Wattanachant, C., Suwanapugdee, A., Suksathit, S. & Mongkol, M. (2002). Growth performance of naked-neck chicken under village production systems. *Thaksin University Journal*, 5, 53–61.

Wattanachant, S., Benjakul, S. & Ledward, D. A. (2004). Composition, color, and texture of Thai indigenous and broiler chicken muscles. *Poultry Science*, 83, 123–128.

Wattanachant, S. & Wattanachant, C. (2007). Chemical composition, properties and microstructure of Thai indigenous chicken muscles as influenced by age and rearing systems. [Research report], Prince of Songkla University. Songkhla, Thailand. 77p.

Young, I., Northcutt, J. K., Buhr, R. J., Lyon, C. E. & Ware, G. O. (2001). Effect of age, sex, and duration of postmortem aging on percentage yield of parts from broiler chicken carcasses. *Poultry Science*, 80, 376–379.

Žlender, B., Holcman, A. & Rajar, A. (1995). The effect of provenance of chickens on dressing percentage and meat composition. In *3rd International Symposium Animal Science Days. Perspectives in the production of various kinds of meat, 26-29 September, Bled, Slovenia* (pp. 233–239). Biotechnical Faculty, University of Ljubljana.