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Research Title/ Field	Article (Abstract)	Download
Growth rate and carcass characteristics of large white pigs fed on ensiled cassava pulp diets 	**Original Research, B61** **Rhule, SWA, Asiedu P, Baiden RY, Ameleke GY, Sottie, ET and Otsyina HR.** ***Online J. Anim. Feed Res.*, 2(4): 328-331, 2012.** **ABSTRACT:** *Twenty four Large White (LW) grower pigs at an average live weight of 27 kg were distributed over three treatments made up of diets containing 0, 25 and 30 percent ensiled cassava pulp. Diets were made similar to contain 15% Crude protein. Pigs were taken off the study on attaining an individual live weight of 60±5 kg slaughtered and carcass characteristics determined. The average live weight gains by the pigs were 0.40, 0.42 and 0.44 kg/day on Diet 1 (0%), Diet 2 (25%) and Diet 3 (30%) respectively. The feed conversion ratios by the pigs were 4.20, 4.30 and 5.00 kg feed /kg live-weight gain for Diets 1, 2 and 3 respectively. Eye muscle area of the pigs were 33.2, 27.3 and 37.7cm2 on Diets 1, 2 and 3 respectively. Trimmed fat on the carcasses were 3.3, 2.6 and 2.4 kg respectively. The study indicated that cassava pulp could be preserved by ensiling for feeding pigs over the grower phase at least: That the cassava pulp fed at an inclusion rate of 30% gave pig performance comparable to that on the cereal-based diet. It was indicated that maize, could be completely replaced in the diet of the grower pig with ensiled cassava pulp.* **Key words:** *Average Daily Gain, Crude Protein, Ensiled Cassava Pulp, Feed Conversion Ratio Grower Pigs, Live Weight*	
Effect of supplementation of concentrate to sweet sorghum (Sorghum bicolor L. Moench) bagasse leaf residue silage on performance and carcass characteristics in native sheep 	**Original Research, B62** **Vidya, B., Ramana Reddy, Y. and Srinivasa Rao, D.** ***Online J. Anim. Feed Res.*, 2(4): 332-339, 2012.** **ABSTRACT:** *The effect of supplementation of concentrate at different levels to sweet sorghum leaf residue (SSBLR) silage on the performance, and carcass characteristics was studied using Nellore growing ram lambs in a 120 day growth trial. A randomized design was applied with groups of seven growing ram lambs (14.05±0.61) and age (4 months), blocked by weight, allocated to one of four treatments; SSBLR silage ad lib (R-1), SSBLR silage + concentrate 170 g (R-2), SSBLR silage + concentrate 225 g (R-3) and SSBLR silage + concentrate 280 g (R-4). At the end of growth trial five representative lambs from each group were slaughtered to study the carcass characteristics and meat quality. The CP NDF and ADF content of SSBLR silage was 7.48, 71.81 and 46.75 per cent, respectively. The average daily gain (ADG) of ram lambs fed ration R-4 were significantly (P<0.01) higher than those fed R-1 and R-2 ration, but the value was comparable with the R-3 ration. The total DMI (g/d) was significantly (P<0.01) higher in lambs fed R-2, R-3 and R-4 rations compared to R-1 ration but DMI (g/d or % b.wt.) from SSBLR silage was not influenced by the level of concentrate supplementation. Negative FCR was recorded in lambs fed sole SSBLR silage and FCR was improved with supplementation of concentrate from R-2 to R-4 rations. Significant difference (P<0.05) in FCR was observed between lambs fed R-2 and R-3, R-4 rations but there was no significant difference between the lambs fed R-3 and R-4 rations. The lambs fed sole SSB silage lost their body weight of 2.14 kg during experimental period resulting in negative ADG and negative FCR. Supplementation of concentrate at 280 g to SSBLR silage resulted in significantly lower cost/kg gain than the other rations. Carcass weight and dressing percentage was linearly (P<0.01) increased as the proportion of concentrate increased in the diet. Supplementation of concentrate at different levels did not significantly influence the per cent whole sale cuts, yield of visceral organs and proportion of meat, bone and fat in whole carcass and chemical composition of meat. The results of the present study indicated that supplementation with energy and protein rich feeds to SSBLR was necessary and concentrate supplementation at 280 g to SSBLR silage found to be optimum for better growth rate, feed efficiency and meat quality in growing Nellore ram lambs.* **Key words:** Sweet sorghum bagasse leaf residue silage, Supplementation, Performance, Carcass characteristics, Sheep	
Pre-weaning growth performance of Sekota sheep breed in Waghimra zone, Ethiopia	**Original Research, B63** **Yiheyis A, Tegegn F, H/Melekot M, Taye M.** ***Online J. Anim. Feed Res.*, 2(4): 340-343, 2012.** **ABSTRACT:** *Pre-weaning growth performances of Sekota sheep breed was studied at Sekota district of Amhara National Regional State, Ethiopia under traditional crop-livestock production systems which is characterized by extensive, low-input low-output system. Two hundred thirty one lambs were monitored from birth to weaning age. Data on growth performances were collected and analyzed using the general linear model procedures of Statistical analysis system software. The least squares mean birth weight, three months weight and average daily weight gains from birth to three months age were 2.73 kg, 11.9 kg and 101 gm, respectively. Parity and type of birth were significant sources of variation for birth weight. Location had an effect of three months weight. The results obtained revealed the potential of the breed for meat production in the prevailing environment. The effect of parity on birth weight indicates special care for lambs from maiden ewes. Management options like integrated health care and supplementation of feed for sheep during the dry season help farmers to benefit from their sheep.* **Key words:** Growth Performance, Pre-Weaning, Sekota Sheep, Daily Weight Gain	
Productivity of desert sheep under grazing condition in north Kordofan, Sudan	**Original Research, B64** **Dawelbait E.M.' Gadallah G.B., Bushara I.** ***Online J. Anim. Feed Res.*, 2(4): 344-347, 2012.** **ABSTRACT:** *This study was conducted in North Kordofan State, with the objectives of studying performance of desert sheep (Hamari) on natural grazing during the dry season, and to investigate the nutritional value for the rangelands prevailing in the*	

	region. To achieve the objectives chemical analysis was done for some plants and trees to determine the nutrients and mineral content according to (AOAC, 1990). In vitro dry matter digestibility and organic matter digestibility were also determined according to Tilley and Terry (1963). Animal digestibility trial was successfully done, when ten rams were reared on natural rangelands for three consecutive grazing periods (30, 60 and days) to study the performance. The data was analyzed as completely randomized block design via analysis of variance with the assistance of SPSS and statitix8 software. The results of chemical analysis showed that CP, CF, ash, EE and NFS were in the range from 6-10, 35-45, 7-10, 1.1-2.1 and 36.7-46.7% respectively. The chemical analysis for selected browse trees were CP5.1%, CF 31-33%, EE 0.4-0.9%, ash 7-8.1% and NFE 53-56.9%. Mineral contents ranged from 0.0144-0.075 ppm for P, 0.002-0.063 ppm for K and 1-2.9 ppm for Iodine. In vitro DM and OM digestibility ranged from 52-59 and 52-62%, respectively. Rams grazing on natural rangelands recorded weight gains during the first grazing period (December), and then they lost weight at the second period (January) and recorded a high weight loss during the third period (February, January-July). Based on the findings it can be concluded that rangelands in the region were deteriorating in quality and quantity as a result which negatively affects livestock performance due to negative effect on animal weight gain leading to weight loss during the period January-July. There is a high need for introducing supplementary feeding and mineral additives. **Key words:** *North Kordofan, animal performance, In vitro, Digestibility, Rangelands*	
Some hematological values for captive Gazella dorcas	**Original Research, B65** **Mohammed Ahmed FA, Mohammed Salih RR, Yousif RA** ***Online J. Anim. Feed Res.*, 2(4): 348-350, 2012.** **ABSTRACT:** *Normal mean values for Hemoglobin, packed cell volume, red blood cell count, white blood cell count, erythrocyte sedimentation rate, were obtained from blood of six males and nine females Gazelle Dorcas. Males had significantly higher values for white blood cell count, and had significantly lower values for red blood cell count than the females. The rest of the parameters were not significantly different between the two sexes. With the exception of the correlation between red blood cell and the packed cell volume, were insignificant.* **Key words:** *Hematology, Values, Count, Blood, Gazella dorcas*	
Communal livestock production in Simbe, Gokwe south district of Zimbabwe 	**Original Research, B66** **Maburutse, B.E., Mutibvu, T., Mbiriri, D.T., Kashangura, M.T.** ***Online J. Anim. Feed Res.*, 2(4): 351-360, 2012.** **ABSTRACT:** *Communal livestock production systems are dynamic being responsive to changes in the socio-political and economic environments. A survey was conducted in Simbe communal area of Gokwe South District in Zimbabwe, to assess current livestock production systems. Five villages and 3 wards were randomly selected and a semi-structured questionnaire administered by 5 trained enumerators to collect data on; house-hold demographics, livestock species kept and their numbers, uses of livestock and waste, feeding and watering as well as livestock health management. Data were analysed using the Statistical Package for the Social Sciences (SPSS) version 16. It was observed that farmers in the study area kept a wide range of livestock species including; poultry (notably; chickens, ducks, turkeys and guinea fowls), goats, cattle, donkeys and pigs. Cattle and goats were the major sources of draught power and income, respectively. Farmers indicated that they faced challenges in feeding and watering their animals during the dry season. Diseases were the major cause of offspring mortality in most animal species while predation was the major cause in chickens. It was recommended that farmers acquire education on production and improve on health and general management.* **Key words:** Livestock, Draught Power, Dry Season, Cattle, Manure, Natural Veld	
Haematological indices of captive black neck ostriches 	**Original Research, B67** **Mohamed Ahmed F.A., Yousif R.A., EL Hessan, Mohmmed Salih RR** ***Online J. Anim. Feed Res.*, 2(4): 361-364, 2012.** **ABSTRACT:** *This study was conducted at Sudan University of Science and Technology College of Veterinary Medicine and Animal Production Department of fisheries science and wildlife in June 2011 to determine hematological values of Black Neck Ostrich Struthio Camelus massaicus collected from El Safa farm North Khartoum. Values of some hematological parameters of 14 Black Neck Ostrich 7 male and 7 female age from 3-4 year, and 70–75 kg in weight were examined to determine the mean values obtained for White Blood cells Count (WBC), Erythrocytes Count (RBC), Hemoglobin Concentration Rates (Hb), Packed Cell Volume (PCV), Mean Corpuscular Volume (MCV/cl) and Erythrocytes Sedimentation Rate (ESR). The result of this study show that there are no significant different in all blood values between samples collected from male and female at p (P<0.05), expect in Red Blood Cells (RBC) there is significant different at (P<0.05). The main target of this study is to comparison between hematological values of Black Neck Ostrich in both male and female.* **Key words:** *Hematological, Ostrich, Parameters, Captivity, Birds*	
Haematological Characteristics of C.garipienius collected from White Nile and Blue Nile at Khartoum State	**Original Research, B68** **Mohammed Ahmed F.A., Yousif R.A., Ahmed Hamed S.H., Mohammed Salih R.R., Abaas Bakheet H.H.** ***Online J. Anim. Feed Res.*, 2(4): 365-368, 2012.** **ABSTRACT:** *This study was conducted at Sudan University of Science and Technology Collage of Animal Production Science and Technology Department of fisheries science and wildlife to determine haematological characteristics of Clarias garipienius collected from White Nile and Blue Nile River. Values of some haematological parameters of twenty C. gariepinus were in the range 41- 49 cm in length and 709 – 806 gm in weight were analyzed to determine the mean values obtained for White Blood cells Count (WBC) and Erythrocytes Count (RBC), Hemoglobin Concentration Rates (Hb), Packed Cell Volume (PCV) and Mean*	

	Corpuscular Volume (MCV/cl) and Leukocytes Differential Counts and chemical analysis of total protein and Blood Glucose. The result of this study show that there are no significant different in all parameters between samples collected from White Nile and Blue Nile at (p<0.05), expect in hemoglobin concentration there is highly significant different at (p<0.01). The main target of this study is to investigate the hematological parameters and some blood chemistry of Clarias garpieninus collected from White Nile River and Blue Nile River in Khartoum State. **Key words:** *Haematologocal parameters, Nile fishes, C.garpinus*	
Isolation and characterization of a lipolytic and phytase producing probiotic for potential application in poultry feed	**Original Research, B69** **Razdan K., Parihar J., Bajaj B.K** ***Online J. Anim. Feed Res.*, 2(4): 000-000, 2012.** **ABSTRACT:** In the current study a total of 35 bacterial isolates from 17 food and fecal samples were examined. Five among those were earmarked as putative probiotic candidates. All the selected isolates survived the low pH conditions of 2.0, and resisted the presence of bile salts (0.02-0.25%) and NaCl (2-14 %), indicating their ability to survive in the gastrointestinal (GI) tract conditions and hence making them suitable candidates for probiotic applications. The selected probiotic isolates showed considerable levels of hydrophobicity indicating their potential adhering properties with the gut epithelium. In addition the five selected probiotic candidates depicted substantial antagonistic action against potent pathogens like Bacillus subtilis, B. cereus, Escherichia coli, Pseudomonas aeruginosa, P. alcaligenes, Staphylococcus aureus and Streptococcus sp. The isolates CM-4 and KD-7 were most remarkable as they inhibited all the pathogens tested including S. aureus and Streptococcus sp. Extracellular enzymatic studies showed that all the five strains produced phytase whereas isolate CM-4 and KD-7 were the only lipase producers found. However no amylase protease activity was detected. Isolate CM-4 was found to be the best among all five as it showed all desirable probiotic features viz. bile salt, NaCl and pH tolerance, maximum hydrophobicity, antagonistic action against pathogens, phytase and lipase activity, therefore was identified by using 16S rDNA sequencing and MEGA BLAST. **Key words:** Probiotics, Phytase, Lipases, Hydrophobicity, Antibacterial Activity	
The requirements of crude protein by large white breeding sows and piglets in Ghana 	**Original Research, B70** **Rhule S.W.A., Asiedu P.** ***Online J. Anim. Feed Res.*, 2(4): 378-383, 2012.** **ABSTRACT:** *Eighteen Large White gilts at an average initial live weight of 100.39kg were distributed by completely randomized block design over three treatments. There were three cereals-based diets with three different calculated levels of crude protein (CP) namely control breeder diet, Diet 1 (13.16% CP), Diet 2 (12.56% CP) and Diet 3 (12.01% CP) with corresponding lactation diets namely control lactation Diet 1 (LD1) (16.00% CP), Diet 2 (LD2) (14.50%CP) and Diet 3 (LD3) (13.20%CP). Additionally there were three creep diets comprising control Diet 1 (CD1) with 23.01%CP, Diet 2 (CD2) with 21.46% CP and Diet 3 (CD3) with 20.00% CP. The average live litter size of sows were 8.50, 8.40 and 6.67 on Diets 1, 2, and 3 respectively (P>0.05). The number of piglets weaned decreased with decreasing CP in the diet being 7.83. 7.80 and 5.33 on Diets 1, 2 and 3 respectively but were not found to be significantly (P>0.05) different. The average birth weights of the piglets were similar at 1.45, 1.34 and 1.40 kg on Diets 1, 2 and 3 respectively (P>0.05). The milk yield by the sows at 28 days of lactation were found to be 3.06, 3.03 and 5.44kg/day on LD1, 2 and 3 and significantly (P<0.05) different being higher on the lowest CP diet. There was inconsistency with the milk yield at 42 days of lactation with significantly (P<0.05) different values of 4.87, 8.33 and 3.60kg/day on lactation with lactation diet 1, 2, and 3 respectively. It was observed that live weight gains by the sows during gestation significantly (P<0.05) increased with decreasing CP levels in the diets and were 30.3, 36.3 and 34.0 kg on Diets 1, 2 and 3 respectively. The ADGs of the piglets on the creep diets were 0.22, 0.17 and 0.19 kg/day on CD1, CD2 and CD3 respectively, and found to be significantly (P<0.05) different. The study indicated that decreasing levels of CP in the diet at gestation could affect the reproductive performance of the Sow. Decreasing CP in the lactation diet significantly affected sow performance adversely. Whereas a decrease of 1.5% CP in the lactation diet gave similar performance in the sow as the control 3.0% decrease in the CP markedly reduced the performance. Decreasing CP in the creep diets significantly reduced the ADG of the piglets. It was shown that 1.5% reduction in the CP in the creep diets significantly decreased the average daily gain of the piglets compared to that on the control.* **Key words:** *Average Daily Gain, Birth Weight, Dietary Protein Requirement, Large White Gilts, Milk Yield, Weaning Weight.*	
A study on the prevalence of sheep and goat skin defects in Bahir Dar Tannery, Ethiopia 	**Original Research, B71** **Assefa M., Tesfaye D., Taye M.** ***Online J. Anim. Feed Res.*, 2(4): 384-387, 2012.** **ABSTRACT:** *A study to estimate the prevalence of sheep and goats skin defect was carried out at Bahir Dar Tannery. A total of 400 (200 sheep and 200 goat) sheep and goat skins were sampled and examined for skin defect at pickled stage. The study showed that there were different skin defects responsible for the decline in quality grades of skin. From the total skin examined, ekek (58.3%), scratch (22.5%), flying defect (13.8) and scar (11.3%) were common defects. For sheep skins ekek (67%), processing defect (12.5%), scratch (12%) and processing defect (8.5%) were important skin defects and only small number (8.5%) were with no defect. In goats skin, ekek (49.5%), scratch (33%), scar (17.5%) and flying defect (15%) were important defects. Skin quality grades 6 (22.3%), 5 (21.8%) and 4 (18.5%) were frequently observed skin grades. There were unappreciable numbers of rejects (12%) while quality grade 1 was the least frequent (6.3%). Ekek was significantly (p<0.05) higher in sheep skin (53%) than goat skin (23.5%). However; scratch was significantly (p<0.05) higher in goat than in sheep, but other defects were not significantly (p>0.05)*	

	different between the two species. Examination also showed that 26 (13.5%) and 22 (11%) were rejected in sheep and goat skins, respectively. Integrated efforts towards good animal husbandry and animal health care are very important for better quality skin. Furthermore, detailed studies on the distribution, seasonal occurrence and the direct and indirect economic impact of ectoparasites should be undertaken. Meanwhile, tanneries should collaborate with such studies to maximize the economic gain in the long run. **Key words:** *Ectoparasite, Ekek, Goat Skin, Sheep Skin, Skin Defect, Pickled Skin*	
Comparison of slaughter, carcass values of Sudan ecotypes goats fed different levels of energy/protein 	**Original Research, B72** **Tameem Eldar A.A., Elamin K.M., Amin A.E., Hassan H.E.** ***Online J. Anim. Feed Res.*, 2(4): 388-393, 2012.** **ABSTRACT:** *This experiment aimed to assess the slaughter and carcass values of different Sudan goat ecotypes (Nubian, Desert and Swiss Nubian) fed different levels of energy/protein. Nine male goat kids (2-3 months and average weight 9.23 kg) of either ecotypes were used in a 3x3x3 arrangement, fed three experimental diets A (control), B and C, with varying energy: protein 1:0.14, 1:0.16 and 1:0.18 respectively. The study showed that Nubian goats possessed heavier slaughter weight; empty body weight, warm and cold carcass weight than the Desert and Swiss Nubian goats in the ration B and C. Dressing percentage on both basis (slaughter weight and empty body weight) of Nubian were higher for ration B and C. Warm carcass weights of all goat ecotypes increased directly with energy: protein ratio. Highest weight of leg, loin, rack and neck and shoulder were recorded by Nubian goats for ration B and C. It was concluded that, all ecotype kids respond well to increasing energy protein levels. According to the results obtained local goat ecotypes, mainly Nubian goats, responded well to improved nutrition, therefore results obtained can be applied for the local goat ecotypes studied to encourage goat meat consumption and exportation.* **Key words:** *Leg, Loin, Nubian, Neck, Rack, Shoulder*	
Effect of Dietary Levels of Cowpea (*Vigna unguiculata*) Seeds on Egg Quality 	**Original Research, B73** **Balaiel N.G., Abd Elati Kh.A., Dousa B.M.** ***Online J. Anim. Feed Res.*, 2(4): 394-397, 2012.** **ABSTRACT:** *The objectives of this study were to evaluate the effect of including 3 dietary levels of grain meal cowpea (Vigna unguiculata) 0, 5, 10 and 15% on external and internal egg characteristics. Seventy two laying hen of 28 weeks age were randomly allocated into 4 dietary treatments of 0, 5, 10 and 15% levels of cowpea seeds, which were further replicated 6 times in completely randomized design. Feed and water supply were offered to birds ad libitum while standard management practices were adopted. The results showed that the external parameters like maximum length and width, shell thickness and shell % and egg weight were significantly (P<0.05) affected by dietary treatments. Egg shape index was not significantly (P>0.05) influenced by dietary treatments. Internal quality characteristics were not significantly (P>0.05) affected by dietary treatments except for albumin weight, albumin percentage, yolk index and yolk colour. It is concluded that commercial egg characteristics such as egg weight is satisfactory maintained with 5 to 1`0% inclusion of cowpea grain meal in balanced diets for layers.* **Key words:** *Cowpea Levels, Layers, Eggs*	

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GROWTH RATE AND CARCASS CHARACTERISTICS OF LARGE WHITE PIGS FED ON ENSILED CASSAVA PULP DIETS

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ABSTRACT: *Twenty four Large White (LW) grower pigs at an average live weight of 27 kg were distributed over three treatments made up of diets containing 0, 25 and 30 percent ensiled cassava pulp. Diets were made similar to contain 15% Crude protein. Pigs were taken off the study on attaining an individual live weight of 60±5 kg slaughtered and carcass characteristics determined. The average live weight gains by the pigs were 0.40, 0.42 and 0.44 kg/day on Diet 1 (0%), Diet 2 (25%) and Diet 3 (30%) respectively. The feed conversion ratios by the pigs were 4.20, 4.30 and 5.00 kg feed /kg live-weight gain for Diets 1, 2 and 3 respectively. Eye muscle area of the pigs were 33.2, 27.3 and 37.7cm² on Diets 1, 2 and 3 respectively. Trimmed fat on the carcasses were 3.3, 2.6 and 2.4 kg respectively. The study indicated that cassava pulp could be preserved by ensiling for feeding pigs over the grower phase at least: That the cassava pulp fed at an inclusion rate of 30% gave pig performance comparable to that on the cereal-based diet. It was indicated that maize, could be completely replaced in the diet of the grower pig with ensiled cassava pulp.*

ORIGINAL ARTICLE

Key words: *Average Daily Gain, Crude Protein, Ensiled Cassava Pulp, Feed Conversion Ratio Grower Pigs, Live Weight*

INTRODUCTION

The need to improve efficiency, lower production costs and supply a product that meets consumers' expectations are key elements required for producers to remain profitable and viable (Mullan and D'Souze, 2005).

Cassava has been known to be a good source of energy for pigs for many years. Cassava-fed pigs were found to grow slower than maize-fed pigs but had firmer fat and more evenly distributed lean meat (Dodoo, 1981). It was indicated that whilst 30% cassava in the diet of the grower-finisher was best for average daily gains in live-weight, a level of 45% resulted on leaner pig carcass (Barnes and Oddoye, 1985).

Studies on the replacement of maize with sun-dried cassava in pig diets have been done in Ghana (Okai, 1971; Fleischer 1975; Dodoo, 1981). Levels of up to 55% in pig grower diets and 65% in pig finisher diets have been fed with no adverse effects on growth and carcass characteristics. Cassava-fed pigs were found to have superior feed conversion efficiency than those corn-fed (Dodoo, 1981). Average daily live-weight gain of the weaner pig was depressed as the level of cassava in the diet increased from 20% to 29% (Rhule et al., 1998).

Processing cassava into various products would generate considerable quantities of by-products such as peels and pulps. Studies on cassava peels have shown that it may be included up to a level of 37.5% in the diet of young pigs (Sonaiya and Omole, 1997). Whilst studies have been done on the peel (Tewe, 1987), very little has been done on the pulp as feed for pigs.

This project was undertaken to determine the optimum level at which the cassava pulp could be incorporated in the diets of grower-finisher pigs.

MATERIALS AND METHODS

Experimental Design

Twenty-four Large White pigs of an average initial-weight of 27 kg were used in a completely randomized design (CRD) feeding trial. The pigs were randomly allocated to three dietary treatments with four replicates per treatment and fed diets containing graded levels of ensiled cassava pulp. The ingredient composition of the diets is shown in Table 1. The calculated dry equivalents of the pulp were weighed in the morning and mixed with the previously compounded dry components of the diets before feeding.

Animals and management

The pigs were housed in individual well-ventilated concrete floored pens measuring (3 x 1). Kepromec (Ivermectin), a broad-spectrum anthelminthic, was administered by injection for the control of both internal external parasites.

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Feeding

Pigs were fed on restricted basis, a daily quantity of feed equivalent to 5% of group total live weight. Water was provided *ad libitum.* The pigs were individually weighed weekly and the daily feed allocation adjusted accordingly. The pigs were fed until they attained an average live weight of 60±5 kg.

Growth Measurement

The pigs were weighed at the commencement and end of the study. The mean of the two weights represented the initial and final live weight. Feed and water were withdrawn twelve hours before weighing. The difference between the final and initial body weights represented the weight gain. At the end of the study, the pigs were then slaughtered and their carcass characteristics measured.

Table 1 - Composition of diets containing cassava pulp fed to Grower-Finisher pigs

Ingredients composition	Diets 1 (control)	Diet 2	Diet 3
Maize	33.30	0	0
Wheat bran	30.3	0	0
Cassava pulp	0	25.0	30.0
Cassava (whole)	0	17.3	10.3
Cassava peels	0	22.0	17.0
Palm kernel cake	30.00	30.0	30.0
Fishmeal	1.0	3.0	3.0
Soya bean meal	4.0	8.0	8.0
Oyster shell	1.0	1.0	1.0
Salt	0.5	0.5	0.5
Vitamin and TMP[1]	0.2	0.2	0.2
Total	100	100	100
Determined composition (%)			
Moisture	44.32	61.30	63.62
Dry matter	55.68	38.70	36.38
Crude protein	14.19	13.45	15.37
Ether extract	5.46	4.70	6.21
Ash	8.89	5.81	8.25
Crude fibre	18.03	18.64	23.37

[1]Vitamin and TMP (Trace Mineral Premix): Inclusion rate is 25 kg/tonne to supply the following per tonne of feed: Vit.A, 12,000,000 IU; Vit.E, 15000 mg; Vit.B1, 1500 mg; Niacin 30,000 mg; Vit.B6, 1500 mg; Vit.D3, 4500,000 mg; Vit. K3, 3,000 mg; Pantothenic acid,12000 mg; Vit.B12, 10,000 mg; Vit. B2,6000 mg; Folic acid, 800 mg, Iron, 60,000 mg; Copper 75,00 mg; Iodine, 750 mg; Manganese, 130,000 mg; zinc, 70,000 mg; Selenium, 300mg. calcium,17.50%, Lysine,1,330 mg; Methionine, 1,075 mg; B-Corotenic acid, 350 mg.

Statistical Analysis

The data obtained was subjected to analysis of variance (Steel et al., 1997).

RESULTS AND DISCUSSION

There were no health related problems nor mortalities that may be attributed to the amount of ensiled cassava pulp in the diets. The analyzed composition of the diets is shown in Table 1. The diets containing the pulp had very high moisture levels compared to the control diet, being highest in diet 3. Increasing levels of the pulp in the diets resulted in increasing levels of crude fibre in both diets 2 and 3.

The general performance of the pigs on the dietary treatments is shown in Table 2. The ADG of the pigs was similar for Diets 1, 2 and 3 (P>0.05) (Table 2). The FCR by the pigs on Diet 1 was similar to that on Diet 2 and higher than was attained on Diet 3 (P>0.05) (Table 2).

Table 2 - Performance of grower large white pig fed on cassava pulp based diets

Items \ Dietary Treatments	1	2	3	SEM	P
Initial wt (kg)	26.75±1.80	27.75±4.13	27.25±2.56	0.29	NS
Final wt (kg)	60.25±4.15	60.80±7.36	61.25±5.57	0.60	NS
ADG (kg/day)	0.40±0.05	0.42±0.15	0.44±0.17	0.04	NS
FCR	4.20±1.08	4.30±1.87	5.00±1.83	0.87	NS

P: level of significance; NS: not significant. (P >0.05); SEM: standard error of differences of means

The carcass characteristics measured on the pigs were found to be similar (P >0.05) on Diets 1, 2 and 3 respectively (Table 3).

Pigs on the diet, which contained 30% cassava pulp, had slightly higher ADG than those on the 25% cassava pulp diet. This indicates that pigs will consume diets containing cassava pulp up to 30% without adverse effects on growth. The ADG of the pigs on the diets containing the cassava pulp were higher than those on the cereal diet on this study and similar to other studies (Tewe O O and Iyayi E 1989; Rhule, 1998; Rhule, 2001). However, ADG of the pigs on Diets 2 and 3 were higher than value obtained with pigs on similar studies with 30% palm kernel cake diets as used in this study (Rhule, 1996).

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Feed conversion ratios of the diets by the pigs were within a range of 3.2 to 4.8 obtained on similar studies (Rhule, 1995; 1996; 1998). Feed conversion ratio obtained with the pigs in this study could be considered similar to values of 5.09 from other studies (Oke, 1978).

Table 3. Mean carcass characteristics of large white grower-finisher pigs fed on cassava pulp-based diets

Items \ Dietary Treatments	1	2	3	SEM	P
Live weight at slaughter (kg)	58.75±4.15	54.00±7.36	60.25±5.57	3.15	NS
Dressed wt (kg)	41.12±2.88	26.70±8.04	42.50±4.33	3.58	NS
Dressing Percentage (%)	70.61±0.51	54.27±5.99	70.34±1.37	5.36	NS
Carcass length (cm)	66.92±1.24	63.75±2.29	66.97±2.29	1.14	NS
Shoulder fat (cm)	2.70±0.20	3.10±0.28	3.33±0.36	0.17	NS
L fat (cm)	0.98±0.09	1.20±0.13	1.00±0.30	0.11	NS
P_2 (cm)	0.90±0.15	1.20±0.22	1.03±0.16	0.11	NS
Eye muscle area (cm^2)	33.54±5.22	27.58±2.29	37.86±4.82	2.64	NS
Absolute values of body components (kg)					
Collar	3.50±0.55	3.20±0.31	4.00±0.42	0.21	NS
Hand	2.80±0.22	3.20±0.38	2.82±0.30	0.17	NS
Rib Back	1.93±0.18	1.80±0.20	1.93±0.17	0.10	NS
Rump back	2.00±0.15	1.80±0.32	2.10±0.19	0.13	NS
Streak	2.30±0.23	2.00±0.24	2.00±0.31	0.14	NS
Ham	5.77±0.76	4.50±0.51	5.30±0.47	0.35	NS
Head	4.60±0.34	4.63±0.45	4.05±0.82	0.31	NS
Trimmed fat	3.30±2.29	2.60±0.79	2.40±0.38	0.16	NS

P: level of significance; NS: not significant. (P >0.05); SED: standard error of differences of means

The indices considered for the pig carcass evaluation were found to be similar for all the dietary treatments. No significant differences (P>0.05) were observed in the carcass dressing percentages of pigs. These observations corroborate some of the earlier studies (Okai *et al.,* 2001). The mean values for carcass length, backfat thickness, loin eye muscle area and primal cuts were not significantly (P>0.05) affected by the dietary treatments imposed, however there was a trend towards improvement in carcass leaness of LW pigs as the levels of cassava pulp increased from 0 to 30%.

Pigs on Diets 2 and 3 had lower trimmed fat than on Diet 1. The lower trimmed fat on Diets 2 and 3 compared to Diet 1 could be an indication that the carbohydrate of the pulp, energy source, was more readily available leading to efficient utilization of the crude protein in the diet for muscle development. There would be a protein-sparring effect. Although, the LW on this study were slaughtered at about 60kg live-weight, the Eye muscle area of 37.70cm^2 on Diet 3 could be considered comparable to a range of 36.3 to 43.3cm^2 obtain with pigs at 90kg live weight on similar diets containing 30% Palm Kernel Cake (Rhule, 1996).

CONCLUSION

The study indicated that cassava pulp could be preserved by ensiling. It has also shown that maize, the expensive ingredient, could be completely excluded from the diets of grower-finisher pigs and that 30% inclusion of ensiled cassava pulp in the diet had no detrimental effort in pigs performance.

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EFFECT OF SUPPLEMENTATION OF CONCENTRATE TO SWEET SORGHUM (*Sorghum Bicolor* L. Moench) BAGASSE LEAF RESIDUE SILAGE ON PERFORMANCE AND CARCASS CHARACTERISTICS IN NATIVE SHEEP

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ABSTRACT: *The effect of supplementation of concentrate at different levels to sweet sorghum leaf residue (SSBLR) silage on the performance, and carcass characteristics was studied using Nellore growing ram lambs in a 120 day growth trial. A randomized design was applied with groups of seven growing ram lambs (14.05±0.61) and age (4 months), blocked by weight, allocated to one of four treatments; SSBLR silage ad lib (R-1), SSBLR silage + concentrate 170 g (R-2), SSBLR silage + concentrate 225 g (R-3) and SSBLR silage + concentrate 280 g (R-4). At the end of growth trial five representative lambs from each group were slaughtered to study the carcass characteristics and meat quality. The CP NDF and ADF content of SSBLR silage was 7.48, 71.81 and 46.75 per cent, respectively. The average daily gain (ADG) of ram lambs fed ration R-4 were significantly (P<0.01) higher than those fed R-1 and R-2 ration, but the value was comparable with the R-3 ration. The total DMI (g/d) was significantly (P<0.01) higher in lambs fed R-2, R-3 and R-4 rations compared to R-1 ration but DMI (g/d or % b.wt.) from SSBLR silage was not influenced by the level of concentrate supplementation. Negative FCR was recorded in lambs fed sole SSBLR silage and FCR was improved with supplementation of concentrate from R-2 to R-4 rations. Significant difference (P<0.05) in FCR was observed between lambs fed R-2 and R-3, R-4 rations but there was no significant difference between the lambs fed R-3 and R-4 rations. The lambs fed sole SSB silage lost their body weight of 2.14 kg during experimental period resulting in negative ADG and negative FCR. Supplementation of concentrate at 280 g to SSBLR silage resulted in significantly lower cost/kg gain than the other rations. Carcass weight and dressing percentage was linearly (P<0.01) increased as the proportion of concentrate increased in the diet. Supplementation of concentrate at different levels did not significantly influence the per cent whole sale cuts, yield of visceral organs and proportion of meat, bone and fat in whole carcass and chemical composition of meat. The results of the present study indicated that supplementation with energy and protein rich feeds to SSBLR was necessary and concentrate supplementation at 280 g to SSBLR silage found to be optimum for better growth rate, feed efficiency and meat quality in growing Nellore ram lambs.*

Key words: *Sweet sorghum bagasse leaf residue silage, Supplementation, Performance, Carcass characteristics, Sheep*

ORIGINAL ARTICLE

INTRODUCTION

India ranks third in the world in sheep population and has about 73.99 million sheep and 154 million goats (FAO, 2010). Small ruminants in India mainly depend on grazing and browsing resources to meet their nutrient requirements. However, due to continuous depletion of grazing land they are subjected to severe nutritional stress, adversely affecting their production performance. Full utilization of crops and their by-products in the balanced production of food, feed and industrial products is likely to become increasingly important in India. Hence, it is necessary to explore the possibility of utilizing newer feed resources for feeding ruminant livestock.

Sweet sorghum (*Sorghum bicolor* L. Moench) is one of the most efficient dry land crops. The crop is more water–use efficient than sugarcane and is recently gaining importance as a feedstock for ethanol production (Reddy et al., 2005). Use of sweet sorghum bagasse leaf residue (SSBLR) - that remain after juice extraction could mitigate fodder shortage and add further value to a sweet sorghum bio-fuel value chain as a tradable feed resource

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(Blummel et al., 2009). In bio-ethanol production systems in India (and elsewhere) SSBLR are generated in large amounts. A crop yielding 40 ton fresh stalk/ha and 50 per cent extractability would yield about 20 tons/ha SSBLR. Under such conditions SSBLR can be converted to silage and stored for feeding livestock. In fact SSBLR is good for silage making (Rao et al., 2008) since it contains 50% moisture after extraction of juice.

In view of the above, the present study is aimed to evaluate the effect of supplementation of concentrate to SSBLR silage on growth performance and carcass characteristics in native sheep.

MATERIALS AND METHODS

Cropping conditions of sweet sorghum

Sweet sorghum is a warm-season crop that matures earlier under high temperatures and short days. It tolerates drought temperature stress better than many crops, but it does not grow well, under low temperatures. It can be grown on soils ranging from heavy clay to light sand. Rainfall of 500 – 600 mm distributed ideally across growing period is the best, unless the soil can hold much water. Seed rate is 7-8 kg seed/ha with a recommended density about 7000 plants/ha. Most of the sweet sorghum varieties mature between 115-125 days during rainy season. Sweet sorghum yields 25-75 ton/ha green matter, according to soil fertility and rainfall.

Site of study

The experiment was carried out at the College of Veterinary Science of S V Veterinary University, Rajendranagar, Hyderabad, India (17^0 12′ N, 78^0 18′ E, 545 m above sea level) in India. The ambient temperature and relative humidity values during the period of study were in the ranges of 33- 44^{o}C and 29-36 %, respectively.

Experimental feeds preparation

Sweet sorghum bagasse leaf residue (SSBLR) procured from decentralized crushing unit of ICRISAT, Patancheru, established at Daulathabad, Medak dist under National Agriculture Innovation Project (NAIP, Component- 2) in chopped form after extraction of juice. The chopped bagasse is made into silage in a trench type of silo with dimensions of 12'l x 9' w x 6'h so as to accommodate about 10 tons of silage. Sugarcane molasses, urea (fertilizer grade) and common salt were added at 1, 0.5 and 0.5 per cent respectively while making the silage and they were mixed in water (50 l/ton) thoroughly with stick and were sprinkled uniformly on each layer of the chopped SSB in the silo. Great care was taken while compacting and sealing the chopped SSB to prevent trapping of air in the silo so as to maintain strict anaerobic environment in the silo. Silo was opened on 30th day after sealing for the feeding of experimental ram lambs. Concentrate mixture (CP 17%; ME 10.6 MJ/kg DM) was prepared using locally available feed ingredients (Table 1).

Table 1 - Ingredient composition (g/kg) of concentrate mixture

Ingredient	Level (g/kg)
Maize grain	310.0
Ground nut cake	165.0
Sunflower cake	200.0
Deoiled rice bran	230.0
Molasses	50.0
Urea	15.0
Mineral mixture*	20.0
Salt	10.0

*contains calcium-30 %, phosphorous-9 %, magnesium-2.114 g, Copper-312 mg, cobalt-45 mg, iron-979 mg, zinc 2.130-g, iodine-156 mg, D.L. methionine-1.929 g L.lysine-4.40 g

Experimental animals, housing and feeding management

Twenty eight ram lambs with an average body weight of 14.05±0.61 aged about 4 months were divided into 4 groups each group comprising of 7 lambs in a Completely Randomized Design (CRD). The following treatments were allotted at random to the 4 groups of Nellore ram lambs. The first group (R-1) of growing Nellore ram lambs was fed sole SSBLR silage *ad libitum.* The second group (R-2) was fed concentrate mixture @ 170 g (approximately 30% of the total dry matter intake (DMI)) + SSBLR silage *ad lib.* The third group (R-3) was fed concentrate mixture @ 225 g (approximately 40% of the total DMI) + SSBLR silage *ad lib.* The fourth group (R-4) was fed concentrate mixture @ 280 g (approximately 50% of the total DMI) + SSBLR silage *ad lib.* The lambs were de-wormed and vaccinated against Peste des petits ruminants (PPR) and enterotoxaemia diseases before inducting into the 120-d growth trial and housed in well ventilated pens (4m x 3m) with facilities for feeding and watering. During the study hygienic conditions were maintained in the pens by draining appropriately to allow the water to run off, and they were regularly cleaned. Experimental feeds were offered 3 times at equal intervals in a day and fresh drinking water was made available *adlibitum* at all times. During the growth trial period experimental ram lambs were weighed at fortnightly intervals for two consecutive days in the morning before feeding and watering. Daily feed intake was recorded by weighing the feed offered and refusals. Samples of offered feed and left over were collected biweekly and analyzed for proximate principles (AOAC, 1997) and fiber fractions (Van Soest et al., 1991).

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Slaughter procedures

After growth trial, five animals from each group were randomly selected for carcass studies. The lambs were fasted for 18 hrs with free access to water and slaughtered as per the standard procedures by Halal method. The live weights before slaughter were recorded. Stripping, legging, dressing and evisceration were performed by adopting the standard procedures described by Gerrand (1964). Carcass, edible (Testicle, spleen, pancreas, kidney, heart, liver) and non edible (Head, skin, fore and hind canons, lungs with trachea, gall bladder, penis, empty GI tract) offal weights were recorded immediately after slaughter. Lungs, trachea and heart were weighed as one piece and designated as pluck. Weight of ingesta was determined as the difference between full and empty digestive tract. The empty live weight was computed as the difference between pre slaughter weight and weight of digestive content. The hot carcass was then split to fore and hind quarters. The fore and hind quarters were further split along the mid line and the left half was disjointed as per ISI (1963) specifications to standard wholesale cuts viz. leg, loin, rack, neck and shoulder and breast and fore shank. The meat samples were collected from *Longissmus dorsi* muscle immediately after slaughter for qualitative analysis. The samples were analyzed for moisture, protein, fat and ash according to methods of A.O.A.C. (1997).

Statistical analysis

Statistical analysis of the data was carried out according to the procedures suggested by Snedecor and Cochran (1994). Least-square Analysis of variance was used to test the significance of various treatments and the difference between treatments means was tested for significance by Duncan's new multiple range and F Test (Duncan, 1955).

RESULTS AND DISCUSSION

Chemical composition

DM (34.83) and CP (7.48) content of SSBLR silage (Table 2) was higher than the DM and CP (5.0) content of ensiled corn crop residue as reported by Lopez-Guisa et al. (1991) and it may be due to addition of urea to the SSBLR while making silage. The OM, CF, EE, NFE were comparable, where as NDF, ADF and hemicellulose of SSB silage were higher than the values of sorghum stover silage reported by Sudesh Radotra and Upadhay (2005). The lignin content of SSB silage was comparable with the values of corn crop residue silage (Lopez-Guisa et al., 1991).

Table 2 - Chemical composition (% DM) of SSBLR silage and concentrate mixture

Nutrient	% level	
	SSB silage	Concen. mixture
Proximate principle		
Dry matter	34.83	89.50
Organic matter	92.46	88.31
Crude protein	7.48	17.27
Ether extract	1.99	3.45
Crude fibre	37.14	9.34
Nitrogen free extract	45.86	58.25
Total ash	7.53	11.68
Cell wall constituents		
Neutral detergent fibre	71.81	32.05
Acid detergent fibre	46.75	13.32
Hemicellulose	25.06	18.73
Cellulose	31.16	7.09
Acid detergent lignin	9.05	3.11

Each value is the average of triplicate analysis. On dry matter basis except for dry matter

Body weight changes and growth rates

There was decrease in live body weight of lambs fed sole SSBLR (R-1) silage and the lambs lost on an average 2.14 kg body weight by the end of the trial. ADG increased (Table 3) progressively either significantly ($P<0.01$) or non significantly as the level of concentrate supplementation increased and the increased ADG might be due to significantly higher CP digestibility and DCP and ME intakes by the lambs fed R-2, R-3 and R-4 rations. Abdul et al. (2008) reported that animals fed on the supplement gain weight while those not supplemented lost weight. Loss in weight of lambs in R-1 fed sole SSBLR silage might be due to catabolism of body tissues to supply the much-needed nutrients for vital activities in the body and mis matching of energy and nitrogen in the rumen for microbial protein synthesis. Singh et al. (2011) reported feeding on residues of cereals like maize, millet and sorghum alone, resulted in the weight loss of the animals between 11 to 16%. This is because of the relatively low digestibility, low crude protein content and low content of available minerals and vitamins in the cereals residues. Similar negative average daily gain was reported by Koralangama et al. (2008) in sheep fed sole maize stover and ADG increased with supplementation of concentrate/cowpea to maize stover. Jadoon et al. (1990) observed negative ADG in ram lambs fed maize and oat silage alone and increased ADG observed with supplementation of concentrate to maize and oat silage.

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Table 3 - Effect of feeding SSBLR silage with different levels of concentrate on performance and cost economics in growing Nellore ram lambs

Parameter	Ration				
	R-1	R-2	R-3	R-4	SEM
Initial weight (kg)	14.05	14.05	14.00	14.00	0.35
Final weight (kg)**	11.91^{c}	18.53^{b}	20.20^{ab}	21.53^{a}	0.69
Weight gain (kg)**	-2.14^{c}	4.48^{b}	6.20^{ab}	7.53^{a}	1.59
Average body wt. (kg)**	12.98^{b}	16.29^{a}	17.1^{a}	17.76^{a}	0.49
Metabolic body wt. (kg)	6.81^{b}	8.11^{a}	8.41^{a}	8.65^{a}	0.18
Average daily gain (g)**	-17.91^{c}	37.26^{b}	51.70^{ab}	62.76^{a}	6.49
Feed intake					
Silage (kg/d)	1.12	1.12	1.07	1.13	0.03
Concentrate (g/d)	—	170^{c}	225^{b}	280^{a}	0.00
DMI (g/d)**	351.17^{c}	507.06^{b}	536.88^{ab}	606.90^{a}	30.22
DMI (% b. wt.)	2.70	3.11	3.14	3.42	0.10
DMI (g/kg $w^{0.75}$)	51.34^{b}	62.52^{a}	63.84^{a}	70.16^{a}	2.42
Feed conversion ratio (DMI, kg/kg gain)*	-19.61^{c}	13.61^{a}	10.38^{b}	9.67^{b}	4.06
Feed cost (₹/kg)					
Silage	1.25	1.25	1.25	1.25	–
Concentrate	11.09	11.09	11.09	11.09	–
Economics	-77.98^{c}	88.18^{a}	74.18^{b}	71.95^{b}	12.24
Cost/ kg weight gain*(₹)					

Each value is the average of seven observations. ^{a,b,c} values bearing different superscripts in a row differ significantly *(P<0.05), **(P<0.01) 1 US $ = 54.8, wt.-weight

Sohail et al. (2010) and Jadoon et al. (1990) observed that the lambs fed maize silage and concentrate gained more daily gain than those fed sole maize silage. Maize, sorghum and other grass silages supplemented with different protein sources (such as fish meal, concentrate and addition of nitrogen sources) increased growth rate of growing animals (Kim et al., 2000). Petit and Castonguay (1994) observed that the ADG was lower (P<0.01) for lambs fed sole silage than those fed the silage plus concentrate, and it was increased with increase in the amount of concentrate being fed. Similar results were reported by Sartori et al. (2004) with sunflower silage in sheep and Chauhan and Gupta (1992) in buffalo calves with oat silage.

Dry matter intake

The total DMI (g/d) was significantly (P<0.01) higher in lambs fed R-4 ration, followed by those fed R-3, R-2 and R-1 rations (Table 3). The DMI (g/d) was increased by 44.39, 52.88, and 72.82, respectively when lambs fed R-2, R-3 and R-4 rations compared to R-1 ration. Present results indicated that total DMI was increased with supplementation of concentrate. Similar results were reported by Caplis et al. (2005) with grass silage supplemented with different levels of concentrate. Chauhan and Gupta (1992) reported that highest DMI in buffalo calves was observed in oat silage plus concentrate ration than those fed oat silage alone. However, Petit and Castonguay (1994) observed no significant difference in total DMI (g/d) among the steers fed silage and silage plus concentrate. In the present study there was no significant difference in total DMI when expressed as per cent body weight among the four dietary treatments. Further, the DMI (g/d or % b.wt.) from SSBLR silage was not influenced by the concentrate supplementation which was also reported by Kumar et al. (2010) in sheep fed SSBLR silage supplemented with concentrate. There was significant difference (P<0.05) in total DMI per unit of metabolic body weight between sole SSBLR silage and concentrate supplemented groups. Similar results were reported by Sartori et al. (2004) with sunflower silage or maize with increasing proportion of commercial concentrate. Whereas increased (P<0.05) DMI per unit of metabolic body weight with increasing concentrate proportion up to 43:57 concentrate: roughage ratio was reported by Bhuyan et al. (1996). Eifert et al. (2004) reported that there was linear increase in DMI (kg/d or g/kg $w^{0.75}$) as the concentrate level increased to triticale silage.

Feed conversion ratio

Feed conversion ratio (DMI kg/kg gain) in Nellore growing ram lambs fed R-1, R-2, R-3 and R-4 rations ranged from -19.61 to 9.67 (Table 3). Negative FCR was recorded in lambs fed sole SSBLR silage and FCR was improved with supplementation of concentrate from R-2 to R-4 rations. Significant difference (P<0.05) was observed between R-2 and R-3, R-4 rations and there was no significant difference in FCR between the lambs fed R-3 and R-4 rations. The R-3 and R-4 rations were 23.73 and 28.94 per cent more efficient in FCR than those fed R-2 ration. Negative FCR in lambs fed R-1 ration is due to decrease in body weight during the experimental period. The growth rate was improved with increase in the proportion of concentrate in the diets and the FCR accordingly improved. Similarly Pereira et al. (2007) in beef cattle observed an improved FCR with supplementation of concentrate at different levels to sorghum (*Sorghum bicolor (L.) Moench*) silage Sohail et al. (2010) in sipli lambs reported higher feed efficiency when maize silage was supplemented with concentrate. Petit and Castonguay (1994) observed that the FCR was higher for lambs fed silage plus concentrate, and it increased with increase in the amount of concentrate being fed. Bhuyan et al. (1996) observed higher feed conversion efficiency as the

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concentrate proportion increased in the diet of kids. Similar results were reported by Sartori et al. (2004) with sunflower silage or maize with increasing proportion of commercial concentrate in the ration.

Economics

The cost of feed/kg gain (₹) in lambs fed R-1, R-2, R-3 and R-4 rations was -77.98, 88.18, 74.18 and 71.95, respectively (Table 3). Among the concentrate supplemented groups cost (₹)/kg live weight gain was significantly (P<0.01) highest in ram lambs fed ration R-2 followed by R-3 and R-4 rations and negative cost (₹)/kg live weight gain was recorded in Nellore ram lambs fed sole SSBLR silage which was due to loss of body weight during the experimental period. The cost (₹)/kg live weight gain was lower by 18.40 and 3.00 per cent in ram lambs fed R-IV ration than those fed R-2 and R-3 rations, respectively. The reason for highest cost (Rs.)/kg live weight gain in lambs fed R-2 ration than those fed the other supplemental experimental rations could be due to low level of supplementation with concentrate to the ram lambs.

The total cost of feed amounts to the extent of 60-80 per cent in livestock farms (Reddy et al., 2009) and the average value of feed cost (70%) is accepted under Indian conditions (Hegde, 2006). Increased profitability of lamb production is dependent on reducing input costs and/or increasing production output. Any reduction in feed intake or increase in feed efficiency without compromising on growth rate or carcass quality can have a significant positive impact on lamb production (Snowder and Van Vleck, 2003). In the present study, the results shown that supplementation of 280 g concentrate to SSB silage is consider to be economical in growing ram lambs.

Carcass and Meat Characteristics

Live Weight and Carcass Weight: The live body weight, empty body weight and carcass weight was significantly (P<0.01) lower in lambs fed sole SSBLR silage than those supplemented with concentrate (Table 4). Among the concentrate supplemented groups the values were significantly (P<0.01) lower in lambs fed R-2 ration compared to those fed R-3 and R-4 rations. Prasad et al. (1981) reported higher hot carcass weight in native and cross bred lambs fed higher proportion of concentrate. Caplis et al. (2005) reported that the carcass weight was significantly increased with increasing level of concentrate to grass silage. Petit and Castonguay (1994) reported higher carcass weight in cross bred lambs fed higher proportion of concentrate.

Dressing Percentage: The mean dressing percentage on slaughter weight and empty body weight ranged from 39.15 to 49.01 and 51.36 to 59.17 in lambs fed R-1, R-2, R-3 and R-4 rations, respectively (Table 4). Significantly (P<0.01) higher dressing percentage was recorded in lambs fed R-IV ration on any basis. Petit and Castonguay (1994) reported high levels of concentrate supplementation increased dressing percentage. Similar results reported by Chestnutt (1992) and Povey et al. (1990) who observed that inclusion of concentrate increased dressing percentage, final live weight, and carcass weight of lambs fed silage. Jabbar and Anjum (2008) reported that high concentrate in the diet also improved dressing percentage in lambs. Papi et al. (2011) stated that the dressing percentage increased linearly with increasing level of concentrate in the diet.

Contrary to the present study, Bhuyan et al. (1996) reported insignificant dressing percentage improvement with various proportions of concentrate to roughage. Similar results were reported by Dien et al. (1990) with increased proportion of concentrate to roughage in buffalo calves.

Table 4 - Effect of feeding SSBLR silage with different levels of concentrate on carcass characteristics in growing Nellore ram lambs

Parameter	Ration				
	R-1	R-2	R-3	R-4	SEM
Pre slaughter wt. (kg)	13.06^{c}	18.06^{b}	20.26^{a}	20.26^{a}	0.90
Empty body wt. (kg)	9.96^{c}	14.33^{b}	16.94^{a}	16.78^{a}	0.86
Carcass wt. (kg)	5.13^{c}	7.63^{b}	9.13^{a}	9.93^{a}	0.56
Dressing %					
On slaughter wt.	39.15^{c}	42.24^{bc}	45.05^{b}	49.01^{a}	1.19
On empty body wt.	51.36^{b}	53.27^{b}	53.88^{b}	59.17^{a}	1.04

Each value is the average of five observations

Proportion of Wholesale Cuts: Supplementation of concentrate to SSBLR silage at different levels did not significantly influence the per cent wholesale cuts of the lambs. Similar results were reported by Bhuyan et al. (1996) and Dien et al. (1990). There was significant (P<0.05) difference in edible, non edible portion and ratio of edible and non edible portions of lambs fed sole SSB silage and concentrate supplemented group. Contrary to the findings of the present study Bhuyan et al. (1996) reported non significant difference in edible and non edible portions. Neck, shoulder, rack–loin, and leg weights were not affected by concentrate level (Papi et al., 2011).

Yield of Visceral Organs: Supplementation of concentrate to SSBLR silage did not affect the yield of pluck, liver, heart, testes, GIT, spleen, lungs with trachea as percentage of pre-slaughter weight (Table 6). The results of the present study were in accordance with the findings of Dien et al. (1990). Skin, head, kidney, lung and spleen weights were not affected by concentrate level in the diet (Papi et al., 2011).

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Table 5 - Effect of feeding SSBLR silage with different levels of concentrate on yield of whole sale cuts and edible, non edible portions (% carcass weight) in growing Nellore ram lambs

Parameter	Ration				
	R-1	R-2	R-3	R-4	SEM
Fore shank	17.24	15.44	16.68	16.90	0.50
Neck and shoulder	26.63	26.83	25.44	25.58	0.77
Rack	12.45	10.58	12.02	11.27	0.53
Loin	12.61	11.84	11.91	11.17	0.42
Leg	31.04	35.28	33.93	35.07	0.99
Edible portion (% slaughter wt.)	53.09^{b}	55.14^{ab}	57.83^{a}	58.88^{a}	0.86
Non edible portion (% slaughter wt.)	22.04	19.04^{b}	18.33^{b}	19.16^{b}	0.54
Non edible : edible portions	2.41^{b}	2.91	3.15^{a}	3.08^{a}	0.10

Each value is the average of five observations

Table 6 - Effect of feeding SSBLR silage supplemented with concentrate at different levels on yield of visceral organs (% pre slaughter weight) in Nellore growing ram lambs

Parameter	Ration				
	R-1	R-2	R-3	R-4	SEM
Pluck	4.05	3.98	3.64	3.63	0.07
Liver	1.58	1.78	1.81	1.73	0.06
Kidney	0.30	0.27	0.26	0.29	0.01
Heart	0.48	0.49	0.47	0.45	0.02
Testes	0.44	0.45	0.57	0.58	0.05
GIT full	31.62	27.86	30.34	26.68	0.88
GIT empty	7.83	7.79	7.96	7.51	0.16
Spleen	0.46	0.43	0.40	0.35	0.02
Lungs with trachea	1.98	1.70	1.35	1.45	0.10
Skin (kg)	2.05	2.06	2.08	2.09	0.15
Head (kg)	1.28	1.32	1.34	1.36	0.12
Blood (kg)	0.46	0.47	0.49	0.51	0.07

Each value is the average of five observations. P>0.05

Proportion of Meat, Bone and Fat in Carcass: No significant variation could be seen in bone and meat yield (%) and their ratios in various wholesale cuts among dietary treatments (Table 7). Fat percentage numerically increased from R-1 to R-4 rations. Reddy and Raghavan (1987) found no significant change in lean, bone and fat proportions with increasing concentrate level in the diet. Papi et al. (2011) indicated that lean and bone weights were not affected by the different levels of concentrate whereas subcutaneous and total fat weights were least for lambs fed the diet containing 30% of concentrate and greatest for lambs fed the diet containing 50% of concentrate.

Table 7 - Per cent yield and ratio of bone and meat in whole carcass in Nellore ram lambs fed SSBLR silage supplemented with concentrate at different levels

Parameter	Ration				
	R-1	R-2	R-3	R-4	SEM
Carcass wt. (kg)	5.13^{c}	7.63^{b}	9.13^{a}	9.93^{a}	0.56
Meat	53.75	51.80	51.72	51.32	0.38
Bone	38.91	39.85	39.17	38.89	0.27
Fat	7.36	8.35	9.12	9.81	0.29
B-M ratio	1.38	1.30	1.32	1.32	0.01

Each value is the average of five observations.

Contrary to the present findings, Caplis et al. (2005) observed increasing trend in fat percentage and decreased bone proportion with increased concentrate level. Bhuyan et al. (1996) observed significant increase in the percentage of dissectible fat with increased proportion of concentrate in the diet. Dien et al. (1990) reported a significant increase in the percentage of omental and pelvic fat with increasing concentrate level.

Chemical Composition of Meat: The chemical composition of *Longissimus dorsi* muscle is collected from the carcasses of ram lambs fed different experimental rations revealed that the moisture, protein, and ash content of muscle were ranged from 74.5 to 75.0, 21.6 to 21.7 and 1.9 to 2.4, respectively (Table 8).

Supplementation of concentrate to SSB silage did not affect the chemical composition of meat. Bhuyan et al. (1996) and Dien et al. (1990) observed no variation in the chemical composition of meat with increasing concentrate level in the diet.

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Table 8 - Chemical composition of *Longismus dorsi* muscle on fresh basis (%) in Nellore growing ram lambs fed SSBLR silage supplemented with concentrate at different levels

Parameter	Ration				
	R-1	R-2	R-3	R-4	SEM
Moisture	74.96	74.81	74.68	74.41	0.11
Protein	21.64	21.65	21.71	21.73	0.04
Fat	1.45	1.46	1.48	1.49	0.01
Ash	1.94	2.09	2.13	2.38	0.07

Each value is the average of five observations

CONCLUSIONS

SSB silage on sole ration could not meet the nutrient requirements indicating that the supplementation with energy and protein rich feeds was necessary. Concentrate can be included at 280 g to SSB silage to obtain optimum growth rate, feed efficiency and meat quality in growing Nellore ram lambs.

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PRE-WEANING GROWTH PERFORMANCE OF SEKOTA SHEEP BREED IN WAGHIMRA ZONE, ETHIOPIA

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ABSTRACT: *Pre-weaning growth performances of Sekota sheep breed was studied at Sekota district of Amhara National Regional State, Ethiopia under traditional crop-livestock production systems which is characterized by extensive, low-input low-output system. Two hundred thirty one lambs were monitored from birth to weaning age. Data on growth performances were collected and analyzed using the general linear model procedures of Statistical analysis system software. The least squares mean birth weight, three months weight and average daily weight gains from birth to three months age were 2.73 kg, 11.9 kg and 101 gm, respectively. Parity and type of birth were significant sources of variation for birth weight. Location had an effect of three months weight. The results obtained revealed the potential of the breed for meat production in the prevailing environment. The effect of parity on birth weight indicates special care for lambs from maiden ewes. Management options like integrated health care and supplementation of feed for sheep during the dry season help farmers to benefit from their sheep.*

ORIGINAL ARTICLE

Key words: *Growth Performance, Pre-Weaning, Sekota Sheep, Daily Weight Gain*

INTRODUCTION

Small ruminant production is an important agricultural enterprise in Ethiopia. Sheep and goats are important components of the livestock subsector and are sources of cash income and play a vital role as sources of meat, milk and wool for smallholder keepers in different farming systems and agro-ecological zones of the country, they are also sources of foreign currency (Tibbo, 2006). Moreover, due to their high fertility, short generation interval, adaptation in harsh environment and their ability to produce in limited feed resource they are considered as investment and insurance (Tsedeke, 2007).

Sekota sheep is one of the identified indigenous sheep breeds of Ethiopia (Gizaw et al., 2008). Like other breeds of the country, Sekota sheep can be characterized by low productivity in terms of growth rate, meat production, and reproductive performance, which can be attributed to overcrowding, poor nutrition, and the resultant stress that provides a rich atmosphere for disease and serious production losses (Sisay, 2002). However, Sekota sheep is well adapted to drought-prone environment, and are believed to have better tolerance to drought conditions than other sheep breed.

The growth performance of sheep is an important character which determines the overall productivity of the flock and the economic return from sheep production enterprises with the objective of meat production. Increased economic returns from sheep production require improvements in the market weight of lambs to market age (Mengisitie et al., 2010). Pre-weaning growth performance traits such as birth weight and growth rate have important implications on flock productivity, management systems and breeding policies to be followed. The objective of this study was to analyze birth weight and pre-weaning growth performance of Sekota sheep under traditional farmers' management system.

MATERIALS AND METHODS

Description of the Study Area

The study area, Sekota district, is found in Waghimra zone of the Amhara Regional state which is located between 12^0 23' and 13^0 16' north longitudes and 38^0 44' and 39^0 21' east latitudes. Sekota district is located in the eastern part of Waghimra zone, 435 km north east of Bahir Dar (capital of the region) and 720 km north of Addis Ababa. Sekota district represents from hot to warm sub-moist agro ecology having an altitude of <1500m *("Kola")* to cold sub-moist agro ecology of 1800 -2200 m *"Dega" agro* ecology. (MoA, 1998). The annual rainfall,

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which is erratic in distribution, varies between 350 and 650 mm. Generally, the topography of the district is rugged and chain of mountain terrains which limits seriously access to the various parts of the district. The agricultural production system of Sekota district is mixed livestock crop production system dominated by livestock production. The productivity of the land is low emanating from very low rainfall. The main agricultural crops are sorghum, barley, wheat, teff and leant.

Data collection

Data on growth performances of Sekota sheep was collected from a total of 231 lambs from September 2010 to January 2011. For this purpose, a total of 230 Sekota ewes of almost 5 months of pregnancy (based on owners' information) were selected and ear tagged. Reproduction records like birth date, parity, birth type and birth weight were recorded immediately after lambing. Weights of lambs were taken fortnightly using Salter balance. Average daily gain was calculated as $ADG_{t2\text{-}t1} = (W_{t2} - W_{t1})/t2\text{-}t1$; where ADG_{t2-t1} is the weight gain between periods birth and three months age, Wt2 is the weight at three months age, Wt1 is the birth weight of sheep and t2−t1 is the number of days between ages t1 and t2.

Statistical analysis

The General Linear Model (GLM) procedure of Statistical Analysis System (SAS version, 2003) was used to analyze the data. The fixed effects considered in the model were: location (Hamusit, Abia); sex (male, female); parity (1, 2, ..., ≥5) and birth type (single, multiple).

The statistical model was:

$Y_{ijkl} = \mu + L_i + S_j + P_k + B_l + e_{ijkl}$

Where;

Y_{ijkl} = the observation on body weight and weight gain (pre-weaning) of the n^{th} lamb

μ = the overall mean

L_i = the fixed effect of the i^{th} location

S_j = the fixed effect of j^{th} sex

P_k = the fixed effect of k^{th} parity

B_l = the fixed effect of l^{th} type of birth

e_{ijkl} = the random effect

RESULTS AND DISCUSSIONS

Birth weight

Factors affecting birth weight and pre-weaning growth performance of Sekota sheep is presented in Table 1.

The overall least squares mean birth weight of Sekota lambs obtained in the current study (2.73±0.06 kg) was similar with the birth weight of Washera sheep (Mengistie et al., 2010), Gumuz sheep (Abegaz et al., 2011), Afar sheep (Yakob, 2008) and Horro sheep (Abegaz et al., 2002). The birth weight of Sekota sheep, however, was heavier than the weight reported for Menz sheep (Tibbo, 2006; Gizaw, 2002; Kassahun, 2000), local sheep around Dire Dawa (Aden, 2003).

Among the fixed effects considered, parity and type of birth significantly affected birth weight of Sekota sheep. Lambs born from fifth and above parity dams were heavier ($p<0.001$) in weight than their lower parity dam born lambs. This finding is in line with other findings (Mengistie et al., 2010; Gardner et al., 2007) who reported sustained increase in lamb birth weight with dam age up to 6 years. The scientific explanation forwarded for the increased trend of lambs weight at birth with increase in dams parity or age at lambing are competition for nutrients for growth of young ewes and growth of fetus, and the favorable uterine environment provided by the older ewes.

The single born lambs were significantly ($p\leq0.001$) heavier than their multiple born contemporaries (2.93±0.06 vs. 2.53±0.06). This is in agreement with literature (Mengistie et al., 2010; Duguma et al., 2002; Benyi et al., 2006; Tibbo, 2006; Gardner et al., 2007; Yilmaz et al., 2007). This could be because of the finite capacity of the maternal uterine space to gestate offspring (Gardner et al., 2007). In addition, the diminished nutrition supply via blood vessels during prenatal life and the relative decrease of carnuncles attached to each fetus could affect birth weight of multiple born lambs.

Pre-weaning growth

Pre-weaning growth performance of lambs depends up on the inherent genetic potentiality and the mothering ability of ewes. The overall least squares mean one, two and three months weight of sekota sheep is presented in Table 1.

The overall least squares mean three months weight of Sekota sheep obtained in the current study (11.9±0.21 kg) was heavier than weaning weights of Horro sheep and Menz sheep (Kassahun, 2000; Tibbo, 2006) while it was similar with the weaning weights of Washera sheep (Mengistie et al., 2010) Gumuuz sheep (Abegaz et al., 2011) and Horro sheep (Abegaz et al., 2002).

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Location was an important source of variation affecting the three months weight of Sekota sheep that lambs from Hamusit area had heavier weights than lambs from Abia (12.9±0.24 vs. 10.9±0.23; p<0.001). This might be because of the differences in the nutritional condition and management of sheep of the different areas.

Single born lambs were significantly (p≤0.05) heavier than those born twins at one months of age. Better pre-weaning growth of single born lambs is a common trend in many other breeds (Abegaz et al., 2011; Mengistie et al., 2010). However, the birth type effect diminished at two and three months age. This might be because, after some days multiple born lambs may be able to get enough milk from their dams because of increased intensity of suckling. If all the twins equally survive, their total rate of weight gain is greater than that of singles and will be an added attribute of the breed.

Table 1 - Least square means of birth weight, three months weight and growth rate of Sekota sheep

Variable	N	Birth weight (kg)		Three months weight (kg)		ADG (gm)
		Mean±SE	N	Mean±SE	N	Mean±SE
Overall	231	2.73±0.06	226	11.9±0.21	226	102±2.66
Parity		***		NS		NS
1	48	2.47±0.06^{c}	48	11.3±0.21	48	97.1±2.53
2	72	2.77±0.06^{abc}	71	11.7±0.20	71	99.1±2.42
3	75	2.88±0.06^{ab}	69	11.6±0.20	69	97.8±2.45
4	30	2.63±0.08^{abc}	30	11.4±0.28	30	95.0±3.39
≥5	5	2.99±0.18^{a}	5	12.2±0.59	5	117±7.19
Sex		NS		NS		NS
Male	124	2.70±0.07	121	11.9±0.23	121	101±2.93
Female	107	2.76±0.06	105	11.9±0.24	105	102±2.79
Type of birth		***		NS		NS
Single	209	2.93±0.06^{a}	205	12.9±0.19	205	101±2.39
Twin	22	2. 53±0.06^{b}	21	11.8±0.32	21	102±2.92
Location		NS		***		NS
Hamusit	100	2.69±0.07	99	12.9±0.24^{a}	99	113±2.95
Abia	131	2.77±0.06	127	10.9±0.23^{b}	127	102±2.77

ADG- Average daily gain in grams; Means within each sub-class with different superscripts differ significantly *** = P ≤ 0.001 and NS = not significant

At two and three months age lambs from second, third and fifth parity dams had significantly better (p<0.01) growth than lambs from first and fourth parity dams. This is consistent with literature (Kassahun, 2000; Tibbo, 2006), that lambs born from the second and third parity ewes had a significantly higher growth rate than those from maiden ewes. This could be due to the difference in milk supply and maternal care, since maiden ewes produce less milk than average and lack experience to take care of their lamb. Influence of superior maternal environment of older ewes (to some age actually) is expected to be translated into better lamb performance up to weaning (Inyangala et al., 1996).

The effect of *kebeles* was significant (p<0.05) for weights at birth, 2 month and 3 months age. It was consistently observed that, the lambs born in Hamusit *kebeles* were heavier than lambs born in Abia *kebeles*. In the present study in Hamusit *kebele* may be more sheep feed type found than Abia that available for lambs and lactating ewes.

Pre-weaning growth rate

The growth rate of young lambs depends almost entirely on the quality and quantity of feed, the ewes milk yield, lambs milk intake. Furthermore, the milk yield of the dam in turn depends up on the nutrition and mature size of the ewes (Ibrahim, 1998).

The overall mean average daily weight gain calculated from birth to weaning was 101±2.66 gm. This result is comparable to the reports of Kassahun (2000) for Menz breed at on station condition, Mengistie et al. (2010) for Washera breed at on farm condition and was higher than the result obtained from local sheep around Dire Dawa (Aden, 2003). However, it is lower than the growth rate of Horro sheep (Kassahun, 2000), Gumuz sheep (Abegaz et al., 2010).

All the fixed effects considered were not significant which is inconsistent with the reports of other scholars (Mengistie et al., 2010; Abegaz et al., 2011; Kassahun 2000; Aden 2003).

CONCLUSION AND RECOMMENDATION

Sekota sheep breed is one of the short fat tailed sheep breeds of Ethiopia being reared in the degraded areas of Sekota. The results obtained revealed the potential of the breed for meat production in the prevailing environment. The effect of parity on birth weight indicates special care for lambs from maiden ewes. Management options like integrated health care and supplementation of feed for sheep during the dry season help farmers to benefit from their sheep.

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PRODUCTIVITY OF DESERT SHEEP UNDER GRAZING CONDITION IN NORTH KORDOFAN, SUDAN

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ABSTRACT: *This study was conducted in North Kordofan State, with the objectives of studying performance of desert sheep (Hamari) on natural grazing during the dry season, and to investigate the nutritional value for the rangelands prevailing in the region. To achieve the objectives chemical analysis was done for some plants and trees to determine the nutrients and mineral content according to (AOAC, 1990). In vitro dry matter digestibility and organic matter digestibility were also determined according to Tilley and Terry (1963). Animal digestibility trial was successfully done, when ten rams were reared on natural rangelands for three consecutive grazing periods (30, 60 and days) to study the performance. The data was analyzed as completely randomized block design via analysis of variance with the assistance of SPSS and statitix8 software. The results of chemical analysis showed that CP, CF, ash, EE and NFS were in the range from 6-10, 35-45, 7-10, 1.1-2.1 and 36.7-46.7% respectively. The chemical analysis for selected browse trees were CP5.1%, CF 31-33%, EE 0.4-0.9%, ash 7-8.1% and NFE 53-56.9%. Mineral contents ranged from 0.0144-0.075 ppm for P, 0.002-0.063 ppm for K and 1-2.9 ppm for Iodine. In vitro DM and OM digestibility ranged from 52-59 and 52-62%, respectively. Rams grazing on natural rangelands recorded weight gains during the first grazing period (December), and then they lost weight at the second period (January) and recorded a high weight loss during the third period (February, January-July). Based on the findings it can be concluded that rangelands in the region were deteriorating in quality and quantity as a result which negatively affects livestock performance due to negative effect on animal weight gain leading to weight loss during the period January-July. There is a high need for introducing supplementary feeding and mineral additives.*

Key words: *North Kordofan, animal performance, In vitro, Digestibility, Rangelands*

ORIGINAL ARTICLE

INTRODUCTION

North Kordofan State area amounts to almost 25 million hectares, out of which 14.5 million hectares are rangelands. The State has a total population of 2.9 million people (5th population and houses census, 2009)

Although the state has vast natural rangelands, it suffers from acute shortage of feed resources, especially in a period of prolonged dry season from January to mid-July, with less pasture and the deterioration of the nutritional value, so it is important to know the impact of the dry season on the performance of the animal to put the necessary measures to address in order to ensure optimal productivity and sustainability.

MATERIALS AND METHODS

The Study Area

This study was conducted in North Kordofan State which lies between latitudes 11°:20'-16°:36'N and longitudes 27°:13'-32°:24'E. The grazing trial was done at Errahad area 80 KM south East of Elobeid the capital of state. While: *In vitro* digestibility was undertaken at range-livestock research laboratory, El-Obeid Agricultural Research Station. Selected samples were analyzed for CF, CP and minerals (P, K, I, Na, Mn) according to (AOAC, 1990).

In vitro Digestibility

The method used in this study was done according to Tilley and Terry (1963). 250 mg from each sample were taken to a 50ml centrifuge tube. Ten ml of buffer-nutrient solution were added to them. The contents were then gently mixed. The tubes were allowed to stand at 39°C for a short period to permit saturation of the

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substrate. The rumen fluid was filtered through two layers of cheese cloth to remove detached fragments then kept in thermos ready for incubation. The ph of the buffer-nutrient solution was carefully maintained at 6.8-7.0. Five ml of rumen fluid inoculums were added to each tube, and then the tube surface was flushed with CO_2 for approximately 10 seconds before stopped with gas release valve, and then incubated at 39°C for 48 hours. The tubes were gently rotated approximately 2, 4, 20, and 28 hours after initiation of incubation to disperse the forage particles. After 48 hours incubation 1ml $HgCl_2$ solution, 2ml of Sodium carbonate solution were added, and then centrifuged for 15 min at 2000 x gravity to sediment the suspended dry matter. Then 25 ml of acid-pepsin solution were added and mixed gently rotated to re-suspend the residue at approx, 2, 4, 20, and 48 hours after the beginning of incubation. After 48 hours, the tube contents were filtered through tarred fritted glass crucibles, and then dried to a constant weight at 102°C. The residue retained on the filter is indigestible dry matter; crucibles were weighted after cooling in desiccators. Then *In vitro* dry matter and organic matter digestibility were calculated using the following formula.

In vitro dry matter digestibility (IVDM) =

100 x Sample DM-(Resid.DM Sample – Mean.resid DM inco.blank) X100
Sample DM

In vitro Organic matter digestibility ((IVOMD)) =

100 x Sample OM-(Resid.OM Sample – Mean.resid OM inco.blank) X100
Sample OM

In vitro dry matter digestibility (IVDM) =

100 x SAmple DM-(Resid.DM Sample – Mean.resid DM inco.blank) X100
Sample DM

In vitro Organic matter digestibility ((MVOMD)) =

100 x _S`mple OM-(ResidnOM_Sa.ple – Mean.resid oM incox100
Sample OM

Grazing trial

Ten rams of same breed (Hamari) and similar age (12 months) were allowed to graze for 90 days for three grazing periods. The rams were treated against internal and external parasites using ivomec drug (dose 0.5 ml/head). Rams allowed to graze under traditional grazing system .The treated animals were watered once every two days.

Body weights were recorded at 30 days intervals. The animals were weighed at the beginning of the experiment and monthly to the end of the experimental period. Parameters measured were body weight. The trial Lasted for three months (90 days).

RESULTS

Chemical analysis of selected range vegetation

Table 1 displays chemical composition and minerals content of over- and understory vegetation. The understory vegetation analyzed included the grasses *Cenchrus biflorus* (Huskneet), *Fimbristylis dichtomo* (Um fissiat), *Eragrostis tremula* (Banu) and *Aristida sp* (Gaw), and the legumes *Zornia glochidiata* (lisseg), *Zalea pentandra* (Rab'a), *Crotalaria pycnosthya* (tagtaga), while the overstorey vegetation included the dominant trees.

Zornia glochidiata (lisseg), *Cenchrus biflorus* (Huskneet) and *Fimbristylis dichtomo* (fissiat) had the highest crude fiber content (41%, 40% and 38%, respectively) while *Eragorstis tremula* (Banu) and *Zalea pentandra* (Rab'a) *Crotalaria pycnosthya* (tagtaga) recorded the highest crude protein content (11%). *Fimbristylis dichtomo* (fissiat), *Cenchrus biflorus* (Huskneet), *Eragrostis tremula* (Banu) and *Aristida sp* (Gaw) had the lowest crude protein content (6.2 %, 6.7%, 6.8%, and 6.6%, respectively).

Acacia Senegal (Hashab) had the highest crude protein (7%) and CF (31%) while *Ziziphus spina-christi* (sidir) contained the lowest CP and CF content with the other two trees recording intermediate contents

Table 1 showed that the phosphorus content was 0.0149 ppm for *Fimbristylis dichtomo* (fissiat) while *Zalea pentandra* (Rab'a), *Aristida* sp (Gaw) and *Eragorstis tremula* (Banu) were 0.097ppm, 0.08 ppm and 0.075 ppm, respectively. Table(6) also showed that the potassium content was 0.063 ppm for *Eragorstis tremula (Banu)* while *Fimbristylis dichtomo* (fissiat), Aristida sp. (Gaw) and *Zalea pentandra* (Rab'a) were 0.055, 0.045 and 0.020 p.p.m, respectively. For Iodine content *Zalea pentandra* (Rab'a) and Aristida sp (Gaw), showed high content of 2.9 and 2.8 ppm, respectively, while *Fimbristylis dichtomo* (fissiat) and *Eragorstis tremula (Banu)* were 1.95 and 1.88 ppm,

In vitro digestibility for some selected grasses

Table 1 illustrate the In *vitro* digestibility (DM and OM) for the grasses *Aristida sp* (Gaw), *Eragorstis tremula* (Banu), *Cenchrus biflorus* (Huskneet), *Crotalaria pycnosthya* (Tgtaga) and *Zalea pentandra* (Rab'a) The in vitro dry matter digestibility of *Zornia glochidiata* was higher than that other grasses (59%) followed by *Cenchrus biflorus* (55), while *Fimbristylis dichotomo*, *Eragorositis termula* and *Aristida sp* had respective values of 52, 52 and 50%. Again *in vitro* OM digestibility for *Zornia glochidiata* was the highest (62%) followed by *Fimbristylis dichotomo* (61%) and *Cenchrus biflorus* (60%), while *Eragorostis termula* and *Aristida sp* had the lowest *In vitro* OM digestibility (58 and 56%, respectively).

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Ram performance under different grazing periods

Table 2 shows ram performance under different grazing periods. The highest body weight gain was recorded after 30 days from grazing (first period, 3.9 kg) while the second and third periods weight change were 1.03 kg and -1.52 kg, respectively. The results indicated that there were significant differences in body weight gain between periods ($P<0.05$). The body weight gain declined at second and third periods.

DISCUSSION

Chemical Analysis and Nutritive Value of Rangeland Vegetation

In this study it was observed that Zornia glochidiata (lisseg), Cenchrus biflorus and Fimbristylis dichtomo (fissiat) had high crude fiber content while Eragrostis termula, Zalea pentandra (Rab'a) and Crotalariat pycnosthya (tagtaga) had crude fiber content of 37, 37, 35%, respectively. Zalea pentandra (Rab'a) had high crude protein content of 11% while Fimbristylis dichtomo (fissiat), Cenchrus biflorus (Huskneet), Eragoristis tremula (Banu) and Aristida sp. (Gaw) had crude protein content of 6.2, 6.7, 6.8 and 6.6%, respectively. This means that the Crude Protein of these grasses is sufficient for maintenance (Milledford and Mison, 1954). A critical value of about 3.6% crude proteins in feed is required (NRC, 1981), below which the apparent crude protein digestibility declines. It was obvious from the analysis that these species were not poor in nutritive value although they grow in the semi arid areas. However, the most critical time for livestock in the area is the dry season (Feb-June) when the nutritive value of range grasses decline sharply and reach CP levels of below 2% (El-Hag and El Wakeel, 1998).

Acacia Senegal (Hashab) had crude protein and crude fiber contents of 7% and 31%, respectively, while Ziziphus spina-christi (sidir) had respective values of 5 and 31%. Other trees in the two studied zones had values lying between these means. Trees and shrubs are estimated to contribute 20-30% of livestock feed sources in greater Kordofan (Darag and Suliman, 1988).

The dry matter digestibility of Zornia glochidiata (legume) was significantly higher compared with other selected grasses (Fimbristylis, dichotomo, Cenchrus biflorus, Eragorositis termula and Aristida). No significant differences among the in vitro DM and OM digestibility of the grasses were found. This was expected due to the fact that these grasses belong to the same family with almost similar fiber content which is the main factor contributing to in vitro digestibility. Minson (1971) and Kalmbachr et al. (1980) reported that the organic matter digestibility decreased with decrease in leaf percentage and increased with age. These results agreed with Mc Donald and Whitten bury (1973), who reported a range of 50-80% organic matter digestibility for young grasses.

Mineral content for the dominant plants

Range plants in the area had lower mineral contents. This necessitates provision of supplementary mineral sources for livestock grazing these rangelands. K deficiency affecting the normal growth, also Tetanus symptoms will be observed. These deficiencies might be one of the major causes of the lower animal productivity in these areas. Iodine deficiency would lead to Endemic-goiter, reproductive failure, death and hairless of embryos. Also, toxic symptoms can be observed for calves of 100 kg wt when an iodine concentration of 500 mg/kg was offered Wilson (1980).

In vitro digestibility

The dry matter digestibility of *Zornia glochidiata* (legume) was significantly different compared with other selected grasses (*Fimbristylis, dichotomo Cenchrus biflorus*, *Eragorostis termula* and *Aristida sp.*), while the dry matter digestibility for grasses were not significantly different.

This may be attributed to the fact that, they belong to the same family with almost similar fiber content which is the main factor contributing to *in vitro* efficiency. In addition to the low protein content in the four grasses which was nearly similar.

The value for organic matter digestibility, for *Zornia glochidiata* was higher than the other selected grasses (*Fimbristylis dichotomo Cenchrus biflorus*, *Eragorositis termula* and *Aristida sp.*). This may be attributed to the differences of the mineral content. These results agreed with Mc Donald and Whitten bury (1973), the range of the organic matter digestibility of young grasses is between 50-85%.

Ram Performance under different grazing periods

Ram weight gain declined progressively with advancing dry season. Rams gained weight during the first period but the rate of gain during the second consecutive period was very low whereas rams lost weight during the third period. This may be attributed to high quality and quantity of forage during the first period of grazing. High quality forage may decline due to the selective grazing in the first period therefore decreasing in body weight for the second period, and negative body weight for the third period. Ellis and Swift (1988) stated that diet quality drops to maintenance level by the mid-dry season, and loss of condition, reduction of production continue for several months until the following rainy season. Wilson (1991) concluded that livestock production systems in Africa are influenced by the annual rainfall and its effect on main vegetation characteristics. Based on the findings it can be concluded that: Supplementary feeding is needed to overcome the prolonged dry season (January-July) in the term of concentrates and mineral sources. Strategically storage for forages should be considered when planning to reduce gaps of forage.

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Table 1 - Proximate chemical composition (%DM-basis) and *In vitro* digestibility of Range vegetation

Species dominant grasses	CP %	CF %	DM %	ASH %	E.E %	NFE %	P ppm	K ppm	I ppm	IVDMD %	IVOMD %
Aristida sp (Gaw)	6.2	38.8	93	7	1.2	46.7	0.08	0.05	2.8	50	56
Eragrositis tremula (Banu)	6.8	37	94.2	7.8	2.2	46.2	0.075	0.06	1.88	52	58
*Cenchrus*ai_ biflorus (Huskneet)	6	40	93.7	13	1.5	38.8	-	-	-	55	60
Zalea pentandra (Rab'a)	11	37	84	13	2.3	36.7	0.097	0.02	2.9	-	-
Zornia glochidiata (lisseg)	9	41	81	11	1.2	37.7	-	-	-	59	62
Crotalariat pycnosthya(gtaga)	10	35	80	11	2.2	37.8	-	-	-	-	-
Fimbristylis dichtomo (fisyat)	6.2	39	94	10	1.1	43.7	0.15	0.06	1.95	52	61
Dominant trees:						-	-	-	-	-	-
Balanites aegyptiaca (higleeg)	5.2	31	93.5	7.6	0.8	55.4	-	-	-	-	-
Acacia Senegal (Hashab)	7	31	93.7	8	0.7	53.3	-	-	-	-	-
Acacia tortillas (Seyal)	5.7	30.5	94.5	7	0.4	56.9	-	-	-	-	-
Ziziphus-spainna-christi (sidir)	5	31	93.4	7.5	0.9	55.6	-	-	-	-	-
Leptadenya pyrotechnica	5.1	33	94	8.1	0.54	53.3	-	-	-		-

Table 2 - Ram performance during different grazing periods

Parameter	1st period	2nd period	3rd period	SE±
No. of rams	10	10	10	0
Days on test	30	60	90	0.57
Av. initial body wt (kg)	35.34	36.6	35.5	0.39
Av. final body wt (kg)	36.6	35.5	33.93	1.58
Total wt change (kg)	3.9	-1.52	-1.57	1.58
Daily wt change (kg)	0.13	0.51	-.052	1.23
Av. Initial metabolic body wt ($wt^{0.75}$)	18.8	19.34	18.9	1.21
Av. Final metabolic body wt ($wt^{0.75}$)	19.3	18.9	18.27	0.44
Total $wt^{0.75}$ wt change	2.7	1.37	-1.40	1.2
Daily $wt^{0.75}$ wt change	0.22	0.60	-61	20.13

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SOME HEMATOLOGICAL VALUES FOR CAPTIVE GAZELLA DORCAS

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ORIGINAL ARTICLE

ABSTRACT: *Normal mean values for Hemoglobin, packed cell volume, red blood cell count, white blood cell count, erythrocyte sedimentation rate, were obtained from blood of six males and nine females Gazelle Dorcas. Males had significantly higher values for white blood cell count, and had significantly lower values for red blood cell count than the females. The rest of the parameters were not significantly different between the two sexes. With the exception of the correlation between red blood cell and the packed cell volume, were insignificant.*

Key words: *Hematology, Values, Count, Blood, Gazella dorcas*

INTRODUCTION

Reference intervals for hematological and blood chemical constituents were reported for different species of gazelles including Dorcas gazelle, *Gazella dorcas*, Grant gazelle, *Gazella granti*, Cuvieri gazelle, *Gazella cuvieri,* Thomson's *gazelle*, *thomson*i, Speke's gazelle, *Gazella spekei* and Dama gazelle, *Gazella dama* (ElNabi et al., 2009).

Reference ranges for hematology and blood chemistry were also investigated in captive mountain (Gazella Gazella) and sand (*Gazella subgutturosa marica*) gazelles in Saudi Arabia (Mohamed et al., 2010) along with data on their blood coagulation and platelet parameters (ElNabi et al., 2009; Hussein et al., 2010a,b).

Knowledge of these variables is important as an aid for the diagnosis and prognosis of diseases and for assessing the health status of these animals and their ability to sustain he stressful conditions of desert life (ElNabi et al., 2009; Mohammed et al., 2010).

Cloudsely-Thompson and Ghobrial (1965) outlined the physiological basis for survival of G*azella* d*orcas* (= *Dorcas gazelle*) in captivity. The effect of seasonality on blood urea, haemoglobin content (Hb), packed cell volume (PCV), red blood cell (RBC) count, and plasma protein and serum electrolytes of *G. dorcas* were investigated by Ghobrial (1967). Hawkey et al. (1980) studied the impact of quick capture on the circulting erythrocytes in captive zoo animals including gazelles and related the increase in circulating erythrocytes to splenic concentration and to the significant decrease in erythrocyte size and Hb content.

The objective of this study was to establish reference ranges for hematology in healthy male and female Dorcas gazelles. These data are needed for future reference to evaluate the physiological status, pathophysiology and clinical aspects of this species.The interest in game ranching and its oriented export trade in Sudan prompted this work to provide the basic haematological and serum chemical values for captive *G. dorcas.*

MATERIAL AND METHODS

Animals: six male and nine female Dorcas gazelles, aged 2-3 years were investigated between February and March, 2012. The animals were part of a herd of 30 gazelles currently kept in Soba farm Southern of Khartoum, Sudan. Their founder population comprised 15 male and 15 female gazelles originally obtained from private collections in the Sudan. They were housed in an animal enclosure and some were kept in breeding pens. They were vaccinated against enzootic infectious diseases and given coccidiostats and anthelminthics as necessary. Feeding consisted of a balanced diet of commercial concentrate (16% protein) with free access to water and mineral salt licks. All of the studied animals were checked by a wildlife veterinarian and found to be clinically normal and none of the adult females was pregnant at the time of sampling.

Sampling

Blood samples were collected in heparinized tubes from the jugular vein using disposable syringes. Haematological analyses were carried out according to the methods of Dacie and Lewis (1984) and included

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determination of haemoglobin concentration (Hb), packed cell volume (PCV), red blood cell (RBC) count, white blood cell (WBC) count, erythrocyte sedimentation rate (ESR), (Varley, 1986).

RESULTS

The Table 1 showed the hematological values for Dorcas gazelles. Table 2 showed the differential count of the blood of Gazella dorcas.

Table 1 - Mean±SD of some Haematological values of the Blood of Gazella dorcas

	Males (N=6)	Females (N=9)
Parameters	M±SD	M±SD
PCV%	31.14±4.45	31.25±3.53
Hb%	12.94±1.95	12.81±1.61
TWBS(per/µL)	5.38±.762	5.88±1.04
RBS10^{12}/L	7.78±.636	7.26±1.01
ESR mm/hour	0	0

Table 2 - The Differential count of WBcs of the blood of Gazella dorcas

	Males (N=6)	Females(N=9)
Parameters	M±SD	M±SD
lymphocytes	65.16±3.06	65.55±2.78
Neutrophil	29.33±1.50	28.33±2.00
Eosinophil	3.83±1.16	3.88±0.781
Monocyte	1.50±.83	2.00±0.50
Basophile	0.16±0.40	0.33±0.50

DISCUSSION

There is very few blood data published in wild animals in Africa. The blood obtain from wild animals they most either be shot or immobilized. Most data are within limit reports by Fay. The blood picture was influenced in some animals by the environmental factors especially warthog. Other factors influenced in blood pictures like: age, sex, pregnancy or lactation (Bush M, Smith E E and Custer R S (1981).

Statistical analysis (Table 1) showed insignificant differences between sex in WBC (5.38±0.762), (5.88±1.04) in male and female respectively and RBC (7.78±.636), (7.26±1.01) in male and female respectively.

Means and ranges of hematological parameters are shown in Table 1 and 2, respectively. Mean RBC, HB, PCV, WBC, ESR, and TDC values were similar in male and female gazelles. Lymphocytes constituted the most predominant type of leucocytes (40-60%) in these gazelles and had significantly (P≤0.05) higher value in female as compared to male gazelles and consequently, TLC was also significantly (P≤0.05) higher in female as compared to male gazelles (Table 2).

However, insignificant differences in PCV, Hb and ESR were found between both males and females *G. dorcas*. Rietherk et al. (1994) observed significant differences between sex in Hb but not in PCV in *G. gazella*. The PCV% of *G. dorcas* is comparable to that recorded in Gazella mhorr (47.40±5.54) and *Gazella cuvier* (47.30± 2.66) by Abaigar (1993). The RBC, WBC and Hb values were slightly higher than those recorded by Abaigar (1993) in *G. mhorr* and *G. cuvier*. In *G. cuvier*, the Hb value was slightly higher than that of *G. mhorr*. The haemoglobin concentration tended to be higher in males than females but fluctuated in the same animal. This might be related to release into the blood of newly produced rythrocytes. Mohamed (2001) suggested that during tense erythrogenesis many immature RBC are released into peripheral blood. The differences in PCV value between male and female *G.dorcas*, although statistically insignificant, are in harmony with the sex related diffrences in RBC. The RBC and the PCV values were found to be higher in males and tended to increase with age (Abaigar, 1993). According to Bush et al. (1981), the RBC count varies with age, sex, physiological state, temperature, time of the day and season. The ESR, an indicator of the well-being of an organism, was similar in male and female of *G. dorcas*.

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COMMUNAL LIVESTOCK PRODUCTION IN SIMBE, GOKWE SOUTH DISTRICT OF ZIMBABWE

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ABSTRACT: *Communal livestock production systems are dynamic being responsive to changes in the socio-political and economic environments. A survey was conducted in Simbe communal area of Gokwe South District in Zimbabwe, to assess current livestock production systems. Five villages and 3 wards were randomly selected and a semi-structured questionnaire administered by 5 trained enumerators to collect data on; house-hold demographics, livestock species kept and their numbers, uses of livestock and waste, feeding and watering as well as livestock health management. Data were analysed using the Statistical Package for the Social Sciences (SPSS) version 16. It was observed that farmers in the study area kept a wide range of livestock species including; poultry (notably; chickens, ducks, turkeys and guinea fowls), goats, cattle, donkeys and pigs. Cattle and goats were the major sources of draught power and income, respectively. Farmers indicated that they faced challenges in feeding and watering their animals during the dry season. Diseases were the major cause of offspring mortality in most animal species while predation was the major cause in chickens. It was recommended that farmers acquire education on production and improve on health and general management.*

Key words: *Livestock, Draught Power, Dry Season, Cattle, Manure, Natural Veld*

ORIGINAL ARTICLE

INTRODUCTION

Livestock production is the most important agricultural activity in most of the countries in Southern Africa (Mamabolo and Webb, 2005). Around 70% of the human population of Sub-Saharan Africa (SSA) are primarily or partly dependent on livestock (Lenné and Thomas, 2006). Livestock account for 53% of the agricultural capital stock in Sub-Saharan Africa (SSA) and contribute by 30% to agricultural gross domestic product (GDP) (NEPAD, 2005). According to FAO (2001), agriculture is the mainstay of the national economy accounting for about 15 to 20 percent of the GDP in Zimbabwe, providing income and employment for a substantial percentage of the population. Paradoxically, the majority (74%) of communal farmland is on inherently infertile sandy soils in marginal areas characterised by low and erratic rainfall (Gambiza and Nyama, 2000).

Communal livestock productivity is therefore very poor, owing to the above, among other factors. In addition to poor soils, most crop-livestock production relies directly on rainfall, and adverse changes in quantity and temporal patterns of rainfall are a major risk to production (Masikati, 2010). Feed shortages especially during the dry season therefore constitute a serious challenge to communal livestock production (Masikati, 2010). Communal livestock production largely relies on the natural veld for feed. Due to the seasonality of rainfall in Zimbabwe, there are wide variations in the quantity and quality of these natural pastures following the seasonal rainfall distribution (Sibanda, 1986).

Agricultural production systems in the semi-arid tropics have been assessed over a long period of time. Although a wealth of knowledge on this subject exists, production systems are dynamic. The climatic and socioeconomic changes occurring in many parts of the region are rapidly transforming traditional, extensive crop and livestock management practices (Masikati, 2010). Changes and shifts in production systems occur in response to the changing environment, socio-economic and political systems among other factors. As such, agricultural production systems as currently practiced by farmers in the semi-arid tropics of sub-Saharan Africa are different from those used in the past (Masikati, 2010). In order to ensure meaningful research interventions, it is therefore essential to undertake an appropriate assessment of the current crop-livestock farming systems (Masikati, 2010). The main aim of this study was therefore, to assess current livestock production systems in Simbe communal area of Gokwe South district in Zimbabwe.

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MATERIALS AND METHODS

Study site

Gokwe is the largest district in Zimbabwe in terms of area and lies to the north-west part of the country. It is in the Midlands province in the country's agro-ecological region III. Mean annual rainfall in the region ranges between 600 to 650 mm. Most of the rainfall is experienced during the period from November to February. December and July are the wettest and driest months, respectively. The weather station is at about 18.22°S 28.90°E and at an altitude of about 1 282 m. The area is characterized by predominantly sandy soils and the most common land tenure system is communal with a few resettlement schemes in places (Gwimbi and Mundonga, 2010).

Selection of sampling units

Sampling units in the target population were hierarchal in nature, where in the highest level were wards, followed by villages and then households. The multistage sampling procedure was used to come up with the participants in the survey. Three wards (wards 1, 2 and 3) were randomly selected followed by a random selection of 5 villages per ward. Four households were randomly selected from each village to participate in the study. Sampling frames for the wards, villages and households were obtained from the chief, headmen and village heads, respectively.

Data collection and analyses

Semi-structured questionnaire and interviews: A survey was conducted in Simbe communal area of Gokwe South District. Semi-structured questionnaires and interviews with farmers were used to collect data. The questionnaire was designed to capture the following;

Demographics: Demographic details were captured. These included; name of the village, sex of the respondent, age and level of training attained by the respondent, his/her farming experience, house-hold size, sex of head of household and the house-hold age distribution.

Livestock production

Farmers were interviewed on production practices. Data collected on this aspect included; species kept, relative importance to livelihood, use of livestock, identification of constraints on production and their possible solutions, drought coping and mitigation strategies, management practices (feeding, watering and health provision) as well as draught power status and needs.

Focus group discussions and literature review

Focus group discussions were also used to collect semi-structured data. A set of purposively selected farmers would gather together with the researcher to discuss issues and concerns based on a list of key aspects influencing livestock management practices in the area. A review of literature was also employed to complement the questionnaire as the main mode of data collection. Data were analysed using the Statistical Package for Social Sciences (SPSS) version 16.

RESULTS AND DISCUSSION

Livestock species and flock/herd size

Farmers in Simbe communal area kept various livestock species including; chickens, cattle, goats, sheep and turkeys (Figure 1) to name a few. Indigenous chickens were the most numerous and common species kept. Flock sizes ranged from 3 to 80 birds per house-hold and the mean flock size was 16. The mean observed in the study is similar to observations in earlier studies (17.5) in Rushinga (Muchadeyi et al., 2004). This is slightly contrary to findings by other researchers who recorded means of 22.7 and 20.7 for Gutu and Zhombe communal areas, respectively (Masimba et al., 2011; Mlambo et al., 2011). However, the range observed in this study is generally similar to 2 – 75 observed in Zhombe (Mlambo et al., 2011). Cattle were the second most numerous livestock species kept in Simbe communal area. The mean herd size observed was 8.1 with a range of 3 to 30 cattle per house-hold. The mean is close to 9.1 recorded for Chikombedzi (Scoones and Wolmer, 2000).

Uses of livestock

According to Figure 2, cattle played a vital role as a source of draught power for 96% of the house-holds interviewed. Christensen and Zindi (1991), stated that ownership of less than 4 cattle is considered as inadequate access to draught power. Most of the house-holds in Simbe communal area, however, had sufficient access to draught power as shown by the mean herd size of 8.1 (Figure 1). This is higher than the mean recorded for Masvingo and Sanyati (3.6) (Ndlovu et al., 2004). However, herd sizes ranged between 3 – 30 cattle per house-hold, suggesting that some of the farmers interviewed had insufficient access to draught power (Christensen and Zindi, 1991). Donkeys seemed to be an alternative source of draught power as reported by 25% of house-holds having a very low average herd size (0.37) per house-hold. This is in sharp contrast with observations by Ndlovu and co-workers (2004) who stated that five to seven donkeys is the most common holding. Ndlovu and co-workers (2004),

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however noted that cattle are the major source of draught power in the communal areas of Zimbabwe whereas donkeys are an important source of supplementary draught power. Despite the extremely low average herd size for donkeys in this study, their contribution as a source of draught power was quite significant as reported by 25% of house-holds in Simbe communal area. It is likely that the 4% that did not use cattle draught power used donkeys to pull implements requiring traction force.

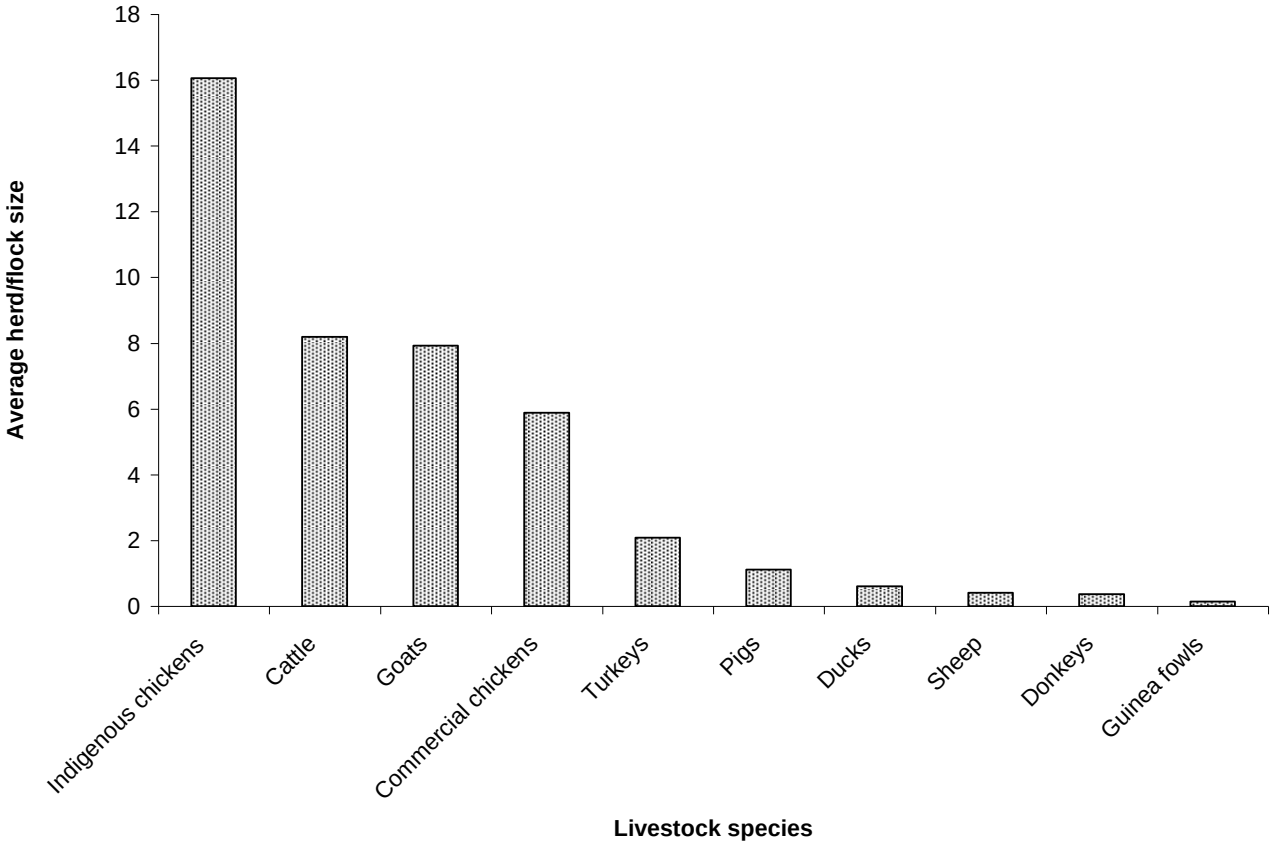

Figure 1 - Livestock species and mean numbers per house-hold in Simbe

Indigenous chickens showed numerical dominance over cattle, however the latter played a wider range of critical roles in the livelihoods of Simbe communal farmers being a very important source of draught power (96%), manure (94%), milk (90.2%), meat (60.8%) and their use in various cultural activities (29.4%) including payment of bride price. This agrees with observations by Mavedzenge et al. (2006) and Peeling and Holden (2004) who stated that cattle in the communal areas have multiple uses – for draught power, transport, milk, manure, savings, bride-wealth payments, and that meat and hides were terminal products obtained at the end of their productive life. Dovie and co-workers (2006) reported that using animals for ploughing was the most valued benefit.

Elsewhere, it was noted that cattle production is the most important livestock subsector in South Africa (Musemwa et al., 2008). Goat flock sizes in this study averaged 7.9 per house-hold. This is contrary to observations by Mahanjana and Cronjé (2000) who recorded a mean goat flock size of 16 in the Eastern Cape region of South Africa. This study also revealed that goats are an important source of meat (78.4%) and milk (23.5%). This is in agreement with observations by Mamabolo and Webb (2005) who stated that goats primarily produce meat but also produce milk. There was evidence that goats were also used for cultural activities such as *Masungiro* (a common practice in the Shona culture in Zimbabwe).

Uses of livestock waste

Farmers in this study indicated that they obtained significant quantities of waste from cattle, sheep, goats and chickens, among other species of livestock (Figure 3). The respondents used dung from cattle as; manure (94%), a source of income (13.7%) among other uses (25.5%) including use as floor polish. The use of cattle dung as manure is quite common as observed by other researchers including; Musemwa et al. (2008), Ndlovu et al. (2004) as well as Gambiza and Nyama (2000). Musemwa et al (2008) reported that farmers in communal areas of South Africa even combined cattle waste and sold it to companies that manufacture organic fertilizers. About 80% of the farmers in Simbe used chicken waste as manure while 76.5% indicated that they used goat waste as manure. Pig waste was not very popular (7.8%) among farmers as a source of manure. This is probably because of the low mean flock sizes for pigs thus generating very low quantities of waste. Other respondents indicated that they just left waste in the kraal.

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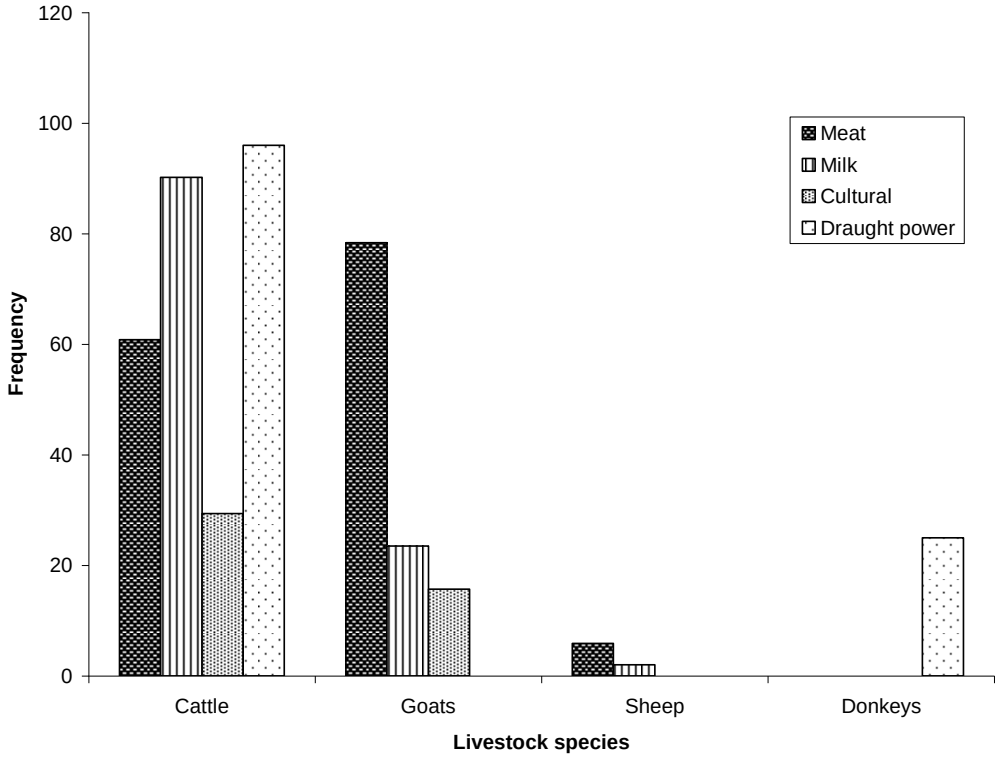

Figure 2 - Uses of some livestock species kept in Simbe

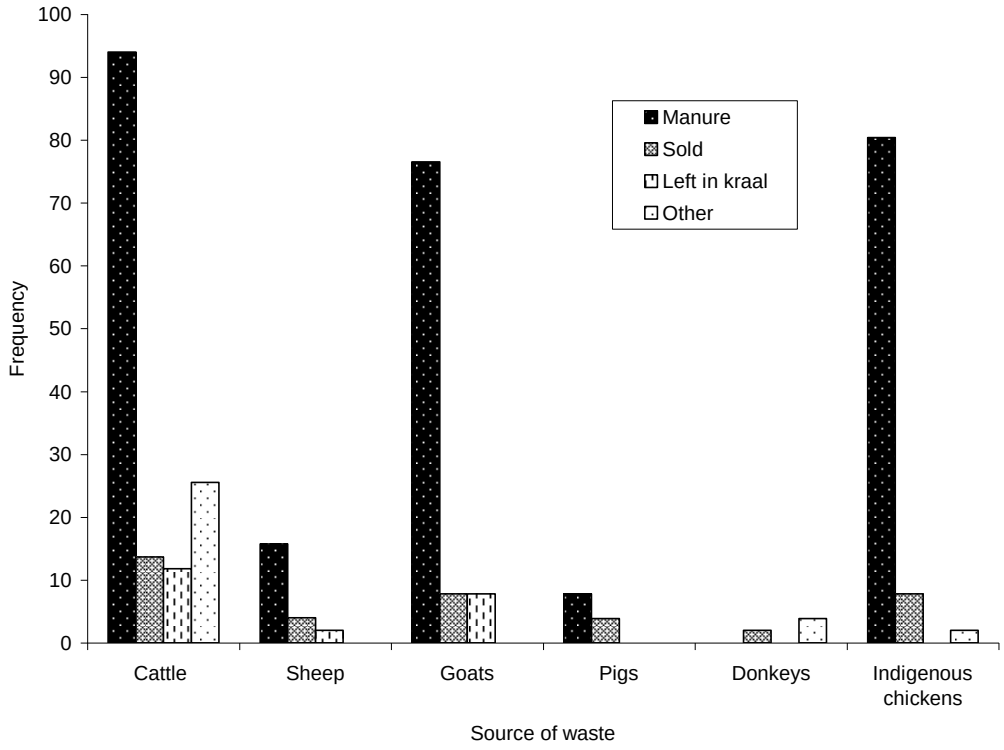

Figure 3 - Uses of livestock waste

Livestock rankings as sources of income

Crops were ranked higher than livestock as sources of income in Simbe communal areas. This is in agreement with findings by Masikati (2010) in Nkayi where crop production was ranked high in terms of importance. Masikati argued that crop production was necessary for both subsistence and cash income (Masikati, 2010). However, the contribution of livestock towards generating income for house-holds in Simbe was quite evident. Goats were assigned the highest (29.4%) rank as a source of income among livestock species kept in Simbe (Figure 4). This confirms observations by Masikati (2010) who stated that farmers keep cattle mainly for

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draught power and milk, while goats are for cash income. This is attributed to their fast turn-over and salability compared to cattle (Shumba, 1994). According to Shumba (1994), advantages of goat production include: high profitability and fast turnover due to earlier maturity and shorter generation interval; suitable meat quantities for rural families and easy salability among other factors. Mahanjana and Cronje (2000) noted that the main reasons given for keeping goats in a study in South Africa were for slaughter during traditional ceremonies (35%) and for cash sales (23%). Goats were also more important than sheep as a source of income in this study. Their dominace over sheep confirms observattions by Mamabolo and Webb (2005), who reported that goats are generally more prolific and easier to manage than sheep for people with little animal management experience such as in most communal areas. The second most important source of income among livestock was chicken production, followed by cattle. This is only logical given that chickens are very important as a source of meat for house-hold consumption hence less popular as a source of income. However, they are also more easily disposable compared to cattle whose ownership patterns can be very complicated, compounded by the various roles played by the latter, including draught power provision.

Feeding and watering

The natural veld was the most common source of feed for livestock as reported by most respondents in Simbe. About 88% of the respondents stated that they relied mostly on the natural veld for feeding their cattle herds. This observation is in tandem with observations by Sibanda (1986) and Ndlovu and Sibanda (1991). Use of crop residues was also reported by farmers in the Simbe communal area. It has been documented that this practice is quite common in many crop-livestock systems. For example, the practice was noted in Ethiopia, Mali and Zimbabwe (Scoones and Wolmer, 2000). The crop residue most readily available and utilized was maize stover, an observation also supported by other researchers (Lukuyu et al., 2009; Sibanda, 1986; Masikati, 2010). This was mainly fed to cattle especially in the dry season. This indicates the existence of integration between crops and livestock production in the rural areas as evidenced by the use of cattle and donkeys as sources of draught power while residues are fed to animals. Masikati (2010) also noted that integrated crop-livestock farming is the predominant system of production and subsistence in communal farming systems of Zimbabwe. According to Masikati (2010), a few farmers used crop residues to mitigate feed shortages and residues used were fed untreated, thus they were of low nutritional value to animals.

Most farmers in the study area used perennial rivers (51%) followed by dams/ponds (25.5%), boreholes (9.8%) and seasonal rivers (5.8%) as sources of water for their livestock herds (Figure 5). Other sources, though less common, included open and protected wells as well as springs.

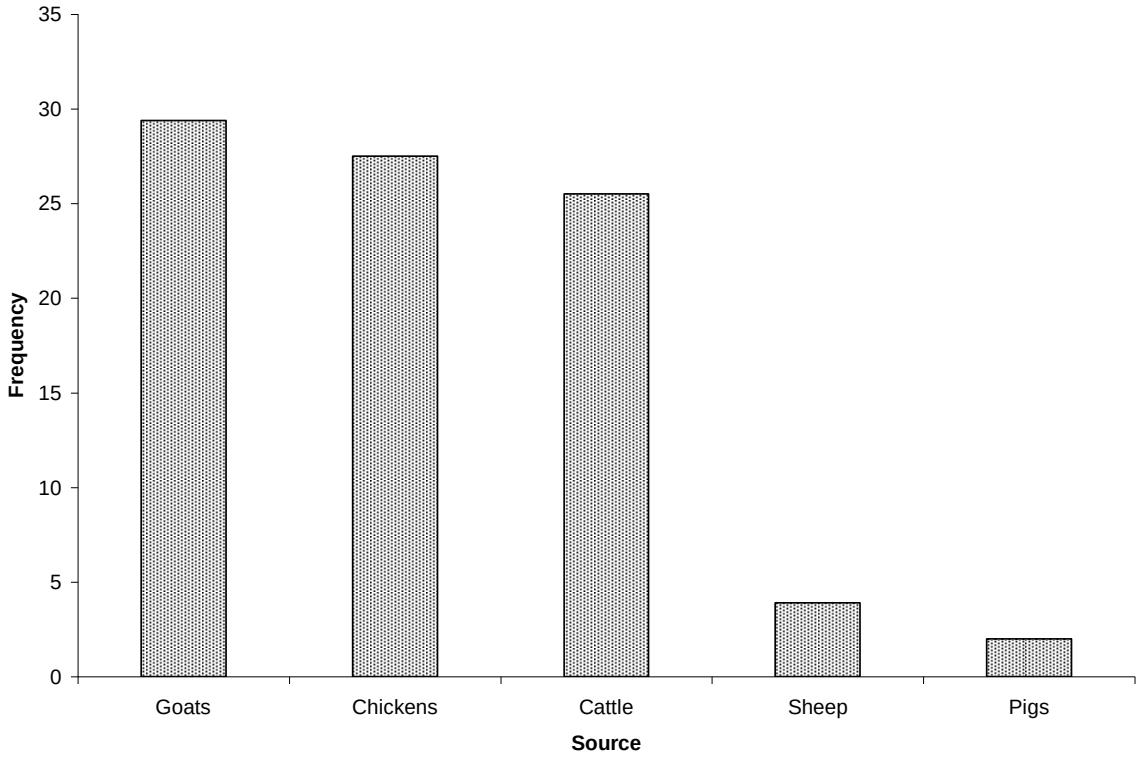

Figure 4 - Rankings for livestock species as sources of income

Feeding and watering

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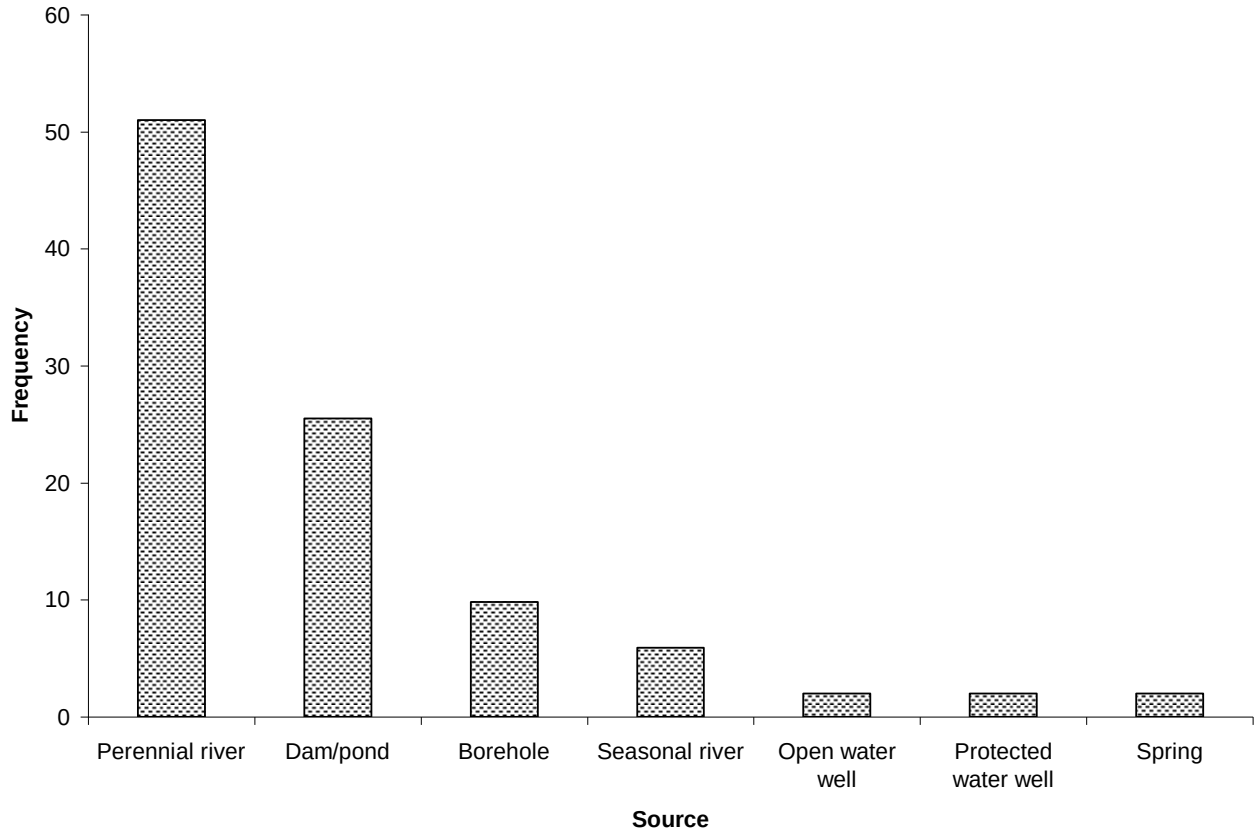

Figure 5 - Common sources of water for livestock in Simbe communal area

Distance to watering point

Most of the farmers in Simbe agreed that the provision of water for livestock was indeed essential. There was seasonal variation both in availability as well as distance to water source. Only about 4% of the respondents indicated that they had water right at their house-holds during the dry season compared to 21.6% during the wet season (Figure 6). About 51% showed that water sources were within 1 km from their homestead during the wet season against 25.5% during the dry season. Most respondents (64.7%) in Simbe indicated that they had to cover up to 5 km to water their livestock during the dry season. However, only about 4% had to cover between 6 and 10 km to water their animals (Figure 6). It is also shown in this study that such distances in search of water are only covered during the dry season. While Masikati (2010) also noted the same trend in water shortages especially in the dry season, the anomaly in comparison to this study regards maximum distance to water sources during the dry season. Masikati (2010) reported distances of up to 14 km whereas the maximum reported in Simbe was 10 km. Livestock depend on water, but when poorly managed, they contribute to the degradation and contamination of water resources. Drinking water is essential for animal survival, but the amount needed is small compared with other uses of agricultural water (Peden, 2007). Figure 7 shows that the majority of farmers watered their livestock twice a day in both the dry season (58%) and the wet season (48%). Up to 15% of the respondents watered their livestock once every 3 days during the dry season. This is probably due to the long distances that farmers and their herds would have to walk (up to 10 km, Figure 6). Masikati (2010) observed in Nkayi communal areas that farmers let their cattle drink once every 2 days.

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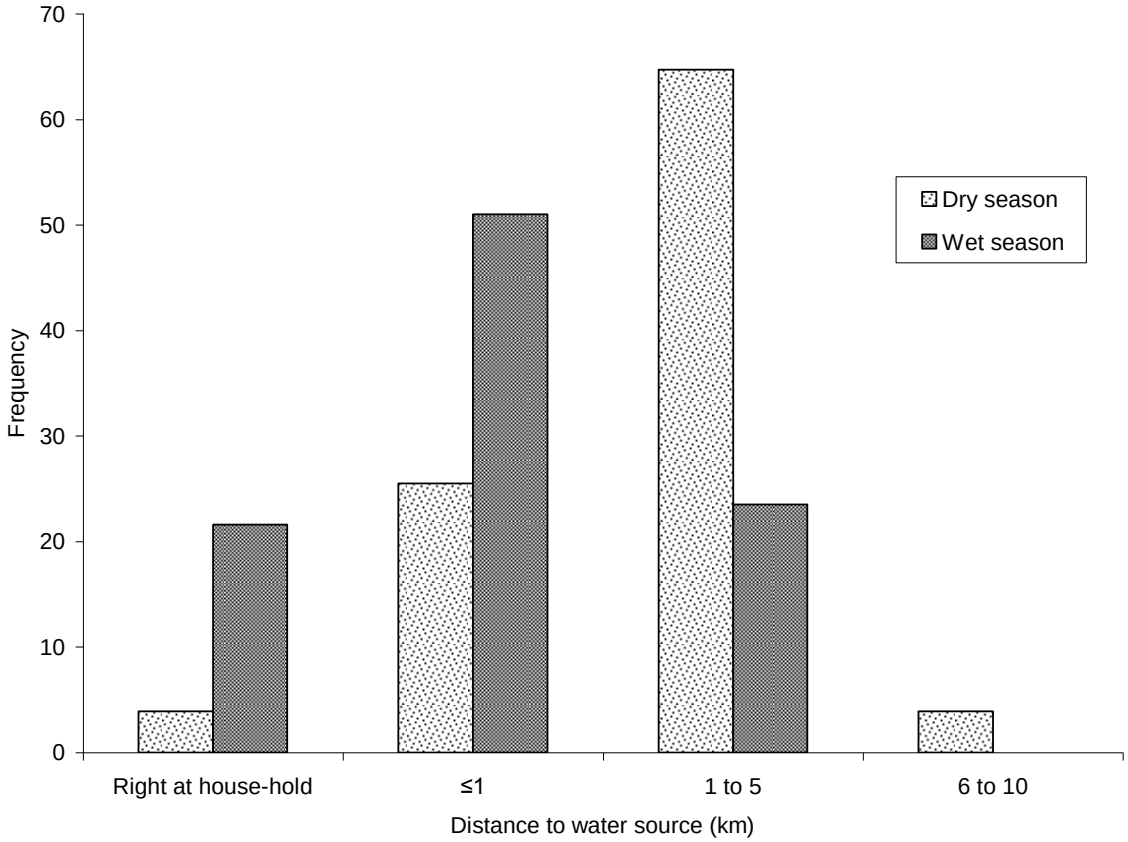

Figure 6 - Variation in distance to watering points between seasons

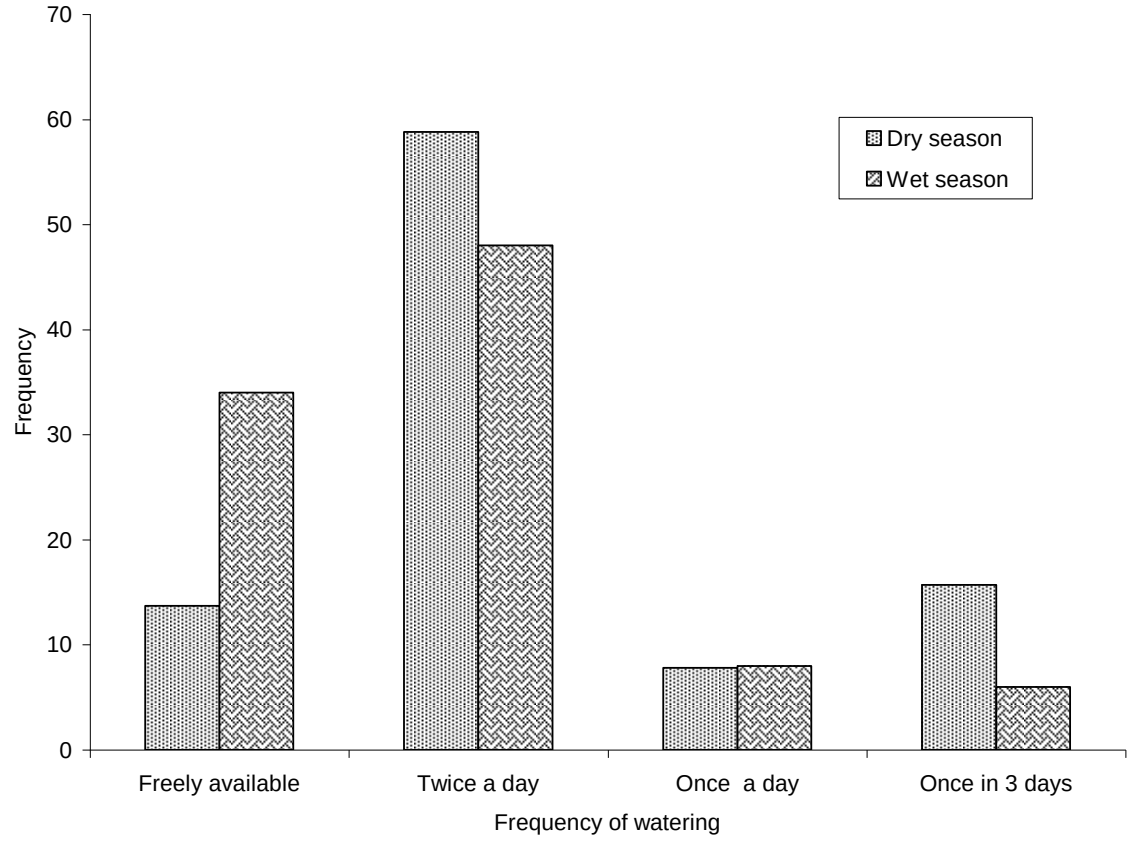

Figure 7 - Frequency of watering

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Livestock health management

About 33% of the respondents indicated that diseases were the major cause of calf mortality (Figure 7) in cattle while up to 6% of the causes of mortality in calves were unclear to the farmers. It emerged from this study that livestock species that were most prone to disease attack were cattle, goats and chickens. Other researchers agree that diseases are a major constraint to the improvement of the livestock industry in the tropics (Devendra et al., 2000) as they decrease production and increase morbidity and mortality (Mwacharo and Drucker, 2005). Turkeys and ducks were the least affected by diseases. These species are generally hardy. Despite the importance of diseases as causes of mortality, respondents were not able to positively identify disease conditions affecting their livestock. This is a common observation among communal farmers as observed in earlier research work including a study by Masimba and co-workers (2011). However, in a study that was conducted in Zhombe communal area of Zimbabwe, farmers showed a good understanding of poultry flock health and managed to positively identify diseases affecting their flocks (Mlambo et al., 2011).

Predation was the chief cause of chick mortality (33.3%) in chickens while diseases contributed (19.6%) to chick losses. Pedersen (2003) noted that, in Sanyati, 18% of the mortality in chickens was a result of diseases. It is interesting however, to note that chickens were the only species where predation occurred. This is probably due to the size of the species and production system which is predominantly extensive, exposing chicks to predators especially wild birds and small carnivores.

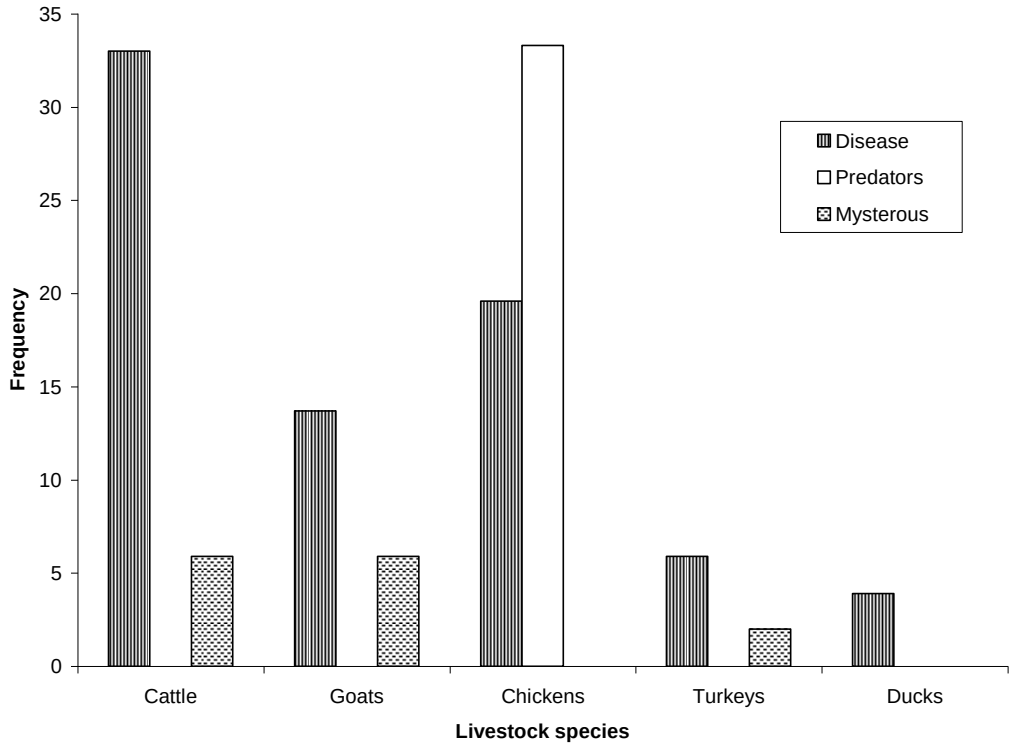

Figure 8 - common causes of offspring mortality in Simbe communal area

CONCLUSION AND RECOMMENDATIONS

Communal farmers in Simbe communal area of Gokwe South district keep a wide range of livestock species including; chickens, cattle, goats, sheep and pigs. Cattle were an important source of draught power and, with other livestock species provided; manure, milk and meat in addition to playing a variety of cultural roles. Crop production was more important as a source of house-hold income compared to livestock production. Among livestock species, goat sales were the most important source of income. Farmers relied on the natural veld for feeding their livestock. There was use of livestock waste as a source of manure for crop production, hence integration between crop and livestock production. The most common source of water for livestock was perennial rivers. Most farmers faced challenges in watering their livestock especially during the dry season and had to travel long distances in search of water.

Diseases were the major cause of offspring mortality for most species excluding chickens where predation dominated. It was recommended that communal livestock producers practice recommended disease prevention and control measures such as vaccinations and the use of antibiotics/relevant ethno-veterinary practices, respectively. Training could also go a long way in improving management practices.

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HAEMATOLOGICAL INDICES OF CAPTIVE BLACK NECK OSTRICHES

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ABSTRACT: *This study was conducted at Sudan University of Science and Technology College of Veterinary Medicine and Animal Production Department of fisheries science and wildlife in June 20 11to determine hematological values of Black Neck Ostrich Struthio Camelus massaicus collected from El Safa farm North Khartoum. Values of some hematological parameters of 14 Black Neck Ostrich 7 male and 7 female age from 3-4 year, and 70–75 kg in weight were examined to determine the mean values obtained for White Blood cells Count (WBC), Erythrocytes Count (RBC), Hemoglobin Concentration Rates (Hb), Packed Cell Volume (PCV), Mean Corpuscular Volume (MCV/cl) and Erythrocytes Sedimentation Rate (ESR). The result of this study show that there are no significant different in all blood values between samples collected from male and female at p (P<0.05), expect in Red Blood Cells (RBC) there is significant different at (P<0.05). The main target of this study is to comparison between hematological values of Black Neck Ostrich in both male and female.*

ORIGINAL ARTICLE

Key words: *Hematological, Ostrich, Parameters, Captivity, Birds*

INTRODUCTION

Clinical haematology has been used for many years in avian medicine for evaluation of health in birds. Hematological and biochemical values can be helpful in assessing infection, organ function and many diseases. The fact that physiological and pathological factors may cause qualitative and quantitative changes in hematological values makes such studies an important aspect of the diagnostic panel and of the monitoring of sick birds (Levi et al., 1989; Perelman, 1999). Qualitative and quantitative hematologic changes in ostriches depend on age, sex, different physiological and pathologic status, stress, nutrition and conditions in particular geographic areas. The results of hematologic parameters in the blood of ostriches should be strictly interpreted because they are necessary together with good anamnesis and physical examination for reaching a proper diagnosis (Perelman, 1999; Raukar, 2004).

Ostriches are peculiar flightless birds with vestigial wings and have well-developed legs. They are the largest living birds, and their adult body weight is ranging from 70 kg to 150 kg (Palomeque et al., 1991; Spinu et al., 1999). Since rapid growth and size achieved at slaughter age are important properties of ostriches, they are considered as a considerable commercial species characterised by economic advantages with relatively low costs. Moreover, ostrich meat is high in protein and low in fat, and its taste is appreciated by consumers (Minelli et al., 1995).

The hematological parameters and the levels of certain plasma metabolites may provide highly valuable information on the physiological status and allow the detection of possible diseases (Jenni-Elermann, 1998; Spinu et al., 1999). Clinical hematology and blood chemistry are known to be influenced by various factors such as diseases, nutritional status, body condition, sex, age, diet, circadian rhythms, captivity etc. (Woerpel et al., 1984; Palomeque et al., 1991; Tully et al., 1998; Spinu et al., 1999; Quintavalla et al., 2001). Therefore, determination of blood constituents for birds are not only relevant diagnostic tools in veterinary medicine, but can also be used as physiological indicators (Perelman, 1999).

The aim of the present study was to present values of certain blood hematological parameters in Black Neck Ostriches between male and female. For this purpose, some haematological parameters used as diagnostic tools in avian medicine were determined.

MATERIAL AND METHODS

Research was carried out on 14 clinically healthy 3-4 years old sexed Black Neck ostriches species *Struthio camelus massaicus* 7 male and 7 female weighted about 70-75 kg. The birds were kept in El Safa farm Northern Khartoum, Sudan at least about two year.

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hematological investigations were conducted in physiology laboratory at college of veterinary medicine and animal production in June 201 1to determining the following parameters of total number of Red Blood Cells (RBC), total number of White Blood Cells (WBC), Packed Cells Volume (PCV), ESR, Mean Corpuscular Volume Cells (MCVC) and Means Corpuscular Hemoglobin Concentration (MCHC) we collected individual samples of blood on heparin, which were processed by classical hematological techniques (5, 9). The finding data of this experiment were analyzed by T- test (student test) and SPSS version 17 as described by Comez and Comez 1984.

RESULTS

Results of total erythrocyte count (TRBC), hemoglobin concentration (Hb), hematocrit (Hct), the mean corpuscular values (MCV, MCH, MCHC) and (ESR) in blood of 14 examined old ostriches 7 male and 7 female are presented in Table 1., Figure 1 and 2.

The reported results show the following: the lowest value for erythrocyte count in female was 16.8 ±8.7^{b}/L and the highest value in male was 19.66±7.7^{a} /L. The lowest level of hemoglobin concentration (H b) was 79.3 g/L in male and the highest level was 80.03 g/L in female.

The mean value of the MCV was 8.6 fL and the standard deviation was 1.14 fL in male. The mean value for the MCV was 5.35 fL and the standard deviation was 1.5% (Table 1).

The mean value of the MCH was 31.8 pg and the standard deviation was 0.45 pg in male and mean value of the MCH was 31.8 pg and the standard deviation was 0.49 pg in female.

The mean value of the total White blood Cells(WBC) was 3010.57 and the standard deviation was 365.28 in male and the mean value of the (WBC) in female was 3013.23 and the standard deviation was 344.63.

The mean value of the PCV was 41.66 and the standard deviation was3.9 in male. The mean value for the PCV was 42.0.1 and the standard deviation was 6.1 in female (Table 1).

The mean value of the ESR was 1.36 and the standard deviation was0.45 in male. The mean value for the ESR was 1.40 and the standard deviation was 0.03 in female (Table 1).

Table 1 - Haematological values of Black Neck Ostrich samples collected from El Safa ostrich farm

Parameters	Units	Male	Female	Sig
RBC	10^{6}	19.66±7.7^{a}	16.77±8.7^{b}	*
WBC	10^{3}	3010.57±365.28	3013.00±344.63	NS
PCV	%	41.66±3.9	42.00±6.1	NS
Hb	%	79.3±3.9	80.03±3.0	NS
ESR	Mm/h	1.36±0.45	1.40±0.03	NS
MCVC	10^{-4}(cm)	8.6±1.14	5.35±1.5	NS
MCHC	%	31.8±0.45	31.80±0.49	NS

$^{a.b}$ within the same row followed by different superscript are significantly different (P≤0.05). NS: No significant, *: significant at P<0.05.

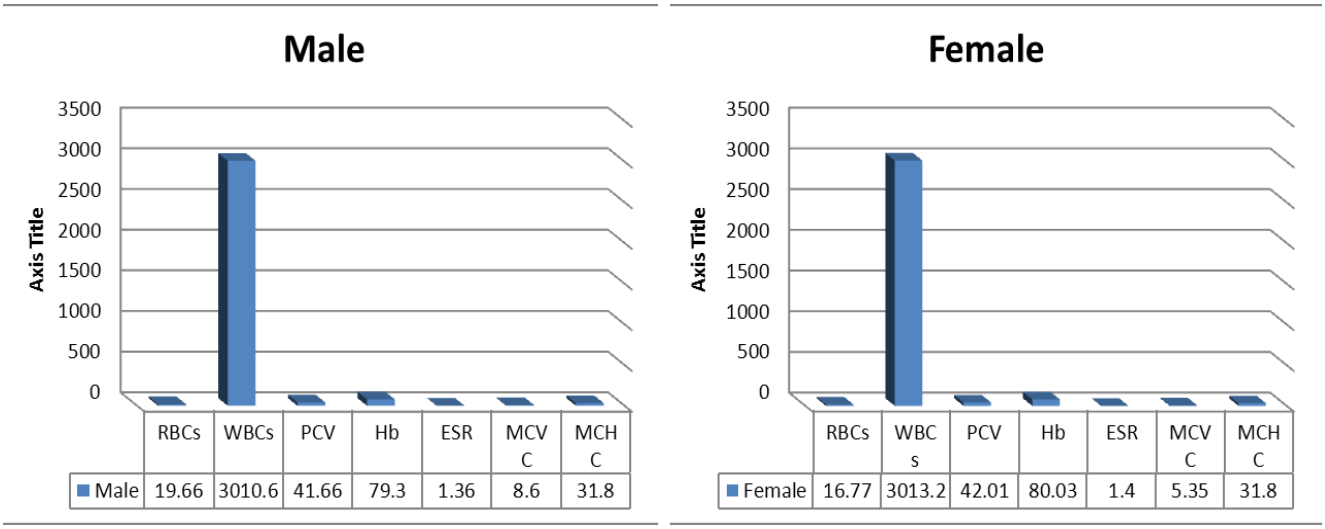

Figure 1 - Hematological values of Black Neck Ostrich male

DISCUSSION

Hematological studies have been widely used as means of assessing the state of health of Ostrich and the establishment of the hematological characteristics of Avian generally serves as a standard for physiology, pathological or toxicological studies.

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The main objective of this study is comparison of blood parameters of Black Neck Ostrich collected from El Safa farm the results obtained revealed no significant different (P<0.05) between the male and female in all parameters examined except (RBC) there is high significant different between male and female.

In case of White Blood Cells (RBCs) there was significant different in $RWBC_s$ count between male and female, White Blood cells in male and female were count at high range (19.66±7.7[a]), (16.77±8.7[b]) respectively in ostrich male and female were an agreement with Palomeque et al. (1991) who find that the average RBC length and width observed slightly larger in adult avian.

Also in case of Red Blood Cells (WBCs) there was no significant different in $TRBC_s$ count between male and female, Red Blood cells in male and female were count at range (3010.57±365.28), (3013±344.63) respectively in the studied ostrich,our findings were similar to those reported by Palomeque et al. (1991) and Spinu et al. (1999), but were higher than those of Levy et al. (1989a) and Polat et al. (2001). Although Levy et al. (1989a) reported that growers may have relatively higher numbers of white blood cells.

The result revealed that there was no significant different in PCV% between male and female (P≤0.05). PCV% in male and female were count at range (41.66±3.9), (42.0±6.1) respectively this finding with agreement to palomeque et al. (1991) and Brown and Jones (1996) who reported mean PVC% similar to our finding.

In this study, comparing the haematocrit with sex groups, it was found that haematocrit values in the ostrich male were similar to ostrich female, the revealed no significant different in haematocrit between the two group (P<0.05). The mean haematocrit values were similar to those reported by (Palomeque et al. 1991; Brown and Jones 1996), but were higher than the values noted by Levy et al. (1989a) for ostrich chicks. In addition, for most birds, it was reported that the values of haematocrit are greater in adults than in juveniles (Palomeque et al. 1991; Peremann, 1999). The age-related increase in haematocrit values might be due to the greater oxygen demand of young ostriches for activity. Besides, Brown and Jones (1996) mentioned that haematocrit in ostriches is well regulated and even ehydrated. Birds show no or little haemoconcentration. The findings in this study for the MCH and MCHC were in agreement with those previously obtained by Palomeque et al. (1991), while the values for MCV were slightly lower in ostrich female than male. Perelman (1999) stated that the MCV, MCH and MCHC in ostriches tend to increase with age, but we study mature bird with same age.

The obtained that there was no significant different in haemoglbin concentration (Hb) between male and female (P≤0.05). Haemoglobin concentration (Hb) in male and female were count at range (79.3±3.9), (80.03±3.0) respectively this finding is agreement some authors have reported that haemoglobin levels of ostriches were within the range of most birds (Palomeque et al., 1991; Perelman, 1999). The values for the haemoglobin concentration were in accordance with those of Levy et al. (1989a). Although our findings were lower than the values obtained by Alomeque et al. (1991) for juvenile and adult ostriches, it was higher than those determined by Polat et al. (2001) for adult ostriches. This may be ascribed to differences in breed and in the physical and environmental condition.

The present study obtained that there is no significant between mean value of the ESR in ostrich male and female. The mean value for the ESR was (1.36±0.45), (1.40±0.03) respectively the findings in this study for the ESR were in agreement with those previously obtained by Palomeque et al. (1991).

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HAEMATOLOGICAL CHARACTERISTICS OF *C.GARIPIENIUS* COLLECTED FROM WHITE NILE AND BLUE NILE AT KHARTOUM STATE

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ABSTRACT: *This study was conducted at Sudan University of Science and Technology Collage of Animal Production Science and Technology Department of fisheries science and wildlife to determine haematological characteristics of Clarias garipienius collected from White Nile and Blue Nile River. Values of some haematological parameters of twenty C. gariepinus were in the range 41- 49 cm in length and 709 – 806 gm in weight were analyzed to determine the mean values obtained for White Blood cells Count (WBC) and Erythrocytes Count (RBC), Hemoglobin Concentration Rates (Hb), Packed Cell Volume (PCV) and Mean Corpuscular Volume (MCV/cl) and Leukocytes Differential Counts and chemical analysis of total protein and Blood Glucose. The result of this study show that there are no significant different in all parameters between samples collected from White Nile and Blue Nile at p (<0.05), expect in hemoglobin concentration there is highly significant different at p (<0.01). The main target of this study is to investigate the hematological parameters and some blood chemistry of Clarias garpieninus collected from White Nile River and Blue Nile River in Khartoum State.*

ORIGINAL ARTICLE

Key words: *Haematologocal parameters, Nile fishes, C.garpinus*

INTRODUCTION

High quality proteins, such as the protein in most fresh fish, can be used to maintain an active metabolism. Low quality protein does not contain all essential amino acids required for use in protein synthesis and means the protein must either be used for energy or converted to fat Fagbenro et al. (2003).

Fishes are rich in Omega–3 fatty acids which plays very important role for normal growth particularly for the blood vessels and the nerves as well as keeping our skin and other tissues youthful. Research studies have revealed that in populations that consume large quantities of fish, with a high utilization of omega3s, there is a reduced risk of heart disease. Fish is important in diets and livelihoods of many poor people suffering from vitamin and mineral deficiencies (Toft et al., 2001).

Many environmental and physiological factors are known to influence fish hematology. These include stress due to capturing, transportation, sampling, age and sex. Therefore, hematological studies have been widely used as means of assessing the state health of fishes. The establishment of hematology of fishes generally serves as standard for physiology, pathological and toxicological studies (Martinez et al., 2004).

Fish hematological analysis can provide valuable knowledge for monitoring the health and condition of the both wild and culture fish. Hematological indices changes depend of the fish species, age, the cycle of sexual maturity and health condition (Blaxhall, 1972). Moreover, hematological tests and analysis for serum constituents have showed useful information in detection and diagnosis of metabolic disturbance and diseases in fishes (Omozusi, 2000).

Blood tissue reflects physical and chemical changes occurring in organisms, therefore detailed information can be obtained on general metabolism and physiological status of fish in different grouping of age and habitat (Kocabatmazve and Ekingen, 1978). Blood parameters have been commonly used to observe and follow fish health, since variations in blood tissue of fish are caused by environmental stress (Shah and Altindag, 2005).

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The aim of the study is to investigate the hematology and blood chemistry of *Clarias garpieninus* collected from White Nile River and Blue Nile River in Khartoum State.

MATERIALS AND METHODS

Locality: This study was conducted at Sudan University of Science and Technology, college of Animal Production Science and Technology, department of Fisheries Science and Wildlife.

Collection of fish samples: The samples were collected by different methods of catch by using gill net and cast net. A total of twenty blood samples of *Clarias gariepinus* were collected from two different localities White Nile River and Blue Nile River.

Blood collection: Blood samples were taken by puncturing posterior caudal vein using 5ml .syringe .then the blood was canted in bottles containing ethylene di amine tetra acetate (EDTA)as anticoagulant (sun-mitt et al., 1999) for determination of blood parameters.

Collected of plasma: Blood plasma was obtained by centrifuging 5ml of whole blood for 6 min and then the supernatant plasma was collected and stored in plastic tubes at -20c for analysis.

Statistical analysis

The findings of this experiment were analyzed by T-test (student test) and SPSS version 17 as described by Comez and Comez 1984.

RESULTS

The mean values for the haematological parameters of *C. gariepinus* studies are shown in Tables 1, 2 and Figure 1 revealed that the total weight (TW), of fish collected from White Nile River was (806.00±156.15) and in Blue Nile River was (709.00±263.62). There was no significant different in the total weight between White Nile and Blue Nile (P>0.05).

Table 1 - Blood parameters of *Clarias garipienius* collected from White Nile and Blue Nile River

Parameters \ Area	White Nile M±SD	Blue Nile M±SD	Significant
W/g	806.00±156.15	709.00±263.62	NS
L/cm	49.10±7.20^{a}	41.40±7.30^{b}	*
TWBCs*10^3	34.60±5.82	38.61±1.95	NS
TRBCs*10^6	2.37±.450	2.42±.185	NS
Hb(g/dl)	9.23±1.58^{b}	11.52±1.76^{a}	**
PCV%	24.20±7.57	30.70±8.58	NS
MCV/cl	39.88±15.58	47.71±6.95	NS
N%	1.50±1.08	1.00±.942	NS
B%	25.40±9.62	24.50±8.00	NS
E%	11.20±8.80	7.40±3.20	NS
L%	30.80±6.78	39.40±9.87	NS
M%	29.90±6.14	27.80±5.83	NS

$^{a.b}$: within the same row followed by different superscript are significantly different (p ≤ 0.05). NS: No significant; *: significant at P<0.05; **: significant at P<0.01. Key: Hb: Hemoglobin concentration rate (%), WBC: White Blood cell counts (×10^3/mm^3), RBC: red Blood cell count (×10^6/mm^3), PCV: packed cell Volume (%), MCV: Mean corpuscular Volume (cemto liter), MCH: means corpuscular Hemoglobin (pico gram), N: Neutrophil (%), B: Basophil (%), E: Eosinophil (%), L: Lymphocytes (%), M: Monocytes (%).

Table 2 - Some blood chemistry of *Clarias garpienius* collected from White Nile and Blue Nile River

Parameters \ Area	White Nile M±SD	Blue Nile M±SD	Significant
Protein	105.58±39.61	127.04±39.15	NS
Glucose	70.48±18.60	72.46±18.75	NS

The total Length (TL), of fish collected from White Nile River was (49.10±7.20^{a}) and in Blue Nile River was (41.40±7.30^{b}). There was significant different in the total length between White Nile and Blue Nile (P>0.05).

White Blood cells (TWBCs) in white Nile River counts were (34.60±5.82 mm3)and in Blue Nile River counts were (38.61±1.95mm^3) there was no significant difference in TRBCS count between white Nile River and Blue Nile River (P>0.05).

Red Blood cells (RBC) in white Nile River counts were (2.37±.450mm3)and in Blue Nile River counts were (2.42±.185mm^3) there was no significant difference in TRBCS count between white Nile River and Blue Nile River (P>0.05).

The Hemoglobin concentrate (Hg), (g/dl) in White Nile River was (9.23±1.58^{b}) and in Blue Nile River was (11.52±1.76^{a}). There was highly significant different in Hg (g/dl) between White Nile River and Blue Nile River (P>.0.01).

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Packed Cells volume (PCV %) in White Nile River counts were (24.20±7.57) and in Nile River counts were (30.70±8.58) there was no significant different in (PCV%) between White Nile River and Blue Nile River (p>.0.05).

Mean Corpuscular Volume (MCV,/ cemto liter, CL) in White Nile River counts were (39.88±15.58) and in Blue Nile River counts were (47.71±6.95) there was no significant different in (MCV) Between White Nile River and Blue Nile River (p≤.05).

The percentages of Neutrophil (N%), Basophile (B%),Esinophil (E%), in White Nile River count were (1.50±1.08), (25.40±9.62), (11.20±8.80) respectively. And in Blue Nile River count were were (1.00±.942), (24.50±8.00), (7.40±3.20) respectively. There was no significant in N%, B%, E%, between White Nile River and Blue Nile River (P>0.05).

The percentages Lymphocytes (L%), in White Nile River were (30.80±6.78) and in Blue Nile River were (39.40±9.87). There was significant different in L% between White Nile River and Blue Nile River (P≤0.05).

The percentages Monotypes (M %), in White Nile River were (29.90±6.14) and in Blue Nile River were (27.80±5.83). There was significant different in M% between White Nile River and Blue Nile River (P≤0.05).

DISCUSSION

Hematological studies have been widely used as means of assessing the state of health of fishes and the establishment of the hematological characteristics of fishes generally serves as a standard for physiology, pathological or toxicological studies.

The main objective of this study is comparison of blood parameters and chemical analysis of *Clarias gariepinus* collected from the White Nile and Blue Nile the results obtained revealed no significant different (p<0,05) between the White Nile River and Blue Nile River in all parameters examined except Hemoglobin concentration (Hb).

In case of White Blood Cells (WBCs) there was no significant different in $TWBC_s$ count between White Nile River and Blue Nile River, White Blood cells in White Nile River and Blue Nile River were count at range (34.60±5.82), (38.61±1.95) respectively in the studied *Clarias gariepinus* were similar to the findings of (Terry, 2000)

Also in case of Red Blood Cells (RBCs) there was no significant different in $TRBC_s$ count between White Nile River and Blue Nile River, Red Blood cells in White Nile River and Blue Nile River were count at range (2.37±.450), (2.42±.185) respectively in the studied *Clarias sp* were similar to the findings of (Adam and *Agab* 2008).

The result revealed that there was highly significant different in Hb between in White Nile River and Blue Nile River (p≤0, 05).but it higher in Blue Nile River because the environment is more contaminate by heavy metals and waste materials also and this may be due to the fact that under the condition of hypoxia caused by the metals, more (Hb) were produced in the poisoned fishes to bind with more oxygen molecules (Joshi et al, 2002a).

This results were in agreement with finding of Barnhart (1969) who found that red blood cells count, haematocrit and haemoglobin concentration vary with diet and strain as well as temperature, season of the year and nutritional status of the fish.

The (Hb) concentration in White Nile River and Blue Nile River ($9.23±1.58^b$), ($11.52±1.76^a$) respectively and this result is similar to those reported by (Gabriel et al., 2004).

There was no significant different in PCV, MCV, between White Nile River and Blue Nile River. Usually RBC system of fish reacts to heavy metal intoxication with anemia but in some cases particularly after short period parameters (RBC, PCV, MCV, HB), may be increased (Blaxhall et al., 1975) Also decrease or increase in blood parameters can be associated with nature of species and the toxicant (Annue,*et.,al* 1994) reported that the RBC elevation attributed to blood cell reserve combined with cell shrinkage as result of osmotic alteration of blood by the action of heavy metals. The PCV can increased from erythrocyte swelling (Heath, 1987).changes in the PCV had been noted with seasonal variation (lane, 1979), and Mahoney and Nulty, 1992).

The range in mean corpuscular volume (MCV) in White Nile River and Blue Nile River count were (39.88±15.58), (47.71±6.95), respectively. This result was similar to finding (Nilza et al., 2003) and (Gabriel et.al., 2004). There was no significant different in (N %, B%, E%, L%, M %) between White Nile River and Blue Nile River (P>0.05). The differential count (N %, B%, E%, L%, M %) in White Nile River and Blue Nile River were count at range (1.50±1.08- 1.00±.942), (25.40±9.62-24.50±8.00), (11.20±8.80-7.40±3.20), (30.80±6.78-39.40±9.87), (29.90±6.14-27.80±5.83), respectively in the studied *Clarias sp* were similar to the findings of (Heath, 1987).

The results revealed variation in differential count finding in agreement with (Joshi et al., 2002b). Who reported that Stress factors due to capture, handling and sampling procedures are factors which can cause intra-species hematological variations.

Total protein there were no significant different between White Nile and Blue Nile River , because they high in it so as to increase in the plasma glucose and total protein can be indicator of a classical general adaptive response to stress in fishes exposed to pollutants (Martinez et al., 2004.also high levels of blood glucose and total protein are caused by disorders in carbohydrate metabolism appearing in the condition of physical and chemical stresses (Wedemeyer and Mcleay, 1981).

The total protein in Nile and Blue Nile River count were (105.58±39.61), (127.04±39.15) respectively in this study were in agreement to Omozusi et al., 2000). Who reported semi similar by results.

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The result also obtained that no significant different in blood glucose between White Nile and Blue Nile River. The blood glucose and in White Nile and Blue Nile River were count (70.48±18.60), (72.46±18.75) respectively there were semi similar to reported by (Olaiya et al., 2003).

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ISOLATION AND CHARACTERIZATION OF A LIPOLYTIC AND PHYTASE PRODUCING PROBIOTIC FOR POTENTIAL APPLICATION IN POULTRY FEED

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ABSTRACT: *In the current study a total of 35 bacterial isolates from 17 food and fecal samples were examined. Five among those were earmarked as putative probiotic candidates. All the selected isolates survived the low pH conditions of 2.0, and resisted the presence of bile salts (0.02-0.25%) and NaCl (2-14 %), indicating their ability to survive in the gastrointestinal (GI) tract conditions and hence making them suitable candidates for probiotic applications. The selected probiotic isolates showed considerable levels of hydrophobicity indicating their potential adhering properties with the gut epithelium. In addition the five selected probiotic candidates depicted substantial antagonistic action against potent pathogens like Bacillus subtilis, B. cereus, Escherichia coli, Pseudomonas aeruginosa, P. alcaligenes, Staphylococcus aureus and Streptococcus sp. The isolates CM-4 and KD-7 were most remarkable as they inhibited all the pathogens tested including S. aureus and Streptococcus sp. Extracellular enzymatic studies showed that all the five strains produced phytase whereas isolate CM-4 and KD-7 were the only lipase producers found. However no amylase protease activity was detected. Isolate CM-4 was found to be the best among all five as it showed all desirable probiotic features viz. bile salt, NaCl and pH tolerance, maximum hydrophobicity, antagonistic action against pathogens, phytase and lipase activity, therefore was identified by using 16S rDNA sequencing and MEGA BLAST.*

ORIGINAL ARTICLE

Key words: *Probiotics, Phytase, Lipases, Hydrophobicity, Antibacterial Activity*

INTRODUCTION

Probiotics are live microbial feed supplements which beneficially affect the host by improving its intestinal microbial balance. The probiotic bacteria most commonly studied include members of the genera *Lactobacillus* and *Bifido bacterium*. *Saccharomyces boulardii, Escherichia coli* and *Enterococcus* strains are used as probiotics in non-food format (Holzapfel et al., 2001). Correspondingly, in feed regulation, probiotics are included in the group of feed additives for stabilising the microbial communities of the digestive tract in monogastric animals and ruminants. They are also known as digestive bioregulators or direct-fed microbials (DFMs). In a narrower sense, the term probiotics is confined to products which consist of one, or a few, well-defined strains of microorganisms. Besides imparting all these beneficial attributes probiotics are also known to produce various enzymes that help in the digestion of monogastric animals, phytases and lipases being the important ones (Khattak et al., 2006). Phytic acid (*myo*-inositol hexakis phosphate, phytate) is the major storage form of phosphorus in cereal, oil and legume (Khattak et al., 2006). Phytase, a specific group of phosphatase hydrolizes phytic acid to myo-inositol and phosphoric acid. In terms of animal nutrition, monogastric animals such as swine, poultry and human are not capable of metabolizing phytate phosphorus owing to the lack of digestive enzymes hydrolyzing the substrate, and therefore, inorganic phosphate is added to their diet to meet the phosphorus requirement, while undigested phytate phosphorus is excreted in manure and poses a serious phosphorus pollution problem, contributing to the eutrophication of surface water in areas of intensive livestock production (Bajaj and Wani, 2011). In addition, phytic acid also acts as an anti-nutritional agent forming complexes with proteins and various metal ions, thereby decreasing the dietary bioavailability of these nutrients. Recently, microbial plants and animal-derived phytases have been made available as feed supplements. They have become the most popular and widely used enzymes in animal farming systems. Due to the ever increasing incidences of bacterial antibiotic resistance, the European Union (EU) has decided to ban antibiotics as feed additives from 1st January 2006 onwards (Simon, 2005). Therefore, a massive hunt has been launched to establish other substances with beneficial effects on animals via modifications of the intestinal microbiota. Among these so called "alternatives to antibiotics" important ones are probiotics. Probiotics due to their ability to create a healthy equilibrium between beneficial and potentially harmful

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microorganisms in the gut by competitive exclusion, and by the production of organic acids etc. are found to be the leaders in feed supplements. The health benefitting attributes of probiotics show wide variation with respect to strain, species and genus therefore, the quest for novel strains with superior health benefitting features is never ending. In the current study a total of 35 lactic acid bacteria (LAB) isolated from food and fecal samples were screened for their probiotically important parameters. The isolate CM-4 which had the most of the desirable probiotic features was identified using 16S rDNA sequencing.

MATERIALS AND METHODS

Chemicals and bacterial pathogens

All chemicals and media components used in this study were purchased from Himedia, Sigma, Ranbaxy and SD fine chemicals, and were of analytical quality. The pathogenic cultures used in this study were: *Bacillus subtilis, B. cereus, Escherichia coli, Pseudomonas aeruginosa, P. alcaligenes, Staphylococcus aureus* and *Streptococcus* sp., and were procured from Microbial Type Culture Collection and Gene Bank (MTCC), Institute of Microbial Technology (IMTECH), Chandigarh, India.

Isolation of bacteria

Bacteria were isolated from samples collected from various sources viz. cow or goat milk, curd, cheese, or cattle excreta. The samples were collected in sterile vials and maintained at 4^{o}C till processed further. For isolation of LAB, the samples were enriched in MRS broth supplemented with acetic acid (1ml/l) and gentamycin (100mg/l), for 18 h and then spread plated on MRS agar and incubated in anaerobic chamber (HI-MEDIA) for 24-48 h. Pin head sized colonies were selected, pure cultured and maintained on skimmed milk broth (10 % skimmed milk and 5 % pH indicator). The cultures were revived after every two weeks. A total of 17 samples were used and 35 pin head colonies were picked up and subjected to morphological and biochemical tests. Five putative isolates CM-4 (from cow milk), KD-7 (from kudan, an indigenous milk product produced upon prolonged boiling of milk), HD (from horse dung), GD (from goat dung) and GM (from goat milk), were studied according to Bergey's Manual of Determinative Bacteriology (Garrity et al., 2004).

Study of probiotically important features of LAB isolates

For studying the ability of isolated LAB to grow over (and tolerate) wide range of pH the MRS broth was adjusted at different pH (2-12) using 1N HCl or 1N NaOH. The LAB cultures were activated by growing them in MRS broth for 18 h and then used this cell suspension for inoculation (@1%, v/v) into different MRS broth tubes (having varying pH). For assessing the ability of LAB to grow in presence of different concentrations of sodium chloride (2-14 %, w/v) and bile salts (0.02-0.25 %, w/v), the MRS broth was added with corresponding amounts of NaCl and bile salts. Incubation at 37˚C under static conditions was given for 24 h and growth was measured spectrophotometerically at 660nm using a UV-VIS spectrophotometer (λ 35, PerkinElmer, USA). Growth in MRS broth at pH 6.5 served as control while assaying growth for various parameters.

Assaying antibacterial activity of LAB

For determining antibacterial activity, the selected LAB was grown in MRS broth for 24 h at 37˚C under static conditions. Samples drawn at various time intervals were centrifuged at 8000g for 5 min (Sigma, 3K30) and the supernatant was filtered through a bacterial filter (Whatman, 0.22 µ). The filtrate obtained was used for assaying the antimicrobial activity after adjusting the pH to 6.5. The test organisms (*Bacillus subtilis, B. cereus, Escherichia coli, Pseudomonas aeruginosa, P. alcaligenes, Staphylococcus aureus* and *Streptococcus* sp.) were cultivated for 18 h at 37˚C (A_{660} 0.8) in Luria-Bertani (LB) broth and spread plated on Mueller-Hinton (MH) agar plates. Wells of 6mm were cut and 50µl supernatant of the test isolates was poured into each well and incubated for 24-48 h at 37 ˚C. Antimicrobial activity was analyzed by measuring the zone of inhibition around the well.

Qualitative assay for enzymes

The five selected strains were examined for their ability to produce extracellular enzyme (i.e., amylase, protease, lipase, and phytase) activities according to Kim et al. (2007) with minor modifications. To detect the amylase, lipase, and protease activities, the selected LAB were subcultured and then centrifuged and the supernatant was considered as the crude enzyme. Amylase activity was examined using starch agar medium (starch 0.25%, and agar 1.5%). For detecting the clear zones of amylase activity, iodine solution was poured over the plates. For lipase activity, the MRS broth was used to subculture the strains. Activity was detected by using a medium that consisted of nutrient agar and tributyrin oil (1%, v/v). For detection of protease activity, the strains were cultured in MRS broth and after anaerobic incubation for 24 h at 37°C, 50 µl of culture supernatant was transferred to wells in the medium consisting of skim milk (0.5%) and agar (1.5%). Clear zone surrounding each well was measured.

Phytase activity was measured using sodium phytate as substrate. The MRS broth that contained 0.25% sodium phytate (HIMEDIA) was used to subculture the strains and the medium consisted of (%, w/v): glucose 1.5, sodium phytate 0.5, NH_4NO_3 0.5, KCl 0.05, $MgSO_4 \cdot 7H_2O$, 0.05, $MnSO_4 \cdot 7H_2O$ 0.02, $FeSO_4 \cdot 7H_2O$ 0.001 and agar 1.5 (pH 7.0). The cultural supernatant was put in the wells cut on the medium of the same composition. Appearance of halos was suggestive of phytase production.

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Cell surface hydrophobicity test:

Cell surface hydrophobicity was determined by the method of Rosenberg et al. (1980). Cultures were grown in 5 ml of MRS broth, centrifuged at 7500 g for 5 min and the cell pellet was washed with 9 ml of Ringer solution (%, w/v): NaCl 6, KCl 0.0075, $CaCl_2$ 0.01 and $NaHCO_3$ 0.01, re-suspended in a cyclomixer and washed thrice. Then 1 ml of the suspension was taken and the absorbance at 580nm was measured. Then 1.5 ml of the cell suspension was mixed with 1.5 ml of n-hexadecane in triplicate and mixed thoroughly in a cyclomixer for 2 min. The two phases were allowed to separate for 30 min. Then 1 ml of the lower phase was taken and the absorbance at 580nm was measured. The percentage of hydrophobicity of strain adhering to hexadecane was calculated using the equation:

$$\text{Percentage of hydrophobicity} = \frac{A_{580}\,(\text{before mixing}) - A_{580}\,(\text{with hexadecane}) \times 100}{A_{580}\,(\text{before mixing})}$$

Identification of isolate CM-4 based on 16S rDNA sequencing

Total DNA was extracted using a HIMEDIA DNA extraction kit as per the manufacturer's instructions. Identification was carried out based on primers targeted against variable regions of the 16S rRNA genes. The universal primer pair used for amplification of 16S rRNA was lac1-27F 5'-AGAGTTTGATCCTGGCTCAG and lac 1 - 1492R 5'TACGGYTACCTTGTTACGACT (IDT/PROMEGA). DNA amplification of the (~1,500 bases) fragment was carried out in a 20µl reaction mixture. All PCR chemicals were obtained from Fermentas. Amplification was performed in a thermocycler (Eppendorf, Mastercycler gradient) with the following running program: initial denaturation 95ºC for 5 min, denaturation 92ºC 1min, annealing 55ºC for 30 s, extension 72ºC 1 min and a total number of 25 cycles were run. The amplicon obtained was sent to Department of Biochemistry, University of Delhi, and South campus for sequencing. Sequence homology and analysis were performed using the Blast program available online at the National Center for Biotechnology Information, NCBI (www. http://www.ncbi.nlm.nih.gov/).

RESULTS AND DISCUSSION

Isolation of bacteria

Of a total of 35 bacterial isolates from 17 samples, 5 fulfilled the set criteria for probiotics, based on morphological (Table 1) and biochemical tests (Table 2), and these were subjected to further studies with regard to probiotically important features like their ability to grow over (and tolerate) broad pH range, and at different concentrations of NaCl and bile salts.

Table 1 - Characterization of the selected lactic acid bacteria (LAB) isolates

Samples	Isolates	Gram- staining	Morphology	Catalase test	Spore- staining	Motility
Cow milk	CM-4	Gram- positive	Cocci	Negative	Negative	Negative
Kudan	KD-7	Gram- positive	Cocci	Negative	Negative	Negative
Horse dung	HD	Gram- positive	Bacilli	Negative	Negative	Negative
Goat dung	GD	Gram- positive	Bacilli	Negative	Negative	Negative
Goat milk	GM	Gram- positive	Bacilli	Negative	Negative	Negative

Table 2 – Carbohydrate utilization pattern of the isolates

Carbohydrates	CM-4	KD-7	HD	GD	GM
Lactose	+	+	+	+	-
Xylose	+	+	+	+	-
Maltose	+	+	+	+	+
Fructose	+	+	+	+	+
Dextrose	+	+	+	+	+
Galactose	+	+	+	+	+
Raffinose	+	+	+	+	+
Trehalose	+	+	+	+	+
Mellibiose	+	+	+	+	+
Sucrose	+	+	+	+	+
L-arabinose	+	+	+	+	+
Mannose	+	+	+	+	-
Inulin	+	+	-	+	-
Sodium gluconate	+	+	-	+	-
Glycerol	+	+	-	+	-
Salicin	-	+	+	+	-
Dulicitol	-	+	-	+	-
Inositol	-	+	-	+	-
sOrbitol	-	+	+	+	-
Mannitol	+	+	+	+	-
Adonitol	-	+	-	+	-
Arabitol	-	+	-	+	-
Erythritol	-	+	-	+	-
L-methy D	-	+	+	+	-
Rhamnose	-	+	-	+	-
Cellobiose	+	+	+	+	-
Melezitose	-	+	+	+	-
L-methyl –d –mannose	-	+	+	+	-
Xylitol	-	+	-	-	+
ONPG	-	-	-	-	-
Esculin	+	+	+	+	+
d- arabinose	+	+	-	+	+
Citrate	-	-	-	-	-
Malonate	-	-	+	-	-
Sorbose	+	+	+	+	-

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Study of probiotically important features

Probiotics are defined as "living microorganisms, which upon ingestion in certain numbers, exert health benefits beyond inherent basic nutrition", interest in this area was initiated by Elie Metschnikov about 100 years ago (Ljung and Wadstrom, 2006). Before reaching the intestinal tract, probiotic bacteria must first survive transit through the stomach where the pH can be as low as 1.5 to 2 (Dunne et al., 2001). Therefore, growth of the isolates was studied spectrophotometrically (A_{660}) in MRS at different pH (2 - 12) at 37 ˚C for 72 h. Growth in MRS at pH 6.5 served as control (Fig. 1). All the LAB isolates except HD showed growth at pH range of 2 to pH 12, (Fig. 2). However, isolates HD and GM displayed a considerable growth at pH of 3 - 4. All the isolates were able to tolerate a low pH of 2 - 4, though an appreciable growth was not reported. At pH 2, isolate CM-4 showed maximal growth which was followed by isolates KD-7 and GM, while at pH 3 highest growth of CM-4 was followed by GM and KD-7. Thus, the entire selected LAB grew over a broad pH range of 2-12 which is a desirable feature for the organism to be a good probiotic. Ability of probiotics to grow or tolerate low pH has been studied by many researchers. Roopashri and Varadaraj (2009) reported that *Lactobacillus plantarum* MTCC 5422 and *Bifidobacterium adolescentis* MTCC 5423 showed good growth at acidic pH of 3.5 - 5.5 in addition to other probiotically important attributes. Similarly in our study, isolate CM-4 was found to grow and survive at a pH of 2. *L. salivarius* MTC 106 survived in the gastric juice at pH 2 (Tinrat et al., 2011). However, among the 15 isolates of lactic acid bacteria examined only three showed resistance to pH 3 (Tatsadjieu et al., 2011).

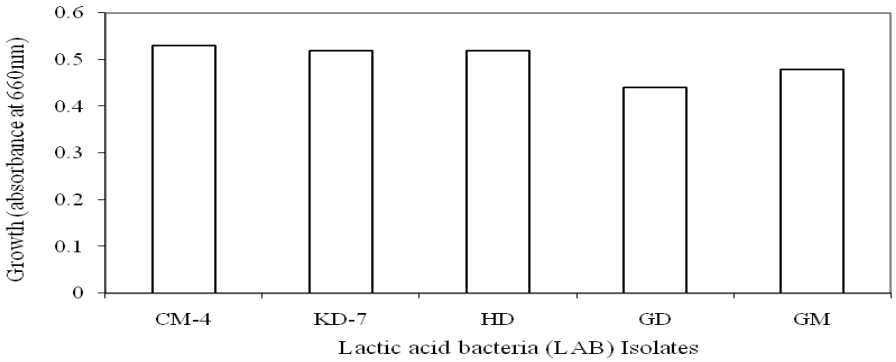

Figure 1 - Growth of lactic acid bacteria (LAB) isolates in MRS at pH 6.5 (Control)

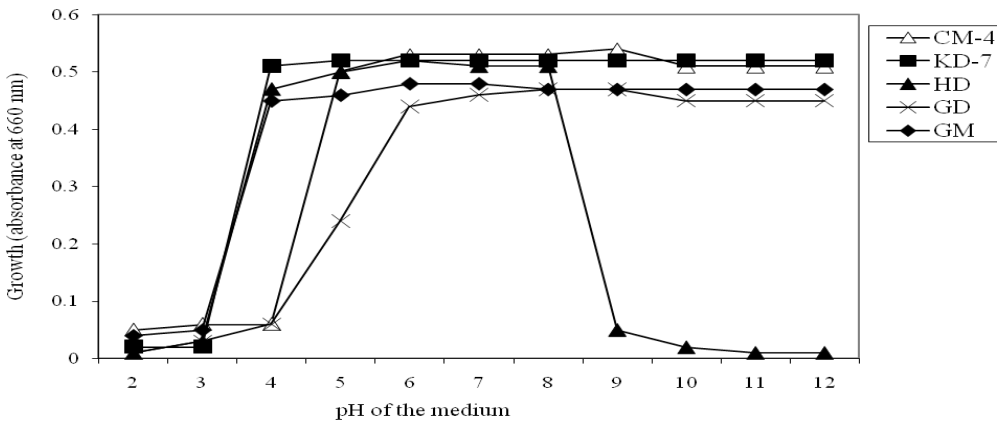

Figure 2 - Growth of the selected LAB isolates in MRS at varying pH

All the LAB isolates exhibited excellent growth in MRS containing 2 - 7% NaCl (Fig. 3). In this range maximum growth was shown by isolate KD-7 and was followed by CM-4, GD, GM and HD. With further increase in NaCl concentration, growth decreased. At 8% NaCl concentration highest growth was observed for the isolate KD-7 which was followed by HD, GD, CM-4 and GM. The isolate CM-4 showed constant good growth up to 13% NaCl concentration while KD-7 could not grow in MRS having above 11% NaCl. Eight to nine % NaCl was the limiting concentration for growth of GM, HD and GD (Fig. 3). Lactic acid bacteria generally tolerate high salt concentrations. It allows the bacteria to begin metabolism, which produce acid that further inhibit the growth of undesirable organisms. When bacterial cells are grown in medium with salt, they experience a loss in their turgor pressure, which in turn affects the metabolism and their enzyme and water activity. Cells overcome this situation by regulating the pressure inside and outside of the cell by inducing osmolytes, such as glycine, betaine, as an adaptive mechanism to withstand increased osmotic potential (Robert et al., 2000). Aswathy et al. (2008) evaluated probiotic characteristics of newly isolated LAB and found that one isolate was capable of growing at NaCl concentration of 12% while majority of others grew well at 8% NaCl concentration. In the present study, it was

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observed that the isolate CM-4 showed good growth up to 13% NaCl concentration while the other isolates were not able to grow beyond 11% of NaCl.

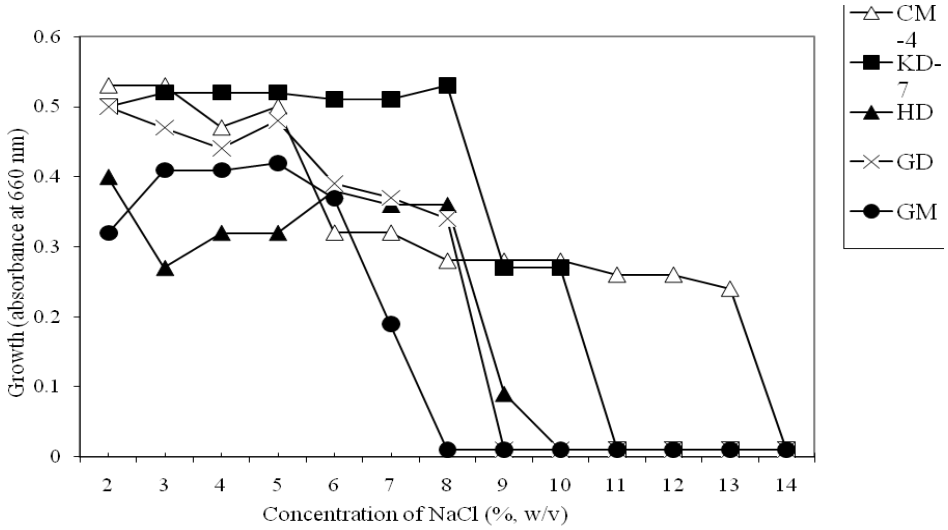

Figure 3 - Growth of LAB isolates at different concentrations of NaCl

LAB isolates were evaluated for their ability to grow in MRS broth containing varying concentrations of bile salts (0.025 - 0.25 %). All the LAB isolates showed good growth at different concentrations of bile salts. The isolates HD, KD-7 and CM-4 displayed maximum growth over all the bile salt concentrations used, while the isolates GM and GD showed a reasonable growth (Fig. 4). Barring isolate GD which realized a sharp decline in growth at concentration above 0.2 % of bile salts, all other isolates grew exceptionally well in MRS with 0.25 % bile salts. Bile tolerance has been described as an important factor for the survival and growth of LAB in the intestinal tract. Bile resistance of some strains is related to specific enzyme activity-bile salt hydrolase (BSH) which helps hydrolyse conjugated bile, thus reducing its toxic effect. BSH activity has most often been found in organisms isolated from the intestines or faeces of animals (Mourad and Nour-Eddine, 2006). In the current study, all the isolates grew well at 0.25% of bile salts. Aswathy et al. (2008) observed that most of the LAB isolates from vegetables, sour dough, milk products, sheep and human excreta exhibited good growth in presence of 0.3 - 0.8 % bile salts. Similarly, Reddy et al. (2007) observed that the growth performance of two native isolates *Lactobacillus plantarum* MTCC 5422 and *Bifidobacterium adolescentis* MTCC 5423 was quite appreciable in the presence of bile salts at concentration levels of 0.15%, 0.3%, and 0.45%, respectively. However, in the presence of 0.45% bile salt, the growth was slightly reduced. Ahmed et al. (2007) examined the growth of five strains of *Lactobacillus reuteri* in presence of different bile salts concentrations and reported that 0.3% bile salt significantly reduced the growth of *L. reuteri* strains. Further, the addition of Tween 80 enhanced the bile salt tolerance of *L. reuteri,* indicating that bile salt and Tween 80 have an influence on the biochemical properties of *L. reuteri* and should be considered for useful applications in enhancing the survival of *Lactobacillus*. Pereira and Gibson (2002) observed that most of the LAB and bifidobacteria isolated from human gut were sensitive to bile salts in the range of 0.2-0.4%., however a few of LAB isolates showed relatively good growth in presence of bile salts.

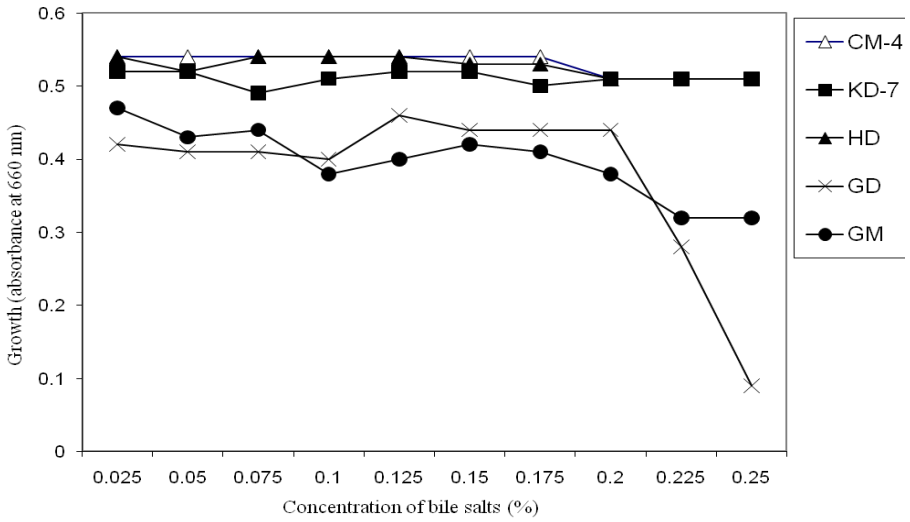

Figure 4 - Growth of LAB isolates at different concentration of bile salts

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Antibacterial activity of LAB isolates against potent pathogens

Another important probiotic attribute associated with LAB is their antibacterial activity against potential human pathogens. The selected isolates were screened for their antimicrobial activity against potential human pathogens such as *Bacillus subtilis, B. cereus, Escherichia coli, Pseudomonas aeruginosa, P. alcaligenes, Staphylococcus aureus* and *Streptococcus* sp. Isolates CM-4 and KD-7 were remarkable as they exhibited antibacterial action against all the pathogens tested. Isolate CM-4 exhibited potent inhibitory activity against *Pseudomonas aeruginosa* (inhibition zone of 14 mm), *B. cereus* (13 mm), *B. subtilis, E. coli, S. aureus* (12 mm, each), *P. alcaligenes* (11 mm) and *Streptococcus* sp. (10 mm) as shown in Table 3. Isolate KD-7 significantly inhibited *B. subtilis* (21 mm) and *P. alcaligenes* (15 mm), while the other pathogens were inhibited to a lesser extent (11-13 mm), and *Streptococcus* sp. was the least inhibited one (9 mm).

Maximum antibacterial activity was observed after 72 h of cultivation, though lower level of activity was observed after 24-48 h (data not shown). All the LAB isolates showed inhibitory effect against most of the test pathogens excluding *S. aureus* and *Streptococcus* sp., however, LAB isolates CM-4 and KD-7 were remarkable as they showed antibacterial activity against these two pathogens also. Two LAB isolates (CM-4 and KD-7) also showed maximum inhibition zone against all the pathogens tested. The LAB isolate GM did not show antagonistic action against any of the pathogens tested. Sholeva et al. (1998) screened 46 strains, out of which only 28 possessed antimicrobial activities. The largest spectrum of inhibition was observed for *Lactobacillus casei* NBMCC300, which inhibited 5 test organisms. Roopashri and Varadaraja (2009) reported that all the 9 LAB isolates showed inhibition against *Bacillus cereus, Listeria monocytogenes* and *Yersinia enterocolitica*, however, only 4 LAB isolates could inhibit the growth of *Staphylococcus aureus*. In the current study, LAB isolates CM-4 and KD-7 were remarkable as they showed antibacterial activity against *S. aureus* and *Streptococcus* sp. These findings necessitate the further study of these two LAB isolates, and prompts for establishment of the active principle associated with antibacterial activity. Aswathy et al. (2008) reported that among a total 16 LAB isolates examined for their antibacterial activity against human pathogens, 14 inhibited *Escherichia coli*, 9 showed inhibitions against *Shigella sonnei*, 7 inhibited growth of *Shigella flexnerii* and 6 caused inhibition of *Staphylococcus aureus*. The inhibition zone size in most of the cases varied from 4-7 mm except in case of the isolate CB5 which showed an inhibition zone of 10 mm against *E. coil*. Similarly, Reddy et al. (2007) reported the antimicrobial property of six selected LAB isolates from *Kanjika,* a wellknown ayurvedic lactic acid-based fermented product, against known food-borne pathogens such as *B. cereus*, *L. monocytogenes*, *E. coli*, *S. aureus* and *Y. enterocolitica*.

Table 3 - Antagonistic action of the selected LAB isolates against pathogens of human significance *

	Diameter of the inhibition zone (mm) Pathogens tested						
LAB	***E. coli***	***B. subtilis***	***B. cereus***	***P. aeruginosa***	***P. alcaligenes***	***S. aureus***	***Streptococcus* sp.**
CM-4	12	12	13	14	11	12	10
KD-7	11	21	12	13	15	12	9
HD	8	12	8	9	8	ND	ND
GD	7	13	9	11	8	ND	ND
GM	ND	ND	ND	ND	ND	ND	ND

*ND= not detected

Enzyme producing ability of the LAB isolates

Enzyme (amylase, lipase, protease, phytase) producing ability of LAB isolates was determined by observing the formation of halos around the colonies on specific agar medium plates. All the bacterial isolates displayed varying level of phytase producing ability. Maximum phytase production was shown by CM-4 (zone size 14 mm, followed by KD-7 (13 mm), HD and GM (10 mm each) and isolate GD (5 mm) as shown in the Table 4. . However, lipase producing ability was expressed only by LAB isolates CM-4 and KD-7. Isolate CM-4 displayed considerable lipase activity (zone size 10mm) while KD-7 showed marginal level of lipase activity (Table 4). No extracellular protease and amylase activity was detected in the LAB isolates of this study. Application of enzymes in poultry started in early fifties and with the advent of technology several enzymes have become cheap and easily available. Application of enzymes of enzymes not only increases the nutritional value of the food but also keeps a regulation on the release of undigested waste material into the environment (Cmiljanic et al., 2005). Abriouel et al.(2005) reported that the enzyme extract from *E. faecium* RJ16 isolated from food was found to possess enzymes important in food industry like phytase and esterase lipase.

Table 4 - Enzymatic activity of the five selected LAB isolates*

Enzyme Activity	LAB Isolates, Zone size, mm				
	CM-4	**KD-7**	**HD**	**GD**	**GM**
Amylase activity	–	–	–	–	–
Phytase activity	14	13	10	5	10
Protease activity	–	–	–	-	–
Lipase activity	10	+	–	–	–

* indicates absence of enzyme activity, + indicates that the activity though present but not measurable

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Cell surface hydrophobicity

The selected isolates displayed variable level of hydrophobicity (Fig 5). Isolate CM-4 displayed maximum hydrophobicity i.e. 93.55% and was followed by KD-7 (76.28%). Isolate GD displayed the least hydrophobicity (63.24%) while rest of the isolates showed hydrophobicity ranging in between 93.55% and 63.24%. Cell-surface hydrophobicity is recognized as measurable physicochemical variables for evaluating bacterial adhesion to the surfaces. The high levels of hydrophobicity of microorganisms are usually associated with the presence of fibrillar structures on the cell surface (Mcnab et al., 1999) and specific cell wall proteins (Kos et al., 2003). Kaushik et al., (2009) reported that *L. johnsonii* LA1 and *L. acidophilus* LA7 showed hydrophobicity level of 47% and 57–58%, respectively.

Strain identification

The isolate CM-4 exhibited most of the desirable probiotic attributes, therefore its identification was done based on 16S rDNA sequencing. PCR amplification of 16S rDNA of isolate CM-4 was executed using universal primers and the amplicon obtained (Fig. 6) was sequenced. The sequence was analysed using NCBI Mega BLAST. The isolate CM-4 was identified to be an *Enterococcus* sp. based upon 16S rDNA sequence as it showed high resemblance (99%) with that of several other *Enterococcus* spp. available in the gene bank data base. Furthermore, the isolate was designated as *Enterococcus faecium* as it formed the part of same cluster as that of *Enterococcus faecium* GM3. The evolutionary history was inferred using the UPGMA method and boot strapping was done using MEGA 5 software (Fig. 7). Even though biochemical tests are quite reliable but for unambiguous and precise identification molecular techniques based upon 16S rDNA sequences are preferred.

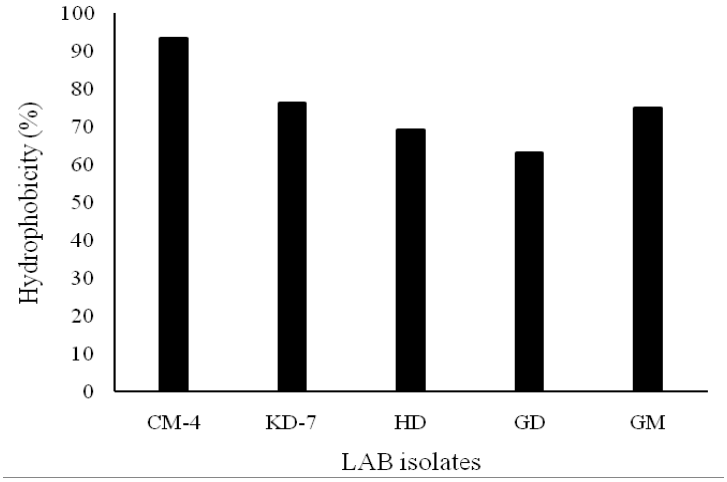

Figure 5 - Cell surface hydrophobicity of the selected LAB isolates

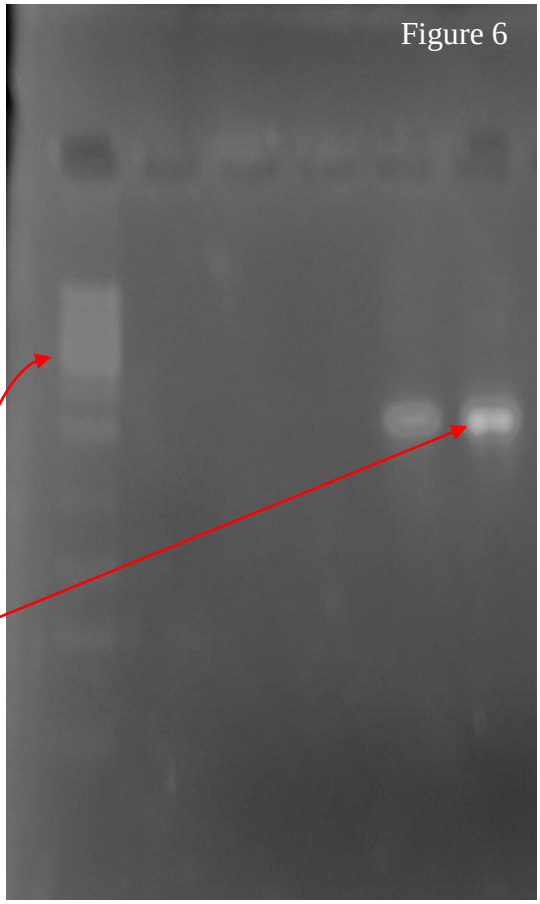

Figure 6 - Agarose gel electrophoresis showing the amplified 16SrDNA using universal primers

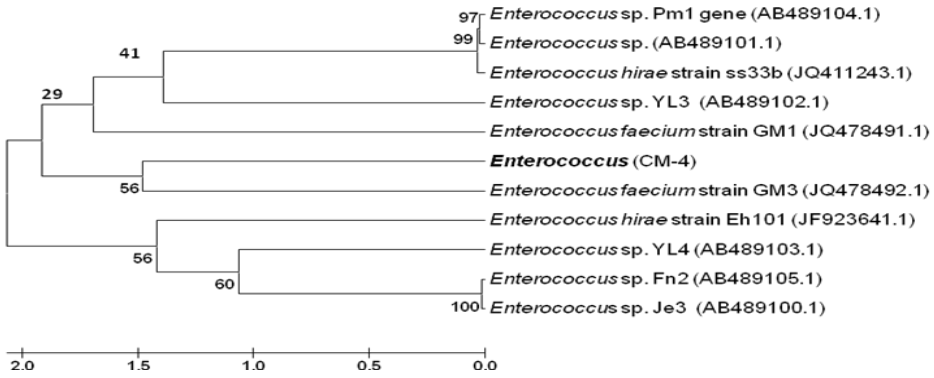

Figure 7 - Phylogenetic tree showing the comparison of 16S rDNA sequence of *Enterococcus* sp. CM-4 with those of other spp. of *Enterococcus* available in NCBI database. Numbers at the nodes are percentage bootstrap values based on 500 replications.

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CONCLUSIONS

The selected five isolates from different samples showed desirable probiotically important attributes like growth, and survival at varying pH, high bile salt and NaCl concentrations. All the isolates survived the low pH conditions of 2.0, and were not inhibited by the presence of bile (0.02-0.25 %) and NaCl (2-14 %) indicating their ability to survive in GI tract conditions and hence making them suitable candidates for probiotic application. Of the 7 potential pathogens (*Bacillus subtilis, B. cereus, Escherichia coli, Pseudomonas aeruginosa, P. alcaligenes, Staphylococcus aureus* and *Streptococcus* sp.) examined for their growth inhibition by 5 LAB isolates, growth of majority of pathogens was inhibited by LAB isolates. The isolates CM-4 and KD-7 were most remarkable as they inhibited all the pathogens tested including *S. aureus* and *Streptococcus sp.* Among all the LAB isolates examined CM-4 possessed most of the desirable probiotic properties, and therefore must be studied further to fully claim its potential for applications in poultry feed.

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THE REQUIREMENTS OF CRUDE PROTEIN BY LARGE WHITE BREEDING SOWS AND PIGLETS IN GHANA

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ABSTRACT: *Eighteen Large White gilts at an average initial live weight of 100.39kg were distributed by completely randomized block design over three treatments. There were three cereals-based diets with three different calculated levels of crude protein (CP) namely control breeder diet, Diet 1 (13.16% CP), Diet 2 (12.56% CP) and Diet 3 (12.01% CP) with corresponding lactation diets namely control lactation Diet 1 (LD1) (16.00% CP), Diet 2 (LD2) (14.50%CP) and Diet 3 (LD3) (13.20%CP). Additionally there were three creep diets comprising control Diet 1 (CD1) with 23.01%CP, Diet 2 (CD2) with 21.46% CP and Diet 3 (CD3) with 20.00% CP. The average live litter size of sows were 8.50, 8.40 and 6.67 on Diets 1, 2, and 3 respectively (P>0.05). The number of piglets weaned decreased with decreasing CP in the diet being 7.83. 7.80 and 5.33 on Diets 1, 2 and 3 respectively but were not found to be significantly (P>0.05) different. The average birth weights of the piglets were similar at 1.45, 1.34 and 1.40 kg on Diets 1, 2 and 3 respectively (P>0.05). The milk yield by the sows at 28 days of lactation were found to be 3.06, 3.03 and 5.44kg/day on LD1, 2 and 3 and significantly (P<0.05) different being higher on the lowest CP diet. There was inconsistency with the milk yield at 42 days of lactation with significantly (P<0.05) different values of 4.87, 8.33 and 3.60kg/day on lactation with lactation diet 1, 2, and 3 respectively. It was observed that live weight gains by the sows during gestation significantly (P<0.05) increased with decreasing CP levels in the diets and were 30.3, 36.3 and 34.0 kg on Diets 1, 2 and 3 respectively. The ADGs of the piglets on the creep diets were 0.22, 0.17 and 0.19 kg/day on CD1, CD2 and CD3 respectively, and found to be significantly (P<0.05) different. The study indicated that decreasing levels of CP in the diet at gestation could affect the reproductive performance of the Sow. Decreasing CP in the lactation diet significantly affected sow performance adversely. Whereas a decrease of 1.5% CP in the lactation diet gave similar performance in the sow as the control 3.0% decrease in the CP markedly reduced the performance. Decreasing CP in the creep diets significantly reduced the ADG of the piglets. It was shown that 1.5% reduction in the CP in the creep diets significantly decreased the average daily gain of the piglets compared to that on the control.*

Key words: *Average Daily Gain, Birth Weight, Dietary Protein Requirement, Large White Gilts, Milk Yield, Weaning Weight.*

ORIGINAL ARTICLE

INTRODUCTION

Requirement for nutrients depends on the physiological, genetic, environmental and other factors such as expected production levels (Wang and Fuller, 1989, Cromwell et al., 1999, Cole and Sprent, 2001). Most standards used in Ghana have been determined in US and Europe. The humidity and temperature in the various ecological zones could greatly modify the requirements for CP as determined in the temperate areas.

All nutrients including CP provided in excess of requirements are excreted in the feaces and urine into the soil and eventually into water bodies. Their accumulation would be detrimental to the proper balance of the soil. It is very essential that this excretion of excess nutrient is reduced to a great extent for sustainable soil balance and fertility.

The cost of feedstuffs for pigs is escalating by the day. The cost of production is raising making pork products expensive to the extent of being unaffordable to the majority of Ghanaians. It is important to reduce the cost of the feed by insuring that only the required quantities of the nutrients and in the appropriate balance are provided the pigs as any excess is wasted and only goes to increase feed cost. Scarcity apart from the high cost of feed for pigs emphasizes the most efficient use of all available feedstuffs. This would require the minimum levels of nutrients from feedstuffs for maximum production within an environment (Azian et al., 1994). Most studies on pigs in Ghana and generally in the tropics have been on grower–finisher pigs with resultant dearth of information on the requirements of the breeder sows and the pre-weaner piglets.

This study was undertaken to determine the requirement for CP by the breeder and lactating Large White sows and suckling piglets in southern Ghana.

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MATERIALS AND METHODS

Animals

Eighteen Large White gilts at an average live weight of 90 kg were used for the study. They were distributed by completely randomized design and constituted into three groups of six gilts each. The groups had similar total weight. Each group was randomly assigned to a treatment.

Treatments

There were three treatments made up of a standard pig breeder diet (NRC 1979), Diet 1 and two other diets with differing CP levels, Diet 2 and Diet 3. All the diets were cereal-based and isocaloric. The compositions of the breeder diets are shown in the Table 1. Each diet had a corresponding lactation diet as shown in the Table 2 and a creep diet as shown in Table 3.

Table 1 - Composition of cereal-based pig breeder diet (%) Diets

Ingredient	1 (Control)	2	3
Maize	48.56	49.54	58.2
Wheat bran	45.27	45.86	37.2
Fishmeal	1.00	1.00	1.00
Soya bean meal	2.57	1.00	1.00
Oyster shell	1.90	1.90	1.90
Salt	0.50	0.50	0.50
Premix[1]	0.20	0.20	0.20
Total	100.00	100.00	100.00
Calculated composition			
Crude protein	13.16	12.56	12.01
Determined composition			
Moisture	12.47	12.80	12.39
Crude protein	14.47	13.36	12.02
Ash	4.78	4.82	4.12
Ca	0.35	0.39	0.38
P	0.44	0.01	0.01

Table 2 - Composition of cereal-based pig lactation diet (%) Diets

Ingredient	1 (Control)	2	3
Maize	47.10	48.10	48.56
Wheat bran	38.80	41.80	45.27
Fishmeal	3.80	2.19	1.00
Soya bean meal	7.70	5.31	2.57
Oyster shell	1.90	1.90	1.90
Salt	0.50	0.50	0.50
Premix	0.20	0.20	0.20
Total	100.00	100.00	100.00
Calculated composition			
Crude protein	16.00	14.54	13.20
Determined composition			
Moisture	12.00	11.54	12.29
Crude protein	16.54	15.27	13.40
Ash	5.30	5.14	4.81
Ca	0.80	0.36	0.30
P	0.01	0.01	0.01

Table 3 - Composition of cereal-based pig creep diets (%) Diets

Ingredient	1 (Control)	2	3
Maize	45.91	47.93	49.73
Wheat bran	21.26	23.00	24.73
Fishmeal	11.81	10.12	8.54
Soya bean meal	19.22	16.95	14.80
Oyster shell	1.10	1.30	1.50
Salt	0.50	0.50	0.50
Premix	0.20	0.20	0.20
Total	100.00	100.00	100.00
Calculated composition			
Crude protein	23.01	21.46	20.00
Determined composition			
Moisture	11.68	10.86	11.59
Crude protein	23.67	21.74	20.01
Ash	6.02	5.45	4.73
Ca	0.72	052	0.53
P	0.01	0.01	0.004

[1]Premix: Vit.A, 12,000,000 IU; Vit.E, 15000 mg; Vit.B1, 1500 mg; Niacin 30,000 mg; Vit.B6, 1500 mg; Vit.D3, 4500,000 mg; Vit. K3, 3,000 mg; Pantothenic acid, 12000 mg; Vit.B12, 10,000 mg; Vit. B2,6000 mg; Folic acid, 800 mg, Iron, 60,000 mg; Copper 75,00 mg; Iodine, 750 mg; Manganese, 130,000 mg; zinc, 70,000 mg; Selenium, 300mg; Calcium, 17.50%, Lysine, 1,330 mg; Methionine, 1,075 mg; B-Corotenic acid, 350 mg.

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Measurement

The gilts were individually–housed and fed the pig finisher diet before being mated. The gilts were fed the respective breed treatment diets after service. Each was fed once- daily 2.0 kg of the breeder diet wet with a feed-to-water ratio of 1:2. Water was provided ad-libitum. The gilt after being mated was weighed at 8:00 am the next morning before feeding. The gilt was fed the breeder diet during gestation.

The next morning on parturition, each sow was weighed at 8:00am before feeding. The piglets were also weight. The sow was then fed once- daily 4.0 kg of the corresponding lactation diet until weaned at forty- two days.

The piglets were weighted at fourteen days of age. The piglets were fed the creep diets at two weeks of age. The litters of two sows on each dietary treatment (breeder/lactation) were assigned to one of the creep diets so that there were six litters on each creep diet. The piglets were weaned from the sows at forty- two days of age. The milk production by each of the sows was determined on the second, fourth and sixth week of the lactation period. The piglets were, for each determination, separated from the sow for about two hours using wood partition. They were then allowed to suckle the sow for about half an hour then separated again. This was repeated five times on the day each time with the litter being weighed before and after suckling. The piglets were weaned at six weeks of age. The sows and piglets were weighed at weaning. The sows were observed for the period of return to oestrus.

Parameters

The parameters considered in the study were litter size, average birth weight of piglets, sow live weight change during gestation, sow live- weight change during lactation, average daily live weight gain of the piglets on only sow milk, average daily live weight gain of the piglet on the creep diets, the number of piglet weaned per sow, the average weaned weight of the piglets and the days for post weaning oestrus by the sows.

Analysis

Samples of the diet were chemically analyzed according to the methods of AOAC 2006. Data was analyzed by ANOVA using SPSS (version 16.0) and LSD was used to determine differences between means. Differences were considered significant at $P < 0.05$.

RESULTS

The determined compositions of the breeder diet are shown in Table 1 (ii). The determined compositions of the lactation diets are shown in Table 2(ii). The CP of LD1 was 0.54% higher than the calculated value with that of LD2 being 0.73% higher. LD3 had similar CP to the calculated. The ash values indicated a decreasing trend in LD2 and LD3 compared to LD1. There was a marked difference in the Ca level in LD1 compared to LD2 and LD3.

The compositions of the creep diets fed to the piglets are shown in Table 3 (ii). The CP of CD1 was 0.6% higher than the calculated value with that of CD2 being 0.28% higher. Crude Protein of CD3 was similar to the calculated value. Ca level in CD1 was higher than CD2 and CD3 which were similar.

The reproductive performances of the sows are shown in Table 4.

Table 4 - Reproductive performance of sows on different crude protein levels

Parameters	Diets Treatment			SEM	SIG
	1	2	3		
Average live litter size of sows	8.50	8.40	6.70	0.61	NS
Average birth weight of piglets	1.45	1.34	1.40	0.057	NS
Average number of piglets weaned	7.83	7.80	5.33	0.64	NS

SIG: level of significance, NS: not significant. (P >0.05), * Significant (P<0.05), SED: standard error of differences of means

The average litter sizes of the sows were not found to be significantly (P>0.05) different on the diets. However, those of Diets 1 and 2 were similar and higher than that of diet 3. The average birth weights of the piglets were not significantly (P>0.05) different on the diets. The average numbers of piglets weaned were found to be similar on diet 1 and 2 but relatively higher than on Diet 3.

The average daily milk yields by the sows on the lactation diets with different protein level are shown in Table 5. The milk yield at 14 days of lactation was significantly (P<0.05) higher on LD1 than LD2 and LD3 which were similar. At 28 days of lactation the milk yields by the sows were found to be significantly (P<0.05) different being similar on LD1 and LD2 and higher in LD3. The milk yields at 42 days of lactation were significantly (P<0.05) different on the diets being highest on LD2 compared to LD1 and lowest on LD3.

Table 5 - Average daily milk yield by sows on lactation at various crude protein levels

Parameters	Diets Treatment			SEM	SIG
	1	2	3		
Average sow milk yield at 14 days (kg/d)	7.14	3.66	3.76	0.82	*
Average sow milk yield at 28 days (kg/d)	3.06	3.03	5.44	0.68	*
Average sow milk yield at 42 days (kg/d)	4.87	8.33	3.60	1.11	*

SIG: level of significance, NS: not significant. (P>0.05), * Significant (P<0.05), SED: standard error of differences of means

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Live weight gains by the sow were significantly (P<0.05) different being highest on LD2 and lowest on the LD1 (Table 6). Live weight loss by the sows during lactation is shown in Table 6. It was significantly (P<0.05) high on LD3 and lowest on LD1. The numbers of days taken by the sows to return to oestrus as shown in table 6 were similar on LD1 and LD2 and significantly (P<0.05) shorter compared to that on LD3.

Table 6 - Average live weight changes in sows at various crude protein levels

Parameters	Diets Treatment			SEM	SIG
	1	2	3		
Live weight gain by sows during gestation (kg)	30.33	36.20	34.00	4.22	*
Live weight loss by sows during lactation (kg)	13.60	19.00	21.60	0.69	*
Period to post-weaning oestrus by sows (days)	6.80	7.20	9.20	0.73	*

SIG: level of significance, NS: not significant. (P >0.05), * Significant (P<0.05), SED: standard error of differences of means

The average live weight of the piglets at age 14, 28 and 42 days are shown in Table 7.
There were not found to be significant (P>0.05) different at each period, there were trends of decreasing live weight from LD1 to LD3.

Table 7 - Average live weight of piglets (kg)

Parameters	Diets Treatment			SEM	SIG
	1	2	3		
Live weight of piglets (14 days)	4.60	4.57	3.81	0.22	NS
Live weight of piglets (28 days)	7.18	6.92	6.71	0.28	NS
Live weight of piglets (42 days)	9.22	9.29	9.01	0.51	NS

SIG: level of significance, NS: not significant. (P >0.05), * Significant (P<0.05), SED: standard error of differences of means

The average daily gains in live weights (ADGs) of the piglets are shown in Table 8. ADGs on LD1 and LD3 were similar and not significantly higher than on LD2 at age 14 days on only the sows' milk. The overall ADGs of the piglets were not significantly (P>0.05) different for the sows on LD1, LD2 and LD3. The ADGs of the piglets on the creep diets were not found to be significantly (P>0.05) different being high on CD1 and low on CD2.

Table 8 - Average daily gain of piglets on diets (kg/d)

Parameters	Diets Treatment			SEM	SIG
	1	2	3		
Overall ADG of piglets on lactation diets	0.18	0.19	0.21	0.011	NS
ADG of piglets on creep diets	0.22	0.17	0.19	0.011	NS
ADG of piglets on only Sows milk (14 days)	0.22	0.18	0.22	0.020	NS

SIG: level of significance, NS: not significant. (P >0.05), * Significant (P<0.05), SED: standard error of differences of means

The interactions of the lactation diets and the creep diets are shown in Table 9.The effects of the creep diets on the ADGs of piglets on LD1 were not found to be different significantly (P>0.05). The ADGs of piglets of sows on LD2 were found to have been influenced by the creep diets although the differences were not significant (P>0.05). Relatively, however, the ADGs were higher on CD1 compared to those on CD2 and CD3 which could be considered similar. Although not found to be significantly (P>0.05) different ADGs of the piglets of sows on LD3 were similar on CD1 and CD3 but higher than that on CD2.

Table 9 - Interactions of Lactation and Creep Diets on Average Daily Live weight Gain of Piglets

Parameters	Diets Treatment			SEM	SIG
	1	2	3		
Piglets ADG on lactation diet 1	0.19	0.19	0.17	0.010	NS
Piglets ADG on lactation diet 2	0.27	0.17	0.17	0.026	NS
Piglets ADG on lactation diet 3	0.23	0.15	0.23	0.016	NS

SIG: level of significance, NS: not significant. (P >0.05), * Significant (P<0.05), SED: standard error of differences of means

DISCUSSION

The CP in Diet 1 was 1.31% higher than the calculated value of 13.16% whilst that of diet 2 was 0.8% higher than the calculated value of 12.56%. The CP in Diet 3 was the same as the calculated value of 12.01%. The determined values of all the control diets could be considered similar to the recommendations of (ARC 1981, Grandhi 1994, Jones and Stahly 1995, NRC 1998 and Kusina et al 1999). These values had been established in other environments. The other diets had values close to the calculated values intended to reduce the CP levels. The requirements for nutrients by pigs are influenced by several factors such as temperature, breed, housing and management. All nutrients not used for production by pigs could be excreted into the soil through the faeces and urine. Concerns have been expressed about excretion of the excess nitrogenous and mineral fractions of the diet and the subsequent pollution of ground water bodies.

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The average birth weights of the piglet were not found to be different on the diets and similar to the weight of 1.4kg reported by Phuc and Ogle 2005. Hoang and Nguyen (2001) however found significant difference between the weights of piglets from Mong Cai sows fed on 12% CP and 14% CP diet at gestation.

The litter sizes on gestation Diets 1 and 2 were similar but indicated a decrease with the low CP of diet 3 though not significant, being 8.5, 8.4 and 6.7 on D1, D2 and D3 respectively. The litter sizes on all the diets this were small compared to sizes of 10 to 12 piglet (Hoang and Nhuyen 2001, Phuc and Ogle 2005). This was the first parity of the sows and that might be expected. The number of piglets weaned decreased with reduction in the CP of the diets being 7.8, 7.8 and 5.3 on Diets 1, 2 and 3 respectively, though non-significantly. Hoang and Nguyen (2001) observed a non-significant influence of CP on the litter size weaned. The average number of pigs lost before weaning was higher on diet 3. Low CP in the diet could result in low litter size and piglet birth weight and higher mortality (Shields et al., 1985).

The milk yield by the sows at 14 days of lactation was higher on LD1 which corresponded to D1. Despite the significant differences in the milk yield during the three phases of lactation, it appeared the CP of the diets had no effect on the milk yields in this study. Clowes et al. (2003) found no difference in the sow milk yield by the different protein levels. However Einarasson and Rojkittikhun (1993) obtained milk yields of 7.4 kg/ day on 14% CP diet and 10.5 kg / day on a 16 % CP diet. Sows would mobilize body reserves to maintain milk yield for the piglets and this could explain the results obtained in this study (Johnston et al., 1995, Nielson et al., 1997). Sows on low CP diets would mobilize body fat particularly than sows on higher CP diets (Shields et al 1985). The milk yields obtained in this study could be considered low compared to other studies by (Einarasson and Rojkittikhun 1993, NRC 1998).

Live weight gain of the sows during pregnancy increased with decreasing CP in the diet being 30.3, 36.2 and 34.0 kg on D1, D2 and D3, respectively. Sows on D3 had lower litter size but higher live weight gain than found on D1. CP is required for the formation and development of the foetus during pregnancy. All energy provided in excess of the available CP is converted into fat and stored in the body. Low protein in the diet has been associated with high maternal fat with low protein accretion whilst high protein in the diet increased the body protein mass (Shields et al 1985). This could have occurred with this study. Weight loss in the sows during lactation was 13.6, 19.00 and 21.6 kg on LD1, LD2 and LD3, respectively. The highest weight loss in the sows was on the lowest CP diet. The results confirmed similar observations by (Hoang and Nguyen, 2001, Clowes et al., 2003). Low protein could induce as much as 30 kg weight loss in sows during lactation (Weldon et al., 1994, Mejia- Guadarrama et al., 2002) Sows on LD3 took a significantly longer period to post- weaning oestrus indicating the influence of the CP in the diet. Sows on LD3 lost the greater live weight during lactation and would require a longer period to get back into the proper physiological condition for follicular activities. Protein is mobilized from both the carcass and the reproductive tract during lactation. The reproductive tract loses the highest proportion of about 26% of its protein (Kim and Easter, 2001). Low protein influences post weaning ovulation rate with sows which mobilized much protein more protein having suppressed ovarian function (Mejia- Guadarrama et al 2002, Clowes et al 2003). As maternal reserves of body protein would be required for reproductive needs high protein levels would be required for increased ovarian follicular development (Shields et al 1985, Clowes et al 2003b) All the periods observed on this study were longer than an average of 5 days obtained on other studies (Hoang and Nguyen 2001, Mejia-Guadarrama et al*.,* 2002, Phuc and Ogle, 2005 Gourdin et al., 2006). However those sows on a 12% CP diet took 16 days to post- weaning oestrus indicating a longer period as the observation in this study

The average live weight of the piglet at 14 day of age was non significantly lower on LD3, been 4.60, 4.57 and 3.81kg on LD1, LD2 and LD3 respectively. Average live weight 28 days of age were similar for LD2 and LD3 and at weaning (42 days) were 9.22, 9.29 and 9.01kg on LD1, LD2 and LD3 respectively

The ADG of the piglets on only the sow's milk at 14 days, of age were 0.22, 0.18 and 0.22 kg/day on LD1, LD2 and LD3 respectively, despite the significant difference in milk yield at this period. The smaller litter size of sows on LD3 would mean adequate milk for the piglets reflecting in the ADG observed. This trend continued to weaning with even a smaller number weaned on LD3 with overall ADGs of 0.18, 0.19 and 0.21 kg/day on LD1, LD2 and LD3, respectively. The ADGs of the piglets on the introduction of the creep diets were 0.22, 0.17 and 0.19 kg/day on CD1, CD2 and CD3, respectively, when the whole groups of sows on the individual lactation diet were compared. Interactions of lactation and creep diets indicated that piglets on both low CP gestation and lactation diets had similar and high ADG as those on the high CP diets (1 and 2). However, the low CP diet CD3 elicited low ADG in the piglets on Diets 1 and 2. The ADG of the piglets on the lactation diets seemed to have been influenced to the same extent by the creep diets.

CONCLUSION

The sow reproductive efficiency was reduced by the low CP diets. To conserve and efficiently utilize the scarce and expensive feed resources and possibly minimize the excretion of excess nitrogenous materials into the soil from pig manure, it may be recommended from the study that breeder diets with 13% CP, lactation diets with 16% CP and creep diets with 21% CP may be fed to the Large White pigs in Ghana.

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A STUDY ON THE PREVALENCE OF SHEEP AND GOAT SKIN DEFECTS IN BAHIR DAR TANNERY, ETHIOPIA

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ABSTRACT: *A study to estimate the prevalence of sheep and goats skin defect was carried out at Bahir Dar Tannery. A total of 400 (200 sheep and 200 goat) sheep and goat skins were sampled and examined for skin defect at pickled stage. The study showed that there were different skin defects responsible for the decline in quality grades of skin. From the total skin examined, ekek (58.3%), scratch (22.5%), flying defect (13.8) and scar (11.3%) were common defects. For sheep skins ekek (67%), processing defect (12.5%), scratch (12%) and processing defect (8.5%) were important skin defects and only small number (8.5%) were with no defect. In goats skin, ekek (49.5%), scratch (33%), scar (17.5%) and flying defect (15%) were important defects. Skin quality grades 6 (22.3%), 5 (21.8%) and 4 (18.5%) were frequently observed skin grades. There were unappreciable numbers of rejects (12%) while quality grade 1 was the least frequent (6.3%). Ekek was significantly ($p<0.05$) higher in sheep skin (53%) than goat skin (23.5%). However; scratch was significantly ($p<0.05$) higher in goat than in sheep, but other defects were not significantly ($p>0.05$) different between the two species. Examination also showed that 26 (13.5%) and 22 (11%) were rejected in sheep and goat skins, respectively. Integrated efforts towards good animal husbandry and animal health care are very important for better quality skin. Furthermore, detailed studies on the distribution, seasonal occurrence and the direct and indirect economic impact of ectoparasites should be undertaken. Meanwhile, tanneries should collaborate with such studies to maximize the economic gain in the long run.*

Key words: *Ectoparasite, Ekek, Goat Skin, Sheep Skin, Skin Defect, Pickled Skin*

ORIGINAL ARTICLE

INTRODUCTION

In Ethiopia, skin from sheep and goat are valuable animal by products for local use as well for export market. In the export market, hide and skin export has got the largest share of animal products next to live animal export. Despite the reports about the deterioration of the quality of leather raw material with an increasing number of reject grades and the appearance of skin disease called *ekek* that is mainly due to lice, keds, and mange infestations (Abadi, 2000), Ethiopian small ruminant skins especially sheep skins have good reputation for quality in the world leather market due to their fine grain and compact structure (Zeleke, 2009; Mohamed, 2000).

The leather industry sector is one of the forth growing economic sectors in Ethiopia (MoARD, 2009). However, because the sector is constrained by different factors like external parasites, inappropriate management of animals, faults during slaughtering and improper handling of skin before reaching to the tannery, the sector is losing large amount of money due to decline in quality and fall in export price (CSA, 2007). Up to 65% of the defect that lead to decline of the quality occur in the pre-slaughter stage of production while the animal still alive and a considerable portion of these pre-slaughter defects are directly associated to skin disease initiated by external parasites (Kassa et al., 1998). With this respect, detail analysis and identification of the defects that deteriorate skin quality and forwarding the corrective measures is very important in order to get the benefit out of the sector. This paper reports different skin quality defects and their prevalence in different quality grades of sheep and goats skin in Bahir Dar Tannery.

MATERIAL AND METHODS

Study area

The study was conducted in 2011 at Bahir Dar tannery in Bahir Dar city, Ethiopia, located at about five kilo meters south of Bahir Dar to the Blue Nile falls. Bahir Dar, capital of Amhara regional state, is found in the north

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western part of Ethiopia located between 11° 36' north latitude and 37° 23' east longitude. Bahir Dar has an altitude of 1780 m a.s.l. It has an average temperature ranging from 27.9 to 13.1°C and receives a mean annual rainfall of 1434 mm (Yihalem, 2004).

The Bahir Dar Tannery was established in 1997 and has a tanning capacity of about 4000 skins per day. The tannery collects considerable number of raw materials from western part of the region. It also obtains from other parts of the country. The tannery processes hides and skins to semi-finished and finished leather for local and export markets (Solomon, 2011).

Study design and sample size

Cross-sectional random sampling method was used for identification of skin defects in the tannery. Sheep and goat skins were taken randomly at pickled stage to identify the type of skin defect. A total of 400 (200 from sheep and 200 from Goat) pickled skins were sampled using the standard sampling method (Thursfield, 1995). Sampling was made after the skin has reached pickled stage and after it is categorized by size as extra large, large, medium and small (ESA 2008). Equal numbers of samples were taken from each size category.

After sampling, it was examined for the defects by the skin selector and graded accordingly as grade1, grade 2, grade 3, grade 4, grade 5, grade 6 and reject (ESA, 2008) based on its overall quality (see Table 1). Skin examination was made by natural light to inspect any defect on the skins. Each skin defect identified was recorded and analysed.

Table 1 - Skin grading based on the defects

Grade	Characteristics of skin
Grade 1	No or one minor visible defect which appearing with in 2.5cm from the edge are likely to depreciate the skin
Grade 2	One defect assessed to a total of 1-2 defect units appearing with in 5cm from the edges
Grade 3	Defect assessed to a total of 3-7 defect units
Grade 4	Defect assessed at more than 7 defect units appearing in not more than 20% of the total area of the skin
Grade 5	Defect assessed at more than 7defects units appearing in not more than 50% of the total area of the skin
Grade 6	Culls of which more than50% of the total area is usable
Reject	Culls of which more than 50% of the total area unusable

Source: Ethiopia Standard Authority (ESA) 2008

Data management and analysis

The collected data was entered and managed in to Microsoft Excel. Descriptive statistics was used to present the data. Statistical Package for Social Sciences (SPSS, 2008) was used for data analysis. Chi-square (χ^2) was used to test the association of species, skin size and different grades with defects. In all the analysis, comparisons having $p<0.05$ were considered to have statistically significant difference.

RESULT AND DISCUSSION

The proportion of sheep and goat skin quality grades to different sizes is presented in Table 2. From the total skins sampled, most of the sampled skins lied in grade 6 (22.3%) and grade 5 (21.8%). The proportion of extra large skins in skin quality grades 2 (3.3%), grade 3 (6.4%) and grade 1 (8%) were small. Among the rejected skins, most (58.3%) were from extra large sized skins while the least were from medium sized skins.

Table 2 - Proportion (%) of sheep and goat skin quality grads to different sizes

Size*	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Reject
Small	9(36.0)	9(30.0)	15(31.9)	17(23.0)	22(25.3)	19(21.3)	9(18.8)
Medium	8(32.0)	5(16.7)	13(27.7)	25(33.8)	25(28.7)	19(21.3)	5(10.4)
Large	6(24.0)	15(50.0)	16(34.0)	18(24.3)	23(26.4)	16(18.0)	6(12.5)
Extra large	2(8.0)	1(3.3)	3(6.4)	14(18.9)	17(19.5)	35(39.3)	28(58.3)
Total	25(6.3)	30(7.5)	47(11.8)	74(18.5)	87(21.8)	89(22.3)	48(12.0)

*Equal number of skins was sampled from each size; Numbers in parenthesis are percentages with in a column (for each grade)

Considering the species, most of the skins from goats lied grade 6 (29.5%), grade 5 (28%) and 4 (20.5%) in their order while for sheep skins almost they were distributed almost uniformly from grade 1 to reject. The proportion of goat skins lied in grade 1 (1.5%) was small.

Table 3 - Proportion (%) of grades on sheep and goat skins

Species	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Reject
Sheep skin	22(88.0)	24(80.0)	34(72.3)	33(44.6)	31(35.6)	30(33.7)	26(54.2)
Goat skin	3(12.0)	6(20.0)	13(27.7)	41(55.4)	56(64.4)	59(66.3)	22(45.8)
Total	25(6.3)	30(7.5)	47(11.8)	74(18.5)	87(21.8)	89(22.3)	48(12.0)

Numbers in parenthesis are percentages with in a column (for each grade)

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From the total skin examined for defects, *ekek* (58.3%), scratch (22.5%), flying defect (13.8) and scar (11.3%) were common defects. For sheep skins ekek (67%), processing defect (12.5%), scratch (12%) and processing defect (8.5%) were important skin defects and only small number (8.5%) were with no defect. In goats skin, ekek (49.5%), sctatch (33%), scar (17.5%) and flying defect (15%) were important defects.

Abebayehu and Kibrom, (2010) reported that in sheep skins, scratch was the highest defect recorded followed by ekek and scar whereas in wet blue goat skin, scratch was frequent followed by scar and demodictic mange. The differences for the most prevalent defect might be because of the differences in the prevalence of ectoparasites in the two areas, management differences and the like.

The prevalence of ekek in the present study is higher than the report by Asp and Tauni (1988) at Awash tannery and by Abebayhu and Kibrom (2010) at Sheba tannery (40.71%) while it was lower than the report at Dessie tannery by Sertse and Wesson (2007) and at Sebeta (89%) tannery by Ermias (2000).

Ekek was significantly ($p<0.05$) higher in sheep (67%) than goat (49.5%). Cockle ("Ekek") is an allergic skin hypersensitivity reaction to Keds that occurs in local Ethiopian sheep. In Ethiopia, keds are considered a major cause of "Ekek" and are visible on the skin surface of affected animals (ESGPIP, 2009). Scratch was significantly ($p<0.001$) higher in goat than sheep. This might be associated to the browsing habit of goats where they browse in bush area which may expose them to much damage as compared to sheep. Scar was also different between the two species. Other defects were not significantly ($p>0.05$) varied between the two animals skins.

Table 4 - Prevalence of different defects on sheep and goats pickled skin

Defect	Sheep skin	Goat skin	Total Prevalence	X2	Pvalue
*Ekek**	134(57.5)	99(42.5)	233(58.3)	5.25	0.022
Flying defect	25(45.5)	30(54.5)	55(13.8)	0.455	0.500
Ring worm	1(16.7)	5(83.3)	6(1.5)	2.667	0.102
Processing defect	17(53.1)	15(46.9)	32(8.0)	0.125	0.724
Scratch	24(26.7)	66(73.3)	90(22.5)	19.60	0.000
Scar	10(22.2)	35(77.8)	45(11.3)	13.889	0.000
Crack	0(0.0)	10(100.0)	10(2.5)	0.000	1.00
Pox	4(40.0)	6(60.0)	10(2.5)	0.400	0.527
Putrefaction	0(0.0)	6(100.0)	6(1.5)	-	-

*Amharic word meaning itching

Table 5 - Proportion of skin defects in different grades of skin quality

Defect	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Reject	X2	Pvalue
Ekek*	3(12.0)	17(56.7)	34(72.3)	42(56.8)	54(62.1)	57(64.0)	26(54.2)	69.20	0.000
Flying defect	0(0.0)	4(13.3)	6(12.8)	12(16.2)	16(18.4)	13(14.6)	4(8.3)	14.49	0.013
Ring worm	0(0.0)	0(0.0)	0(0.0)	4(5.4)	1(1.1)	0(0.0)	1(2.1)	3.00	0.223
Processing defect	0(0.0)	3(10.0)	1(2.1)	7(9.5)	10(11.5)	6(6.7)	5(10.4)	9.25	0.099
Scratch	0(0.0)	4(13.3)	8(17.0)	15(20.3)	21(24.1)	30(33.7)	12(25.0)	29.33	0.000
Scar	0(0.0)	2(6.7)	4(8.5)	6(8.1)	8(9.2)	19(21.3)	6(12.5)	23.93	0.000
Crack	0(0.0)	0(0.0)	2(4.3)	4(5.4)	3(3.4)	1(1.1)	0(0.0)	2.00	0.572
Pox	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(1.1)	9(18.8)	6.40	0.011
Putrification	0(0.0)	1(3.3)	1(2.1)	1(1.4)	1(1.1)	1(1.1)	1(2.1)	0.00	1.00
Total	25(6.3)	30(7.5)	47(11.8)	74(18.5)	87(21.8)	89(22.3)	48(12)		

*Amharic word meaning itching

Table 6 - Proportion (%) of skin defects in different size categories of sheep and goat skins

Defect	Small	Medium	Large	Extra large	Total	X2	P value
Ekek*	57(57.0)	57(57.0)	61(61.0)	58(58.0)	233(58.3)	0.185	0.98
Flying defect	8(8.0)	7(7.0)	25(25.0)	15(15.0)	55(13.8)	15.036	0.002
Ring worm	1(1.0)	4(4.0)	1(1.0)	0(0.0)	6(1.5)	3.00	0.233
Processing defect	14(14.0)	13(13.0)	3(3.0)	2(2.0)	32(8.0)	15.25	0.002
Scratch	17(17.0)	28(28.0)	14(14.0)	31(31.0)	90(22.5)	9.111	0.028
Scar	7(7.0)	11(11.0)	10(10.0)	17(17.0)	45(11.3)	4.689	0.196
Crack	5(5.0)	0(0.0)	0(0.0)	5(5.0)	10(2.5)	-	-
Pox	0(0.0)	1(1.0)	4(4.0)	5(5.0	10(2.5)	2.60	0.273
Putrefaction	1(1.0)	4(4.0)	1(1.0)	0(0.0)	6(1.5)	3.00	0.223

*Amharic word meaning itching

The proportion of skin defects in different quality grades is presented in table 5. Ekek was most important in all quality grades especially in quality grads 6 (64%), grade 5 (62.1%) and grade 4 (56.8%). The most important defects in rejected skins were ekek (54.2%), scratch (25%) and pox (18.8%). Next to ekek, scratch (33.7%) and scar (21%) were important skin defects in skin quality grade 6 while flying defect is the third prevalent in skin quality grades 5 and 4.

Negussie et al. (2011) reported that out of the rejected skins from goats and sheep, 98.8% of them had ekek and scratch, whereas 85.6% of them contained sheep and goat pox and 52.2% of them were having knife cuts.

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However, Asp and Tauni (1988) indicated that ekek is the third most important skin rejection defect next to scratch and technical defects at Awash tannery. The differences in the importance of the various skins defects for the rejection could be due to differences in the epidemiology of ectoparasites and differences in skin processing in various tanneries.

Considering skin defects with respect to skin sizes, ekek was important in all the sizes followed by scratch for small (17%), medium (28%) and extra large (31%) sized skins, and flying defect for large sized skins. Processing defect in small and medium sized skins and scar for large and extra large sized skins were also important.

CONCLUSION AND RECOMMENDATION

The result showed that different skin quality defects are responsible for the decline in quality grades which ultimately determines the benefit from the sector. These defects were both manmade (flying defect, post flying handling of the skin, branding) and biological (external parasites and skin diseases). Therefore, awareness creation for the producers about the effect of skin defect on the revenue from the skin is very important. Control of ectoparasite through combination rotational grazing, sound husbandry practice, and application of insecticide and acaricide should be encouraged to minimize the effect of ectoparasites.

In general, integrated efforts towards good animal husbandry and animal health care are very important. Furthermore, detailed studies on the distribution, seasonal occurrence and the direct and indirect economic impact of ectoparasites should be undertaken. Meanwhile, tanneries should collaborate with such studies to maximize the economic gain in the long run.

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COMPARISON OF SLAUGHTER, CARCASS VALUES OF SUDAN GOAT ECOTYPES FED DIFFERENT LEVELS OF ENERGY/PROTEIN

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ABSTRACT: *This experiment aimed to assess the slaughter and carcass values of different Sudan goat ecotypes (Nubian, Desert and Swiss Nubian) fed different levels of energy/protein. Nine male goat kids (2-3 months and average weight 9.23 kg) of either ecotypes were used in a 3x3x3 arrangement, fed three experimental diets A (control), B and C, with varying energy: protein 1:0.14, 1:0.16 and 1:0.18 respectively. The study showed that Nubian goats possessed heavier slaughter weight; empty body weight, warm and cold carcass weight than the Desert and Swiss Nubian goats in the ration B and C. Dressing percentage on both basis (slaughter weight and empty body weight) of Nubian were higher for ration B and C. Warm carcass weights of all goat ecotypes increased directly with energy: protein ratio. Highest weight of leg, loin, rack and neck and shoulder were recorded by Nubian goats for ration B and C. It was concluded that, all ecotype kids respond well to increasing energy protein levels. According to the results obtained local goat ecotypes, mainly Nubian goats, responded well to improved nutrition, therefore results obtained can be applied for the local goat ecotypes studied to encourage goat meat consumption and exportation.*

ORIGINAL ARTICLE

Key words: *Leg, Loin, Nubian, Neck, Rack, Shoulder*

INTRODUCTION

Goats are of economical and social importance, especially in developing and poor countries and are therefore called the poor man cow (Elhag, 1976). Besides being an important meat animal in Africa, Asia and the far East, the goats are now emerging as an alternative and attractive source of meat in other parts of the world (Devendra, 1990). Although goats have been the common source of meat in many tropical and developing countries (Shelton, 1990)

The goat meat production system around the world is extremely diverse and received little scientific attention compared with sheep and cattle. This may be due to the traditionally low economic significance of goats in the developing countries. Goats in the Sudan are primarily raised for milk production as its meat was not preferred in urban areas, since it was considered by far inferior to that of sheep or cattle. Owing to the recent rapid increase in the prices of mutton and beef, goats' meat gained some popularity and all indications assure the continuity of this trend for more goats' meat consumption in the future.

FAO (1995) reported that goat meat ranked third in international meat production and there is an increase in its production in the developing countries. Goat meat shares about 15% of the total meat production in the Sudan (FAO, 1992). In addition, Hadjipanayiotou et al. (1991) confirmed that a good quality goat's meat is similar to that of sheep and cattle i.e. characterized by low fat content, when the efficiency of production is achieved by improved nutrition and management systems (Timon and Hanrahan, 1986). Goat meat evaluations have received little attention and as a result, knowledge of yield and quality of goat meat is limited when compared to sheep and cattle (Warmington and Kirton 1990; Anous and Mourad, 1993).

In general, the goat meat industry is not well defined as it has grown recently (Oman et al., 1999; Cameron et al., 2001). Few official statistics about goat meat are kept on either a national or state basis (Lillywhite, 2002). It is providing many new opportunities for additional income on diversified farming operations.

The objective of this study was to evaluate the effects of different levels of energy/protein on slaughter and carcass values of different Sudan ecotypes goat.

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MATERIALS AND METHODS

Animals and experimental design

Nine male Nubian goat kids, nine male Desert goat kids and nine male Swiss Nubian goat kids (2-3 months old) with an average weight 9.23 kg were used. The animals were rested, ear tagged and injected prophylactic with abroad spectrum 5% antibiotic Oxytetracycline, for four days and dewormed with broad spectrum anthelmintic Ivermectin.

Experimental rations

Three experimental diets (Table 1) were labeled A, B and C subject to treatment groups. Ration A served as the control. The three rations were based on sorghum, wheat bran, and groundnut cake and groundnut hulls.

Table 1 - Percent experimental ration composition (fresh basis)

Ingredients % \ Rations	A	B	C
Sorghum	11	30	51
Wheat bran	40	25	18
Groundnut cake	8	10	9
Molasses	12	15	12
Groundnut hulls	27	18	8
Minerals/ NaCl	2	2	2
CP%	14.49	14.72	14.91
ME MCal / kg (calculated)	2.08	2.41	2.74
Energy: protein ratio	1:0.14	1:0.16	1:0.18
Chemical composition of the experimental rations (on dry matter basis)			
DM %	97.38	94.97	92.87
EE%	1.03	2.75	2.75
CP %	13.28	14.22	13.60
CF %	16.02	11.13	8.25
Ash %	9.20	9.51	7.66
NFE %	57.85	57.36	60.61
ME MCal / kg	2.58	2.66	2.73

Feeding pattern

Mixing of the experimental rations was done manually after weighing the recipe. The dry small quantity ingredients were mixed first then finally with the molasses and left to dry by air and then packed in labeled sacks (A, B and C).

Slaughter procedure and slaughter data

One animal of average body weigh per each experimental group was selected for slaughter. Slaughter weight was taken after an overnight fasting with access to water. The animal slaughter followed the Muslim practice, severing the right and left jugular veins, carotid arteries, esophagus and trachea by a sharp knife. After bleeding was effected, the animal was hung from hind legs to permit easy dressing. The head was removed at the occipto-atlantal articulation, and the fore and hind feet at the proximal metacarpal and metatarsal joints, respectively. Appendages (head, tail, skin and feet) were weighed each separately. The animal was then eviscerated on a full *linea alba* incision.

Visceral organs, (liver, spleen, kidney, pancreas, intestines, omental fat and genitals) and pluck (heart, lungs, trachea and diaphragm) were separated and individually weighed. The alimentary tract was weighed full and then empty to calculate the fill. The fill was subtracted from the slaughter weight to obtain the empty body weight (EBW). Carcasses were weighed warm (WCW) and cold (CCW) after storage 24 h at 4 °C. The dressing percentages were calculated.

Carcass data

The carcass was split into right and left halves by sawing along the vertebral column. Each half was weighed separately. The left half was then divided into fore and hind saddles cutting between the 12th and 13th rib. The hind saddle was further dissected into two wholesale cuts (leg and loin) by cutting proximal to *Ala* of the *Os ileum* of the pelvic girdle. The fore saddle was separated into two anterior and posterior parts between the 5th and 6th ribs. The anterior part was separated into two cuts neck and shoulder, and brisket and fore shank by cutting mid distance, horizontally parallel to the vertebral column. The posterior part was separated also into two cuts, rack (upper) and plate (lower) by cutting mid distance horizontally parallel to the vertebral column (MLC, 1977).

There is no the information of statistical analysis (cause there is no replicates and one animal is slaughtered from each treat)

Proximate analysis

Sample of meat were proximately analyzed for chemical components according to AOAC (1980).

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RESULTS AND DISCUSSION

Table 2 and 3 shows the slaughter weights of Nubian goats were higher for ration B and C than Desert and Swiss Nubian goats. Empty body weight of Nubian was higher for ration C than other ecotypes. This trend was also observed for feet, lung and trachea, liver and intestine. Highest weight of head and skin showed in Nubian goats for ration B and C. The weight of diaphragm and spleen was similar for all ecotypes in ration C. Nubian goats recorded highest values of kidney, omental fat, genital and tail for ration B and C. Pancreas was similar for both Nubian and Desert goats for ration C.

The pattern by which the treatment affects the yield of slaughter values differed in the three ecotypes. The differences in slaughter and empty body weights produced irregular pattern of internal and external offals weights. The percentage of external offals in this study were better than that reported by Elfadil (2001) in male kids fed high energy high protein levels, but inferior when compared to values reported by Ibrahim (1996). The present findings did not completely agree with the statement reported by Gaili (1977) which indicated that, when non-carcass components were expressed as percentage of empty weight, the treatment effect almost disappeared. The external and internal offals are early maturing organs which form a progressively declining proportion of body weight as body weight increases (Kirton et al., 1972; Tonney et al., 1987).

Table 2 - Slaughter values (kg) of experimental goat kids fed different levels of energy/protein

Goat kids / Items	Nubian			Desert			Swiss Nubian		
	A	B	C	A	B	C	A	B	C
Slaughter weight (kg)	08.90	13.80	15.10	11.60	13.30	10.20	10.00	10.70	10.40
Empty body weight (kg)	7.30	12.40	14.10	10.10	12.50	9.10	8.50	9.80	9.30
Head (kg)	0.87	1.14	1.23	1.05	1.10	0.89	1.05	0.94	0.80
Skin (kg)	0.70	0.95	1.32	0.87	0.90	0.74	0.66	0.79	1.00
Feet (kg)	0.40	0.55	0.63	0.48	0.60	0.41	0.43	0.44	0.46
Heart (kg)	0.09	0.13	0.12	0.08	0.11	0.10	0.08	0.09	0.10
Lung and Trachea (kg)	0.14	0.20	0.21	0.20	0.21	0.11	0.13	0.14	0.14
Diaphragm (kg)	0.04	0.05	0.05	0.05	0.04	0.05	0.03	0.04	0.05
Intestines (kg)	0.90	1.30	1.35	1.00	1.32	0.99	1.15	1.10	0.94
Liver (kg)	0.22	0.28	0.38	0.23	0.26	0.21	0.21	0.28	0.28
Spleen (kg)	0.01	0.04	0.03	0.03	0.04	0.03	0.03	0.03	0.03
Kidney (kg)	0.06	0.06	0.06	0.05	0.05	0.04	0.03	0.05	0.05
Pancreas (kg)	0.02	0.03	0.04	0.02	0.02	0.04	0.03	0.03	0.03
Omental fat (kg)	0.02	0.30	0.32	0.08	0.18	0.25	0.09	0.11	0.09
Genitals (kg)	0.11	0.24	0.22	0.15	0.09	0.11	0.14	0.15	0.16
Tail (kg)	0.02	0.05	0.04	0.03	0.02	0.02	0.03	0.03	0.02

Table 3 - Slaughter values (kg) of experimental goat kids fed different levels of energy /protein

Species	Rations	Slaughter weight (kg)	Internal offals (kg)	Internal offals (%)	External offals (kg)	External offals (%)
Nubian	A	8.9	1.64	18.43	1.97	22.13
	B	13.80	2.94	21.30	2.64	19.13
	C	15.10	2.88	19.07	3.18	21.06
Desert	A	11.60	1.92	16.55	2.40	20.69
	B	13.30	2.59	19.47	2.60	19.55
	C	10.20	2.46	24.46	2.04	20
Swiss Nubian	A	10	2.02	20.20	2.14	21.40
	B	10.70	2.13	19.97	2.17	20.28
	C	10.40	1.98	19.04	2.26	21.73

Table 4 shows that the highest weight of warm carcass and cold carcass for ration B and C recorded by Nubian goats. High losses showed in Swiss Nubian for ration C. Dressing percentage on both basis (slaughter weight and empty body weight) of Nubian were higher for ration B and C than for Desert and Swiss Nubian goats. Highest values of dressing percentage on cold basis showed in Desert goat for ration B. Warm carcass weights of test groups were increasing as energy: protein ratio increases, being higher than the control group. Warm carcass weights of test groups were in the range of 4.46-7.15 kg. This is in accordance to the results reported by Mahgoub et al. (2005), but lower than the results reported by Shrestha and Fahmy (2007). The present results of cold carcass weight compare favorably with result reported by Mahgoub et al. (2005) and Choi et al (2006), but lower than that indicated by Webb et al. (2005) and Ryan et al. (2007). The dressing percentage values reported in this study was compare favorably with values observed by Lupton et al. (2008) and Ryan et al. (2007), but lower than those reported by Abd El-Moula (1996); Elkhidir (1989) and Webb et al. (2005). The dressing percentage on slaughter weight basis reported in this study were lower than the result reported by Sen et al. (2004), but higher than those indicated by Dadi et al. (2005). However the dressing percentage on empty body weight basis reported in this study were lower than the resulted reported by Sen et al. (2004) and Dadi et al. (2005). In the present investigation the

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dressing percentage on worm and cold basis compare favorably with results reported by those Daskiran et al. (2006) and Ibrahim (1996), but then the result showed by Elfadil (2001) for kids fed high energy high protein. Bello and Babiker (1988) reported dressing percentage of 54.1 for the Desert goats and 54.8 for their temperate crosses which were highly comparable with our result.

The low values of dressing percentage observed in this study may be due to the effect of slaughter weight, since there was positive relationship between slaughter weight and carcass weight which was observed by Devendra and Owen (1983) and McGregor (1982). Bhattacharyya and Khan (1988) stated that empty body weight or the amount of rumen and intestinal contents might have affected the dressing percentage. Dressing percentage is usually quoted on the basis of live weight, but it is more accurate to quote this on the basis of empty body weight in order to eliminate the variation caused by the contents of the alimentary tract (Devendra and Owen, 1983).

The proportion of carcass weight loss due to evaporation during dressing or cold storage is referred to as carcass shrinkage or hanging loss. There is direct relationship between carcass shrinkage and fat deposition in the carcass, mainly subcutaneous fat. The values of carcass shrinkage percentage in this study were in the range of 0.16–3.02. These values were lower than those reported by Ibrahim (1996); Osman (1984); Bello (1985) and Elkhidir (1989) in carcasses of Desert goats.

Table 4 - Dressing percentage values of experimental goat kids fed different levels of energy /protein

Species	Rations	Warm carcass weight (kg)	Cold carcass weight (kg)	Carcass shrinkage %	Dressing % (slaughter weight basis) warm	Dressing % (empty body weight basis)	Dressing % (cold basis).
Nubian	A	03.60	03.50	02.78	40.45	49.32	39.33
	B	6.45	6.35	1.55	46.74	52.02	46.01
	C	7.15	6.95	2.80	47.35	50.71	46.03
Desert	A	05.20	05.10	01.92	44.83	51.49	43.97
	B	6.21	6.20	0.16	46.69	49.68	46.62
	C	4.55	4.52	0.66	44.61	50	44.31
Swiss Nubian	A	3.93	2.92	0.25	39.30	46.24	39.20
	B	4.46	4.42	1.90	41.68	45.51	41.31
	C	4.64	4.50	3.02	44.62	49.89	43.27

Table 5 shows that the highest weight of leg, loin, rack and neck and shoulder were recorded by Nubian goats for ration B and C. The weight of plate and brisket and foreshank was similar of Nubian and desert goats for ration B.

In the Sudan the meat production system depends on live weight and visual assessment of the animal. The grading systems practiced should consider that the consumer prefers more lean in the carcass. In the present investigation the percentage of carcass cuts (leg, loin, neck and shoulder) were found lower than the values reported by McGregor (2007). In present study the percentage of primal cuts were lower than that reported by Sen et al. (2004) and Ryan et al. (2007).

Table 5 - Weights (kg) of carcass cuts of experimental goat kids fed different levels of energy: protein.

Species	Rations	Leg (kg)	Loin (kg)	Rack (kg)	Plate (kg)	Neck and Shoulder (kg)	Brisket and Foreshank (kg)
Nubian	A	0.60	0.15	0.13	0.10	0.43	0.40
	B	1.11	0.31	0.30	0.23	0.75	0.55
	C	1.15	0.32	0.29	0.24	0.80	0.70
Desert	A	0.87	0.25	0.22	0.15	0.60	0.50
	B	1.09	0.30	0.29	0.23	0.65	0.55
	C	0.71	0.24	0.20	0.18	0.50	0.45
Swiss Nubian	A	0.62	0.18	0.20	0.14	0.44	0.40
	B	0.80	0.20	0.18	0.16	0.45	0.44
	C	0.74	0.22	0.18	0.16	0.50	0.46

Table 6 Shows the Swiss Nubian goat had higher moisture percent than the Nubian and Desert goats. Compared to Desert and Swiss Nubian goats higher protein percent was observed for Nubian goat fed ration B and C. Fat percentage of ration C for Desert goat was higher than other ecotypes. This trend was also observed for percentage of ash. In the present study, the values of meat moisture percent compared favorably with results reported by those Elfadil (2001); Sen et al. (2004) and Paleari et al. (2008), but lower than the result indicated by Lee et al. (2008). In the present study, the values of meat protein percent compared favorably with values showed by Lee et al. (2008); Sen et al. (2004) and Arguello et al. (2005), but slightly lower than the result indicated by Paleari et al. (2008) . However, fat percentages in this investigation were lower than those reported by Paleari et al. (2008); Lee et al. (2008); Arguello et al. (2005) and Elfadil (2001).

El–Tayeb et al. (1988) reported in mutton significant differences among dietary treatments in percentages of moisture and fat. The moisture increased linearly ($p<0.05$) while fat decreased linearly ($p<0.05$) as the level of

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supplemental blood meal increased. Generally the fat and moisture contents of meat are inversely related. However, the results of moisture and fat obtained here in this study were not in line with the previous statement as the moisture and fat values were irregular. Park et al. (1991) reported 2.27 and 2.03% fat for Alpine and the crosses of Nubian goats respectively which were higher than that reported in the present study.

Lawrie (1991) reported that the mammalian muscle contains about 0.65% of minerals such as phosphorus, potassium and magnesium. The values of ash percentage in this study were lower than those reported by Lee et al. (2008); Ibrahim (199 and Elfadil (2001) and higher than that reported by Shahjalal et al. (1992) for Angora goats (0.76-0.81). Generally, the protein, ash and water percentages of the body decrease with advancing age and fattening (Gaili et al. 1972).

Table 6 - Percent values of meat chemical composition of experimental goat kids fed different levels of energy: protein

Species	Rations	Moisture (%)	Protein (%)	Fat (%)	Ash (%)
Nubian	A	73.25	22.08	0.11	1.10
	B	69.10	22.75	0.83	0.94
	C	70.15	21.35	0.55	1.0
Desert	A	62.21	24.15	0.14	7.75
	B	71.94	19.25	0.66	0.83
	C	69.13	20.30	1.60	2.81
Swiss Nubian	A	73.49	22.93	0.08	1.08
	B	75.10	18.90	0.25	1.01
	C	72.67	19.25	0.23	0.06

CONCLUSION

It is concluded that in domestic goat, the Nubian and Desert ecotypes (in this order) generally performed better than the Swiss Nubian, as reflected in good carcass yields. Exotic blood (genetic) and the tropical environmental conditions were the factors retardant to their adaptation. Therefore results obtained can be applied for the local goat ecotypes studied to encourage goat meat consumption and exportation.

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EFFECT OF DIETARY LEVELS OF COWPEA (*Vigna unguiculata*) SEEDS ON EGG QUALITY

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ABSTRACT: *The objectives of this study were to evaluate the effect of including 3 dietary levels of grain meal cowpea (Vigna unguiculata) 0, 5, 10 and 15% on external and internal egg characteristics. Seventy two laying hen of 28 weeks age were randomly allocated into 4 dietary treatments of 0, 5, 10 and 15% levels of cowpea seeds, which were further replicated 6 times in completely randomized design. Feed and water supply were offered to birds ad libitum while standard management practices were adopted. The results showed that the external parameters like maximum length and width, shell thickness and shell % and egg weight were significantly (P<0.05) affected by dietary treatments. Egg shape index was not significantly (P>0.05) influenced by dietary treatments. Internal quality characteristics were not significantly (P>0.05) affected by dietary treatments except for albumin weight, albumin percentage, yolk index and yolk colour. It is concluded that commercial egg characteristics such as egg weight is satisfactory maintained with 5 to 1`0% inclusion of cowpea grain meal in balanced diets for layers.*

ORIGINAL ARTICLE

Key words: *Cowpea Levels, Layers, Eggs*

INTRODUCTION

The rapid increase in the world population and acute protein shortage particularly, in developing countries has necessitated the urgent need for a means of increasing food production especially cheap and good source of protein. Rich sources of quality protein for the body are mainly animal sources such as poultry (Oloyede et al., 2007). The major hindrance however, to commercial poultry production is the high cost and unavailability of the standard commercial feeding stuff. A need therefore arises for the search into the possible ways of obtaining maximum production in poultry with minimum expenditure, so that the products can be sold at relatively low prices with similar or even better nutritional quality than convectional ones. The legumes as a group show tremendous potential for production of protein for poultry in under developed countries (Leon et al., 1993). Cowpeas are a good source of proteins, minerals and energy (Kochhar et al., 1998). Cowpeas are an excellent food for some individuals because contain no cholesterol and low fat (Eheart et al., 1988). Also protein from cowpeas seeds can be recovered in six solubility fractions and high content of amino acids (Kochhar et al., 1988; Aremu, 1990).

The incorporation of cowpeas protein in the formulation of diets for egg production is limited due to the presence of anti-nutritional factors which may affect the physiological status of layer. However, the levels of inclusion of this legume must be adjusted (Robinson and Singh, 2001). The objective of this study is to evaluate the effect of including different dietary levels of raw grain meal cowpea (*Vigna unguiculata*) on internal and external egg quality.

MATERIALS AND METHODS

The experiment was conducted in Poultry Unit, Faculty of Animal Production, Khartoum University. It extended for 4 months in which ambient temperature range between 28-45^{o}C (Metrological Department, Shambat).

Eggs were collected twice a day in the morning and afternoon and the percentage of hen day egg production were estimated, eggs weight were recorded for all the replicate groups. Eggs were weighed on electronic digital balance. The hen-day egg production percentage were calculated from the total number of eggs actually collected, expressed as percentage of the expected number of eggs for each group per week over 12 weeks period.

Experimental birds

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Total of 28 weeks of age Hisex laying hen were purchased from Coral Company. The birds were previously vaccinated against Marks disease at hatching. They were also vaccinated against (Gumboro) at two weeks of age, New Castle disease at 3 weeks of age and at 11 weeks against fowl pox. The debeaking process was done at 31 weeks of age. Seventy two laying hens were approximately selected for this experiment. Selection was based on the individual body weight. The birds were subjected to adaptation period of two weeks before data collection. The hen day egg production was about 70%. The live body weight ranged from 1300-1500g. The birds were divided into 4 groups (18 birds/ treatment). They were further sub-divided into 6 replicate groups of 3 birds each.

Experimental housing

One battery was used in this experiment. It was cleaned and disinfected using formalin. The batter consists of six lines as four cages each. Birds of each replicate were assigned randomly in 24 cages on 3 tiers wire blocks (50×42×40 cm) of laying batter with 3 birds in each cage.

Experimental Diets

Four iso-caloric and iso-nitrogenous diets were formulated according to nutrient specifications of the standards as recommended by National Research Council (NRC, 1994), as follows: Ration (A) control diet contained 0% level of cowpea seeds, (B) containing 5%, (C) containing 10%, (D) containing 15% of raw cowpea seeds. Each treatment group was randomly assigned to one of the four diets. Feed samples were analyzed for proximate composition according to the methods indicated in the AOAC methods of analysis (1990). The ingredients calculated and determined nutrients content of the experimental layers diets are shown in Table 1.

Table 1 - Composition of experimental layers diets containing dietary levels of cowpea (*Vigna unguiculata*) seeds

Treatments / Ingredients	Dietary cowpea seeds with different treatments ingredients			
	0 (A)	5 (B)	10 (C)	15 (D)
Sorghum	64.50	64.50	64.50	64.50
Groundnut	6.84	6.84	6.79	6.79
Sesame meal	6.00	6.00	0.00	0.00
Wheat bran	10.00	5.00	6.00	1.05
Super concentrate	5.00	5.00	5.00	5.00
Oyster shell	7.00	7.00	7.05	7.00
Salt	0.40	0.40	0.40	0.40
Di-calcium phosphate	0.26	0.26	0.26	0.26
Calculated analysis %				
Me (Mj/kg)	11.90	11.99	11.96	11.88
Crude protein	17.67	16.34	17.05	17.37
Crude fat	5.50	6.50	5.60	6.00
Crude fiber	3.34	3.34	3.94	3.90
Calcium	3.35	3.45	3.26	3.32
Av. Phosphorus	0.49	0.49	0.48	0.48
Methionine	0.36	0.36	0.32	0.31
Lysine	0.69	0.69	0.69	0.76
Determined analysis % (DM-Basis):				
Dry matter	95.05	95.54	93.40	94.15
Crude protein	17.33	18.01	18.70	18.62
Ether extract	6.67	7.33	8.10	6.32
Crude fiber	5.21	6.56	6.078	6.20
Nitrogen free extract	57.64	55.88	50.78	54.01
Ash	8.20	7.76	8.42	7.60
ME (Mj/kg)	12.34	12.55	12.55	11.90

Management:

The birds in each cage were supplied with one drinker. The cages were equipped with 2 feeders. They were kept clean. Droppings were cleaned every day. Birds of all treatments groups received similar care and management. Sixteen hours light (daylight + 4 hours artificial light) were maintained throughout the experimental period. Feed and water were provided ad libitum.

Egg quality management:

Each two weeks external and internal quality characteristics of eggs were measured. Two fresh eggs from each replicate group were weighed. Then the maximum length and maximum width were measured. The shell thickness was also measured by taking samples of shell from top, middle and bottom of egg using 0.2mm vernia caliper (Hitutoyo, Japan). The shell weight was also measured. The shell weight/egg weight was calculated to determine the shell percentage.

Sample eggs from each replicate were broken with a blunt knife, contents poured on a piece of flat glass dish and different components were separated and weighed. The albumin height, mm was taken by 0.2mm vernia caliper on the middle of thick albumin in both sides opposite to the chalaza as an average of two sides. The yolk height, mm, albumin and yolk diameters, cm were measured using 0.2mm vernia caliper. The albumin and yolk

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indices were calculated as the proportion of the height of each to the diameter. Albumin yolk index was calculated as the proportion of albumin weight/yolk weight. Albumin and yolk percentage were calculated the proportion of weight of each/egg weight. Haugh unit was calculated by using following formula

$$\text{Haugh unit} = 100 \log H - \left[\frac{G\,(30W^{0.37} - 100}{100} + {}^{1}/_{9}\right]$$

Where:

H=Albumin height (mm); G= A constant (32) related to the constant of gravitation; W= Weight of egg (g)

Yolk colour scores were recorded as described by Roche yeolk colour fan regarded from 1 to 15.

RESULTS

The effect of dietary treatment on overall external quality characteristics of eggs from layers hen are shown in Table 2. No significant (P>0.05) dietary effect for egg shape index weight of egg sample was significantly (P<0.05) affected by the dietary treatments. It was found to be significantly (P<0.05) higher for birds fed the control diet compared to the others. The lowest value observed for birds that fed diet with15% cowpea seeds. Maximum length and width were significantly (P<0.05) influenced by dietary treatments. It was found to be higher for birds that received the control diet and 5% cowpea seeds than other dietary treatments. Shell weight, shell thickness and shell % were significantly (P<0.05) influenced by dietary treatments. Birds fed the control diet observed to have significantly (P<0.05) higher shell weight and shell percentage compared to the other treatments. The lowest values were observed in birds fed 15% cowpea seeds. The effect of dietary treatments on overall internal quality characteristics of eggs from layer hens is shown in Table 3. No significantly (P>0.05) dietary effect for all internal quality characteristics during the experimental period except for albumin weight, albumin percentage, yolk index and yolk colour score. Albumin weight was significantly (P<0.05) higher in birds fed 5% cowpea seeds than others groups. Albumin percentage was significantly (P<0.05) higher in birds fed 15% cowpea seeds compared to other dietary treatments. Yolk index was significantly (P<0.05) higher for birds fed 5% cowpea seeds compared to others. Yolk index for birds fed the control diet, 10 and 15% cowpea seeds were not significantly (P>0.05) different. Yolk colour score was found to be significantly (P<0.05) higher for birds received 15R cowpea seeds.

Table 2 - External quality characteristic of eggs from layers fed dietary levels of cowpea (*Vigna unguiculata*) seeds during experimental period 31st – 42nd week of age)

Parameters	Levels of cowpea seeds %			
	0 (A)	5 (B)	10 (C)	15 (D)
Egg wt (g)	49.18^{a}	47.51^{ab}	45.27^{c}	45.19^{c}
Maximum length (cm)	5.40^{a}	5.39^{a}	5.27^{b}	5.18^{bc}
Maximum width (cm)	4.30^{ab}	4.29^{ab}	4.21^{b}	4.12^{bc}
Shell weight (g)	5.60^{a}	5.57^{b}	5.56^{b}	4.12^{bc}
Shell thickness (mm)	0.391^{a}	0.328^{ab}	0.320^{c}	0.320^{c}
Egg shape index	0.792	0.803	0.780	0.770
% shell	12.30^{a}	12.26^{ab}	11.89^{bc}	11.74^{c}

Table 3 - Internal quality characteristics of eggs from layers fed dietary levels of cowpea (*Vigna unguiculata*) during experimental period (31st - 42nd) week of age

Parameters	Levels of cowpea seeds %				
	0 (A)	5 (B)	10 (C)	15 (D)	±SEM
Albumin height (mm)	8.72^{a}	8.51^{a}	8.25^{a}	8.22^{a}	0.09
Albumin diameter (cm)	7.20^{a}	7.20^{a}	7.17^{a}	7.128^{a}	0.08
Albumin weight (g)	29.11^{b}	32.40^{a}	30.05^{b}	27.89^{c}	0.78
Albumin index	0.120^{a}	0.116^{a}	0.118^{a}	0.115^{a}	0.005
Albumin %	63.38^{ab}	63.65^{ab}	62.28^{bc}	65.11^{a}	0.76
Yolk height (mm)	120.09^{a}	10.69^{a}	10.67^{a}	10.48^{ab}	0.20
Yolk diameter (cm)	3.41^{a}	3.32^{a}	3.28^{a}	3.36^{a}	0.04
Yolk weight (g)	11.80^{a}	11.53^{a}	11.35^{a}	11.04^{a}	0.38
Yolk index	0.312^{b}	0.328^{a}	0.311^{b}	0.316^{ab}	0.008
Yolk %	26.34^{a}	25.71^{a}	24.18^{a}	23.87^{a}	0.72
Yolk colour	1.15^{c}	1.15^{c}	1.30^{b}	1.42^{a}	0.09
Haugh unit	98.90^{a}	99.20^{a}	98.87^{a}	98.99^{a}	0.46

DISCUSSION

Means values of external quality characteristics of eggs from 31st – 42nd week of age layers fed dietary levels of cowpea seeds revealed the dietary treatments had no effect on egg shape index. Egg weight, shell weight, shell thickness and shell percentage were higher in birds supplemented with the 5% cowpea seeds and the control diet, compared to that received 10 and 15% cowpea seeds, these results similar to the finding reported by Igbasan and Gunter (1997) who noticed a reduction in egg weight sample, egg production, egg mass and shell quality by increasing level of field peas in layers diet. The authors attributed this effect to the poor feed intake and loss in

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body weight which lead to poor egg production during long period of time-whereas, the reduction of shell quality maybe due to calcium and phosphorus chelation by phytate in cowpea seeds (Lon et al., 2000).

The effect of dietary levels of cowpea seeds on internal characteristics of eggs of layers revealed that albumin height, albumin diameter, albumin index, yolk height, yolk diameter, yolk weight, yolk percentage and haugh unit did not appear to be affected by the dietary treatments. In the current study, albumin weight, albumin % and yolk index were higher in the birds received 5% and control diets compared to others dietary treatments which were similar. Egg yolk colour was improved as the level of cowpea increased. A similar observation was reported by Igbasan and Gunter (1997), this may be due to the presence of carotenes in seeds.

CONCLUSION

Cowpea has a good nutritional profile and has been used successfully in poultry feed but in low levels. Inclusion of high level (15%) affected the internal and external egg characteristics due to the presence of anti-nutritional factor.

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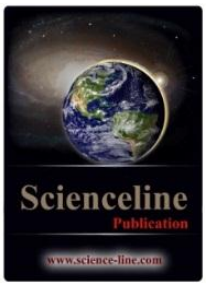

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		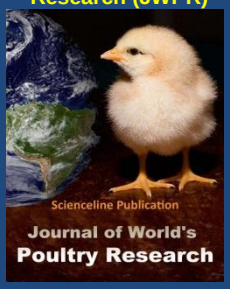	
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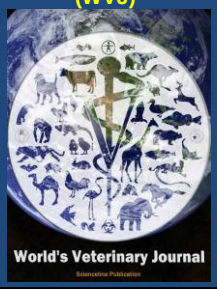		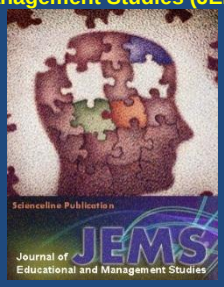	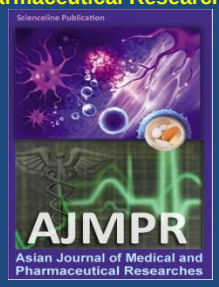
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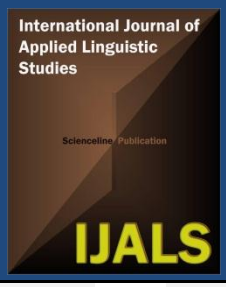			

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