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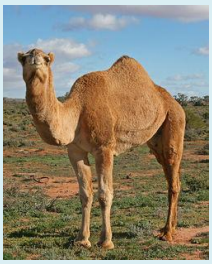
Research Title / Graphical Abstract	Article Information / Abstract	Download
The Influence of Seasons on Blood Constituents of Dromedary Camel (Camelus Dromedarius) 	**Original Research, C1** **Babeker E.A., Elmansoury Y.H.A. and Suleem A.E.** ***Online J. Anim. Feed Res.*, 3(1): 01-08, 2013.** **ABSTRACT:** *This study was carried out in White Nile State, Sudan for a period of one year, and was designed to investigate the effect of seasons on the blood constituents of dromadery camel (Camelus dromedarius). One hundred and four Samples different sex and age were collected in July (Rainy Season), September (Rainy hot summer), October (Dry wet winter) and April (Dry hot summer). The effect of season on some blood hematology, metabolites, enzymes and minerals profile was studied. The results showed higher significant level were: Monocytes, total protein and Glutamic-Oxaloacetic Transaminase (GPT) during rainy season, while MCV, MCH, lymphocytes, Eosinophils and Basophils in rainy hot summer, whereas within dry wet winter were: glucose, albumin and k, even in dry hot summer were: MCHC, total white blood cells, neutrophils, uric acid, creatinine, Serum Glutamic-Oxaloacetic Transaminase (GOT) and Ca. The results also indicate that the fluctuations of seasons were observed in red blood cells, hematocrit (PCV) and E.S.R as lower level. Therefore, it could be valuable to provide that the dromedary camels adapted to tropical conditions.* **Key words:** *Dromedary, Camels, Seasons, Blood Constituents*	Watch Online
Effects of enzyme (Xzyme) supplementation on the performance of laying hens fed diets containing different levels of cassava (*Manihot esculenta, Crantz*) leaf meal  	**Original Research, C2** **Zanu H.K., Kagya-Agyemang J.K. and Avukpor C.M.** ***Online J. Anim. Feed Res.*, 3(1): 09-14., 2013.** **ABSTRACT:** *An eight-week feeding trial was conducted to determine the additive effect of enzyme (Xzyme) and cassava leaf meal on the performance of laying hens. The cassava leaf meal (CLM) replaced different levels of fishmeal at levels of 0, 5, and 10% CLM in three iso-nitrogenous diets. One hundred and twenty Lohman strains of layers at thirty-weeks of age were randomly assigned to the three dietary treatments in a completely randomized design (CRD). Each treatment had forty birds, with ten birds per replicate. The initial average liveweight of birds from each replicate was 1.7 kg. Feed and water were offered ad libitum. Data collected included feed intake, liveweight gain, egg production, carcass characteristics, hematology and serum biochemistry. Economics of production was also calculated. Feed intake of birds on the treatment groups with CLM + xzyme was not different from those on the control. Final weight gain of birds on diet with 10% CLM +xzyme was lower than their counterparts on the other diets. Carcass weight of birds was not affected by dietary treatments. There was no difference in egg production, egg weight, shell thickness, Haugh unit and egg mass between dietary treatments. The rate of utilization of feed was reduced with inclusion of CLM in diet, with birds on 5% CLM+xzyme based diet recording the least feed conversion ratio (FCR). Except for heart, kidney, full proventriculus, full and empty gizzard, the other organs showed differences in their weights. All hematological parameters investigated except Mean Corpuscular Hemoglobin (MCH) showed difference in their mean values. The total serum protein (TSP), albumin, globulin and albumin/globulin ratio showed differences. Cost benefit analysis indicated that profit derived from the incorporation of CLM+xzyme in the diets was the same as control diet.* **Key words:** *Egg Production, Hematology, Layer Diets, Leaf meal, Serum Biochemistry*	Watch Online
Response of two different broiler genotypes to diets containing cocoa pod husk  	**Original Research, C3** **Hagan B. A., Adu-Aboagye G., Asafu-Adjaye A., Lamptey V., Boa-Amponsem K.** ***Online J. Anim. Feed Res.*, 3(1): 15-19, 2013.** **ABSTRACT:** *A total of 300 day old chicks from 2 commercial broiler genotypes were fed diets containing 0, 5, 10, 15 and 20 percent cocoa pod husk (CPH) for 33 days. Thereafter, all the chicks were fed a common finisher diet which was devoid of CPH until 56 days of age. Body weight, feed consumption, feed efficiency and carcass traits (eviscerated, gastro intestinal tract (GIT), feather and liver weights) were measured. Genotype × CPH level interaction was not significant in this study. Body weight of the genotypes differed significantly (P<0.05) at 1, 33 and 56 days but not at 14 days. The different CPH levels however, elicited differences (P<0.05) in the body weight at 15 % and 20 % inclusion rates for ages 14 and 33 days. When fed a common finisher diet at 33 days, recovery in body weight was observed in broilers fed all but 20 % CPH diet by 56 days of age. Feed efficiency which declined beyond 5 % CPH level at 33 days showed an improvement in all broilers except those fed 20 % CPH. Eviscerated carcass, GIT and liver weights showed no differences among the diets. The results suggested that even though growth of chicks deteriorated beyond 10 % CPH by 33 days, advantage should be taken of the tremendous compensatory growth upon CPH withdrawal and thereby increase the starter CPH level to 15 percent.* **Key words:** *Broiler, Cocoa Pod Husk, Diet, Genotype, Performance*	Watch Online
Determination of nutritive value of tomato pomace using in vitro gas production technique	**Original Research, C4** **Rahbarpur A., Taghizadeh A. and Mehmannavaz Y.** ***Online J. Anim. Feed Res.*, 3(1): 20-22, 2013.** **ABSTRACT:** *This study was carried out to the determination of nutritive value of Tomato Pomace (untreated and treated with two levels of urea) using gas production technique. The gas production was measured at 2, 4, 6, 8,10, 12, 16, 24, 36, 48, 72 and 96 h. The gas production of unteated and treated with 1 and 2 leaves of tomato pomace at 72 h were 168.21, 164.21 and 156.66 ml/g DM and there were significant differences (P<0.05). Data showed that Tomato Pomace can be used as a high energy feed in ruminant rations to support growth and lactation, with fewer negative effects on rumen fermentation than starch rich feeds.*	

Key words: *Gas production, Tomato Pomace, Treated with Urea*

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The influence an exogenous enzymes-probiotics complex on the growth performance and carcass traits of albino rats fed diets containing up to 60% rice bran

Original Research, C5
Boateng, M., Okai, D.B. and Amponsah, B.K.
***Online J. Anim. Feed Res.*, 3(1): 23-27, 2013.**

ABSTRACT: *The experiment was conducted to determine the effects of varying levels of rice bran supplemented with Xzyme™ (an exogenous enzyme-probiotic complex) on the growth performance and carcass traits of albino rats. Thirty weanling albino rats with average initial live weight of 66.9±0.3g were randomly allotted to six dietary treatments in a 3 x 2 factorial design (3 levels of rice bran [20, 40 and 60%] by 2 levels [0 and 250mg/kg of diet] of the Xzyme™). There were 5 rats on each treatment which were housed individually in plastic cages. Feed and water were provided ad libitum and their growth performance monitored for 28 days, after which the rats were slaughtered to collect carcass data. The mean values for total feed intake, weekly feed intake and daily weight gain were similar (P>0.05) for all the various dietary treatments. The addition of the Xzyme™ led to an improvement (P>0.05) in feed conversion ratio (FCR) at each level of the rice bran. Both feed cost and feed cost per 100g weight gain values decreased as the level of RB increased despite the extra cost of the added Xzyme™. The carcass characteristics of the albino rats on all the six dietary treatments were similar (P>0.05). The results suggest that albino rats and probably other mono-gastric livestock species can be fed diets containing 60% rice bran plus Xzyme™ without any adverse effect on health, growth performance and carcass characteristics.*
Key words: *Feed, Fibre, Albino rat, Rice bran, Xzyme™*

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Comparison of dry matter digestibility of three variety of sorghum silages with speed feed variety by nylon bag technique

Original Research, C6
Ghareh Dashli K., Taghizadeh A. and Pasandi M.
***Online J. Anim. Feed Res.*, 3(1): 28-30, 2013.**

ABSTRACT: *In this study, four types of sorghum silages were tested with nylon bag technique. Tow fistulae Gizel sheep with average BW 50.5±2.5 kg used in a complete randomized design. Ruminal DM disappearance were measured 0,4,8,12,16,24,36,48,72 and 96 h. Dry matter degradability of R161 and R165 at 96h were 66.88 and 62.35%, respectively were higher and lower DM degradability that showed significant differences (P<0.05). Sorghum silages have high DM degradability and its nutritional composition showed that its can used instead of Alfalfa. It can decrease feed price.*
Key words: *Sorghum Silage, Degradability and Nylon Bags*

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Effect of season and dietary protein level on immune response of three exotic broiler strains in Sudan

Original Research, C7
Huwaida E.E. Malik, Ali O.H.A., Mohamed, E.A.A. and Yousif, I.A.
***Online J. Anim. Feed Res.*, 3(1): 31-35, 2013.**

ABSTRACT: *This study was conducted to investigate the effect of the season (summer versus winter) and dietary protein level (high versus low) using three broiler strains (Ross, Cobb and Hubbard) on immunity; heterophil/lymphocyte ratio and haemagglutination against sheep red blood cells (SRBC). Three hundred and sixty, one-day-old unsexed broiler chicks were used in this study during the summer and winter seasons, 120 from each of Ross strain, Cobb strain and Hubbard strain. Two experiments were executed in a complete randomize design (factorial arrangement 3x2x2). Each strain was divided into two groups, with six replicates (10 chicks per replicate). Group A of each strain was fed on a starter diet containing 23% crude protein for the first four weeks of age, then replaced by a finisher diet containing 21% crude protein. Group B was fed on a starter diet containing 21% crude protein replaced by a finisher diet containing 19% crude protein. Both diet were iso caloric. The results showed that the heterophil/lymphocyte ratio (H/L ratio) increased significantly (P<0.05) during the summer in both Hubbard and Ross strains, but it was not significantly affected by the season in Cobb strain. The total antibody titers against SRBC were decreased during the summer season in the three strains. The level of dietary protein showed no significant effect on H/L ratio in the three strains. Decreasing dietary protein level decreased the total antibody titers against SRBC in both Ross and Hubbard strains. Whereas, it does not affect the total antibody titers against SRBC in Cobb strain.*
Key words: *Broiler Strain; Season; Protein Level; Immune Response*

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The determination of nutritive value of some rangeland plants using nylon bags technique

Figure (11)

Original Research, C8
Ashrafi V and Eivazi P. 2013. B
***Online J. Anim. Feed Res.*, 3(1): 36-39, 2013.**

ABSTRACT: *In order to determine of nutritive value of pasture forages (Agropyron intermedium Boiss, Coronilla Varia, Ziziphora Tenuior and Scorzonera grossheimii lipsch) using in situ, this study was carried out. In this study two fistulated wetheres (35±1.8 kg) were used in in situ method. Ruminal DM and CP disappearances were measured 0,4,8,16,24,36,48,72 and 96 h. Dry matter degradabilities of Coronilla Varia and Agropyron intermedium Boiss at 48 h, were higher and lower, that showed significant differences (P<0.05). Crude protein degradabilities of Coronilla Varia at 96 h was 78.18 % that were higher and showed significant differences (P<0.05). Pasture forages can used largely as a ruminant feeds.*
Key words: *Pasture forages, Gezel sheep, Nylon bag*

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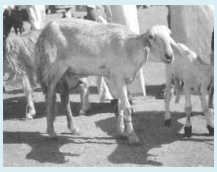
Effect of feeding untreated or urea treated groundnut hull supplemented with different protein sources on blood parameters of Sudan desert lambs



Original Research, C9

Abdel Hameed A, Salih AM, Fadel Elseed AM and Amasab EO

***Online J. Anim. Feed Res.*, 3(1): 40-46, 2013**

ABSTRACT: *Hematology and serum biochemistry from thirty Sudan desert lambs (of an average body weight and age 18.0 ± 0.5 kg and 4-5 months respectively) fed diets contained untreated (UGH) or urea treated groundnut hull (TGH) with different protein supplementations (groundnut cake (GNC), cotton seeds cake (CSC) and fish byproducts (FBP) were investigated. The lambs given six dietary treatments; diets A, B and C were contained TGH supplemented with GNC, CSC and FBP respectively, while diets D, E and F were contained UGH supplemented with GNC, CSC and FBP respectively. Jugular blood samples were taken at 0, 45 and 90 days. There were significant differences between experimental diets in hemoglobin concentration (Hb), red blood cells (RBC), mean corpuscular hemoglobin (MCH) and mean corpuscular volume (MCV) concentrations, while other parameters were similar. Increasing feeding periods resulted in higher increase in Hb, WBC, MCHC and MCH concentrations, while PCV and MCV concentrations decreased. The same trend was observed in total serum protein, urea and triglycerides concentrations with higher values recorded for lambs fed A, B or C diets, while, no differences were found on serum albumin and globulin concentrations. Serum P, K and Na recorded higher values for lambs fed in A and B diets than other experimental diets. as experimental period increased (from 0 to 45 and 90days) serum K and Na concentrations were decreased significantly, while no significant variations in the values of serum Ca and inorganic P. Ration × period interaction had no significant effects on concentration of serum K and Na from A, B and C diets, while there were significant variations on concentration of serum Ca and P. The study revealed that inclusion of TGH supplemented with GNC, CSC or FBP in the diets of growing Sudan desert sheep had positive effects on the haematological and serum biochemical parameters.*

Key words: *Urea, Crop Residues, Protein Sources, Blood Hematology, Blood Biochemical Profile, Sheep.*

Economic studies on immunostimulents in relation to mycotoxin infection in cultured fish

Original Research, C10

Saad, T.T., Ahmed, H.A., El-Gohary, M., Ali, M.A.

***Online J. Anim. Feed Res.*, 3(1): 47-57, 2013**

ABSTRACT: *Studies in the past decade confirm that the growth of both gram-positive and gram-negative foodborne bacteria, yeast and mold can be inhibited by garlic, onion, cinnamon, cloves, thyme, sage, and other spices. Consumption of mycotoxin contaminated foods has been associated with several cases of human poisoning, or mycotoxicosis, sometimes resulting in death. This study concluded that: When the ration or the fish suffered from fungal infection the addition of black seed, garlic and onion will reduce the infection and improve fish health. In Post mortem lesions the fish suffered from mycotic infection showed severe degenerative changes in internal organs especially in the liver, heart and kidneys. The result cleared that, the blackseed is the best herbs that prevented and improve the aflatoxin effect followed by garlic and onion, respectively. The result also showed that level of RBCs and WBCs, differential leucocytic counts, phagocytosis process, serum protein, biochemical analysis of fish body, body weight and body weight gain improved with addition of blackseed, garlic and onion. The residue of aflatoxin in fish flesh decreased in the groups treated with blackseed, garlic and onion than the control or fish fed on the aflatoxin. The results also showed that, frequent supplementation of fish ration with black seed, garlic and onion can reduce the aflatoxin hazards in the fish. The results also concluded that, the higher economic efficiency measures (total return, total costs, net profit, total returns/total costs and net return to total costs) improved in the groups fed with blackseed, garlic, onion and all of them improved economic efficiency measures than the control groups and when all of them added to the fish treated with aflatoxin diet improved economic efficiency results than the group treated with aflatoxin only.*

Key words: *Economic Efficiency, Blackseed, Aflatoxin, Biochemical Analysis.*

Effect of cinnamon and ginger compared to Doxystin (antimicrobial drug) on serum lipid profile in broiler chicks

Original Research, C11

ElBagir, M. Nabiela, Hind, A.A. Elagib, S.A. Abbas, Ginawi, T.A.N.

***Online J. Anim. Feed Res.*, 3(1): 58-61, 2013**

ABSTRACT: *The aim of this study was to assess the effect of the medicinal plants cinnamon (Cinnamomum verum) and ginger (Zingiber officinale), as natural feed additives in comparison to (Doxystin) "(Doxycycline HCl 50 mg and Colistin sulfate" , known antimicrobial growth promoter (on the serum lipid profile of broiler chicks. One hundred and sixty (one day-old) broiler chicks were assigned to four groups of the same mean weight, each with four replicates of ten chicks. The first group was used as control group and fed broilers basal diet, the second group fed the basal diet supplemented with the (Doxystin) as 0.5%, the third and fourth groups fed basal diet mixed with C. verum, and Z. officinale as %٢ of the diet respectively. The experimental diets affected all parameters measured follows, total cholesterol and serum (low density lipoprotein) LDL-C concentration was significantly (P (٠.٠٥>decreased in groups received spices diet compared to Doxystin and control groups .Whereas, the (high density lipoprotein) HDL-C concentration showed significantly (P (٠.٠٥>lower levels in the two spice treated groups compared to the control group only, and the antibiotic treated animals showed similar level to that observed in spice treated groups . Triacylglycerols and the VLDL-C fraction showed clearly reduced values in all treated groups compared to the control group, though the difference was not significant but it was more pronounced in the spice treated groups, as they reported half the level of the control group. It can be concluded that inclusion of C. verum and Z. officinale as feed additives acted as natural hypocholesterolemic agents in broiler chicks in particular and reduced blood lipids in general.*

Key words: *Lipid, Cholesterol, Cinnamon, Ginger, Broiler, Chicks*

Non regulatory constraints affecting pig industry in Zimbabwe

Original Research, C12
Mutambara J.
***Online J. Anim. Feed Res.*, 2(5): 62-67, 2012.**

ABSTRACT: *This study was done to review the status of pig industry in Zimbabwe and find out the non-regulatory constraints to production and marketing using a value chain approach. The study used literature and secondary data from stakeholders and service providers as well as primary data collected through key informant interviews and focus group discussions. Data were analyzed mainly by value chain mapping and descriptive statistics. There are key players and service providers in the pig industry who play various roles from input supply, production, processing until the product is available to domestic and international consumers. Pork production has been going down over time from a record high of 20000 sow units in 2007 to about 10000 sow units in 2010. Pork production is further threatened by weak demand for meat estimated at 8.7kgs per capital. Key internal and external non regulatory constraints identified with percentage scores were poor breeding stock (84%), electricity gap (70%), abattoir fees (73%), skills gap (67%), shortage of abattoir facilities (57%), low production capacity (64%), low yield levels (64%), finance (61%) and low demand for pork (47%). These factors were noted as inhibiting growth and development in the sector. This paper will conclude by indicating that there is a need for a serious review of the operating environment of the industry in order to ensure the smooth running of business in the pig industry in Zimbabwe given the volume of issues identified by stakeholders in the pig value chain. It is recommended that further detailed research and inquiry be made around the various issues identified to provide hard evidence on the impact of such operating environment on the performance of the industry. With this evidence, stakeholders will gain more understanding of the need to create a favorable operating environment that will see growth and development in the pig industry.*
Key words: *Literature, Secondary, Primary, Performance, Evidence, Business, Stakeholders*

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Effect of herbal supplement on growth response and faecal egg counts of cockerels

Original Research, C13
Allinson I.B., Ekunseitan D.A., Ayoola A.A., Ogunade I.M. and Njoku C.P.
***Online J. Anim. Feed Res.*, 3(1): 68-73, 2013**

ABSTRACT: *This study was carried out on 360 day-old cockerels to determine their growth response and faecal egg counts to herbal supplement administration. The birds were brooded and allotted to four treatment groups of 90 birds with three replicates of 30 birds each. The experimental treatment was based on the frequency of administration of the herbal supplement: Control, Weekly, Fortnightly, and every three weeks. Data on growth response and microbial counts were taken. Data obtained were subjected to One-way Analysis of Variance in a Completely Randomised Design. Herbal supplement had significant (P<0.05) effect on the bacteria and oocyst count of cockerels. Bacteria count was highest in the control treatment, while values were significantly similar in cockerels administered with herbal supplement. Oocsyt count was significantly (P<0.05) influenced with highest values obtained in control with lowest values statistically similar in treatment 2, 3 and 4 respectively. The effect of herbal supplement on the growth response of cockerels revealed that most parameters were not significantly (P>0.05) influenced by herbal supplement except Feed: Gain and average weight gain. The best Feed: Gain value and average weight gain was obtained in birds administered the herbal supplement weekly (treatment 2). Conclusively, herbal supplement (extracts) can serve and be used as antibiotic alternatives in poultry for better performance and utilization of feed in terms of feed: gain and weight gain particularly to control the growth of harmful bacteria.*
Key words: *Herbal Supplement, Growth Response, Faecal Egg Count, Bacteria Count, Oocsyt Count.*

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Chemical composition of oilseed cakes and deoiled cakes in Nepal

Original Research, C14
Sharma NK.
***Online J. Anim. Feed Res.*, 3(1): 74-76, 2013**

ABSTRACT: *A study was conducted at Probiotech Industries laboratory from March 2011 to September 2012 A.D to access the qualities of MCs (Mustard cakes), MDOCs (Mustard deoiled cakes) and SDOCs (Soy deoiled cakes) available in different parts of Nepal. Oilseed cakes and deoiled cakes commonly used in livestock and poultry feed in Nepal are MC, MDOC and SDOC. Laboratory findings showed wide variation in chemical composition of these feed ingredients. Mustard Cake contained 91.42% dry matter (DM), 30.12% crude protein (CP), 5.98% crude fibre (CF), 9.29% ether extract (EE), 6.73% total ash (TA) and 1.58% acid insoluble ash (AIA). Mustard deoiled cake varied greatly in DM content ranging from 84.42% to 94.76% with a mean value of 89.84% DM. The mean CP, CF, EE, TA and AIA content in MDOC was 35.65%, 10.28%, 0.69%, 7.61% and 1% respectively. The mean DM content in SDOC was 87.24% but it ranged from 6.23% to 19.26%. Soy deoiled cake contained 44.85% CP, 7.16% CF, 1.03% EE, 7.74% TA and 1.49% AIA on an average though there was marked variation in these parameters. About 32.6% of SDOC samples contained CP above 46%. Since there is quite variation in composition of these oilseed cakes and DOCs, it is suggested that the feed millers and nutritionists of Nepal test each samples before using it for feed formulations.*
Key words: *Mustard Cake, Mustard Deoiled Cake, Soy Deoiled Cake, Nutrient Composition, Quality*

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Prevalence of Enteric Bacteria Isolates from Aquarium Snail (*Ampullaria spp.*) in Abia State, Nigeria

Original Research, C15
Nwiyi P. and Amaechi, N.
***Online J. Anim. Feed Res.*, 3(1): 77-79, 2013**

ABSTRACT: *The freshwater snail (Ampullaria spp.) was evaluated to determine the presence of enteric-pathogens commonly present. The fresh aquarium snail samples were collected from 5 different open markets where they were displayed for sale at Aba and Umuahia. They were processed in the veterinary laboratory of Michael*

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Okpara University of Agriculture Umudike. Different bacterial ranging from salmonella, pseudomonas, Escherichia coli, Proteus, Shigella, Aeromonas, Enterobacter, Klebsiella and Staphylococcus were isolated. The presence of these pathogenic organism showed that Ama-ogbonna and Umungasi market recorded the highest isolate while New market, Ekeakpara and Umuahia central market recorded the least in that order: Escherichia coli, Proteus spp. and Salmonella spp. 30 (25.00%), 26(23.33) and 21(17.50%) recorded the most frequently isolated bacteria while Aeromonas and Staphylococcus spp. recorded the least frequently isolated bacteria 4(3.30%) and 4(3.30%). Due to the fact that these bacteria isolate present health related challenges on consumption of snail, there is the need for snails to be properly washed and cooked before eating.

Key words: *Freshwater Snail**,** Bacterial Ranging, Cooking, Eating*

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Observations concerning haematological profile and certain biochemical in sudanese desert Goat

Original Research, C16

Babeker E.A. and Elmansoury Y.H.A.

***Online J. Anim. Feed Res.*, 3(1): 80-86, 2013**

ABSTRACT: *Blood samples were collected from 30 (15 male and female) apparently healthy Sudanese desert goats ranging under the same field conditions from North Kordofan State, Sudan. This study had analyzed the hematological profile of goats and the influence of sex on the hematological and some biochemical values. On the Erythrocyte parameters sex had any influence: The mean of red blood cell (RBCs) {(12.10 ± 0.53) (×106 /µL) } and the mean corpuscular hemoglobin concentration (MCHC) (35.69 ± 2.94) in males were higher than females {(12.27 ± 0.74) (×106 /µL), 36.45 ± 2.49)%}, while the hemoglobin (HB), packed cell volume (PCV), mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH), were high in males than females. In leukocytary series: Total W.B.Cs, Monocytes (%) and Neutrophils (%) were higher in females, while Lymphocytes (%) and Eosinophils (%) high in males. Neutrophils (%) average was smaller than normal (23.67 ± 1.96) % and mean of Monocytes (%) was higher, which may be interpreted as a potential infection or hermetic aggression. In biochemical: Glucose was elevated in females goats, while total protein and urea higher in male animals. Ever Since the animals are apparently healthy, any value may be regarded as possible infection or metabolic and nutritional disorder.*

Key words: *Haematological Profile, Biochemical Indices, Blood, Desert Goat.*

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THE INFLUENCE OF SEASONS ON BLOOD CONSTITUENTS OF DROMEDARY CAMEL (CAMELUS DROMEDARIUS)

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ABSTRACT: *This study was carried out in White Nile State, Sudan for a period of one year, and was designed to investigate the effect of seasons on the blood constituents of dromadery camel (Camelus dromedarius). One hundred and four Samples different sex and age were collected in July (Rainy Season), September (Rainy hot summer), October (Dry wet winter) and April (Dry hot summer). The effect of season on some blood hematology, metabolites, enzymes and minerals profile was studied. The results showed higher significant level were: Monocytes, total protein and Glutamic-Oxaloacetic Transaminase (GPT) during rainy season, while MCV, MCH, lymphocytes, Eosinophils and Basophils in rainy hot summer, whereas within dry wet winter were: glucose, albumin and k, even in dry hot summer were: MCHC, total white blood cells, neutrophils, uric acid, creatinine, Serum Glutamic-Oxaloacetic Transaminase (GOT) and Ca. The results also indicate that the fluctuations of seasons were observed in red blood cells, hematocrit (PCV) and E.S.R as lower level. Therefore, it could be valuable to provide that the dromedary camels adapted to tropical conditions.*

ORIGINAL ARTICLE

Key words: *Dromedary, Camels, Seasons, Blood Constituents*

INTRODUCTION

Investigation of blood constituents can provide valuable benefit and indication about the general health of animals. Observation of a deviation of certain blood parameters from their normal limits could be an indication for diagnosis or differential diagnosis of a diseased condition (Dessouky, 1992). It has been increasingly realized that more fundamental knowledge of hemogram, blood metabolites and hormones in the dromedary contributes greatly to the understanding of the physiology of this species. Many of the researches that had conducted are incomplete or lack references to fluctuations in the parameters studied caused by environmental conditions or time of sampling during the day. It was thus considered that a useful contribution in physiological knowledge could be made by studying the diurnal variations of blood None sterilized Fatty Acids (NEFA), corticoids, glucose, urea, total proteins, insulin, cholesterol, Glutamic-Oxaloacetic Transaminase (GOT), gamma-GT, Glutamic-Oxaloacetic Transaminase (GPT) (Jimale et al., 1990) and other hematological and serum biochemical values in grazing dromedaries (Dessouky, 1992; Al-Bashan, 2011). Comparison of blood values under different management systems seems to be important as these values reflect the well-being of the animal and are used extensively as diagnostic tests. Serum Glutamic-Oxaloacetic Transaminase (GOT) content is low, but after extensive destruction of cardiac, hepatic, or skeletal tissues, this enzyme is librated into the blood at high levels (Harper, 1971). The estimation of serum GOT is widely used as diagnostic tool for liver injuries, myocardial infarctions, and skeletal muscle sympathies (Ogita and Markert, 1989).

Galyean et al. (1981) found that serum GOT concentration was higher in fasted and transported steers than in untreated controls. Moreover, Schaefer et al. (1990) and Schmidt et al. (1970) reported that blood from stress susceptible pigs had greater concentration of GOT than did blood from stress resistant pigs. Ewan et al. (1968) found elevated serum GOT content in lambs with white muscle disease, a nutritional muscular dystrophy caused by a diet deficient in selenium and (or) vitamin E.

Babeker (2007) reported that increase in GOT lead to increase significantly the Glutamic-Oxaloacetic Transaminase (GPT) in Sudanese sheep.

The camel has provided life in a place uninhabited by most animals (Ouajd and Kamel, 2009). This species is able to survive in hot a temperature that is normally lethal to others species. It can walk 5-7 days with little or no food and water and can lose a quarter of its body weight without impairing its normal functions. All the functions of this species are seen to be adapted to desert environment which is characterized by little water and poor food

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(Wilson, 1988; Ouajd and Kamel, 2009). The one humped camel is an essential source of food and milk in many parts of the world and especially in developing countries in Africa and Asia. The dromedary plays also economic, social and ecological roles (Warden, 1992; Ouajd and Kamel, 2009). The camel possesses unique features which make it superior to other domesticated animals make in the hot and arid desert ecosystem. This reinforced by the ability of camel to traverse considerable distance with much less effort than other species, moving from one patch of short-live vegetation to another.

Camel physiology and special features are therefore not only of a scientific interest, but are the basic substance for people who live in marginal dry land areas. The dromedary camels adapted themselves to ecosystem of dry and arid zones where they are subjected to harsh conditions in addition to the severe fluctuations in the nutritional status, which in turn affect their general performance (Warden, 2004). The protein content of plant species consumed by camels would satisfy most of the protein requirements of camels to perform their various physiological functions (Warden and Farid, 1990).

The concentration of blood metabolites are sensitive to seasonal changes in nutrient supply. Therefore, they could be used as indicators of nutrientional status (Pamba–Gollah et al., 2000). In Sudanese camels the concentrations of plasma glucose and serum urea, creatinine, phosphorus (P) and calcium.

Blood urea concentration was increased in camels, steers and sheep during fasting (Wensvoort et al., 2004). In camels, serum triglycerides concentration has been reported to be affected by a diet (Wasfi, et al., 1987).

Amin et al. (2007) found that the red blood cells count, lymphocytes and basophiles percentages increased significantly during the dry season, while the MCV, MCH and neutrophils percentage increased significantly during the green season.

The pasture quality and quantity are influenced by the seasonal changes in rainfall (Lebon, 1965; Schwartz and Dioli, 1992), which in turn could influence the nutritional status and consequently the in rainfall (Lebon, 1965; Schwartz and Dioli, 1992), which in turn could influence the nutritional status and consequently the blood constituents of camels and comparison of blood values under different management systems seems to be important as these values reflect the well-being of the animal and are used extensively as diagnostic tests. Therefore it was our intention to study the seasonal changes in the some blood hematology, metabolic, enzymes and minerals profile of free ranging camels and to investigate if these could be used as indicators in the evaluation of pasture quality and the predication of metabolic diseases.

In rainfall (Lebon, 1965; Schwartz and Dioli, 1992), which in turn could influence the nutritional status and consequently the blood constituents of camels and comparison of blood values under different management systems seems to be important as these values reflect the well-being of the animal and are used extensively as diagnostic tests. Therefore it was our intention to study the seasonal changes in the some blood hematology, metabolic, enzymes and minerals profile of free ranging camels and to investigate if these could be used as indicators in the evaluation of pasture quality and the predication of metabolic diseases.

MATERIALS AND METHODS

Survey background

This study was carried out in North White Nile State, Sudan (Latitudes 13^0 and 29^0 North, Longitudes 20^0 and 32^0 East). It was conducted all the year during four seasons starting from 20 June 2009 until 19 June 2010. The seasons described by (Haroon, 2002); Rainy season (from 12 June to 18 October), Rainy hot summer season (from 10 October to 17 November), Dry wet winter season (from 18 November to 15 February) and Dry hot summer season (from 17 February to 20 June). Blood samples were collected from apparently healthy camels of different sex and age. The camel herds were naturally ranging and had no feed supplementation except the provision of common salt (NaCl), where approximately l pound of salt was added to 20 L of water during the dry hot summer. The camels have had access to water every 5 - 9 days during the dry season, while water was available ad labium during the others seasons.

Climatic measurements

The daily maximum and minimum ambient temperature (T_a) rainfall and relative humidity (RH) readings were obtained from Eldweem Meteorological Unit in White Nile State. The mean monthly values of ambient temperature, rainfall and relative humidity during the survey period were then computed.

Blood analysis

Samples of blood were collected from camels by jugular vein puncture. Seven milliliter blood samples were collected from each camel using 10 mL plastic disposable syringes. Tow milliliter of the blood sample were immediately transferred to capped and heparinzed tubes (Medical Disposable Industrial Complex MDIC). These samples were used for the hematological analyses and the determination of plasma glucose concentration. The rest of the samples were allowed to clot for 2h at room temperature, the sera were then separated by centrifugation at 3000 rpm for 15 min and stored frozen at -20C for further analysis. Erythrocytic indices were determined according to the methods described in Schalm's Veterinary Hematology (Jain, 1986). The packed cell volume of erythrocytes was determined by the micro-haematocrit method using a special centrifuge. Haemoglobin concentration was determined by the cyano-methaemoglobin method as described by Van Kampen and Zijlstra

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(1961). Mean Corpuscular Hemoglobin (MCH), Mean Corpuscular Hemoglobin Concentration (MCHC) and Mean Corpuscular Volume (MCV) calculated from the following formula (Simon et al, 2001):

MCV fl (femtoliter) = {Hematocrit % × 10} / {RBCs count (in million /uL)}

MCH pg (picogram) = { Hemoglobin (in gm/dL) × 10} / {RBCs count (in million /uL)}

MCHC (g/dL) ={ Hemoglobin (in gm/dL) × 100} / {Hematocrit (in %)}

Differential leukocyte count (DLC) was determined microscopically from a count of 100 leukocytes in thin May-Giemsa stained blood smears (Kelly, 1984). Serum total protein was determined by the Biuret reagent method according to King and Wooton (1965), serum albumin concentration was determined according to the method described by Bartholomew and Delany (1966). Plasma glucose level was determined by the enzymatic colorimetric method using a kit (Plasmatec Laboratory at Products Ltd Germany). The concentration of serum urea was determined by the colorimetric method according to Harold (1988). Serum creatinine concentration was determined by a colorimetric method as described by Henry (1974). Glutamic-Oxaloacetic Transaminase (GOT) and Glutamic-Pyruvic Transaminase (GPT) were determined according to Reitmann-Frankel method (1957). Serum Phosphorus concentration was determined by the colorimetric methods as described by Varley (1967). Serum calcium concentration was measured by the colorimetric method as described by Trinder (1964).

Statistical analysis

The data obtained from the blood samples collected from the camels during the seasons have been subjected to standard methods of statistical analysis was performed using windows based SPSS (Version 10.0, 1999). The analysis of variance (ANOVA) test was used to evaluate the effects of season on blood constituents of the camels.

RESULTS

Climatic data

The prevalent maximum and minimum ambient temperature (T_a), rain fall and relative humidity (RH) during the survey period in the Rainy season (from 12 June to 18 October), Rainy hot summer (from 10 October to 17 November), Dry wet winter (from 18 November to 15 February) and Dry hot summer (from 17 February to 20 June) are shown in Figure 1. The highest mean value of maximum and minimum ambient temperature (43.0°C, 27.5°C) was recorded in May and July during the dry hot summer, respectively, and the maximum mean value of rainfall (116.1mm) and humidity (55%) was recorded in July during the rainy season. The lowest mean value of maximum and minimum ambient temperature (33.0°C, 19.4°C) was recorded in January during the dry weight winter, respectively, and the minimum mean value of rainfall (0.0mm) and humidity (19%) was recorded in April during the dry hot summer.

Seasonal variation in blood constituents of camel Erythrocytes indices

Except for Hemoglobin (Hb), all parameters presented in table (1) showed significant variation due to seasonal effect. R.B.Cs count and the Packed Cell Volume (PCV) was significantly ($p<0.05$) lower during Rainy hot summer and Dry hot summer, respectively. Erythrocyte Sedimentation Rate (E.S.R) increased significantly during Dry hot summer a level slightly higher than that of Rainy hot summer or Rainy season which turndown significantly within Dry weight winter.

Mean Corpuscular Volume (MCV) and Mean Corpuscular Hemoglobin (MCH) demonstrated significant differentiation to seasons of year, increased significantly during Rainy hot summer season and decreased significantly in Dry hot summer. Mean Corpuscular Hemoglobin Concentration (MCHC) showed higher and lower significant in Dry wet winter.

Differential leukocytes count

When compared examined differential leukocytes in the course of seasons of the year, showed highest significant value were: Total W.B.Cs count during Dry hot summer, Lymphocytes and Basophils rations in Rainy hot summer and Monocytes in Rainy season. While the significant lower value were: Neutrophils (%) and Eosinophils (%), during Rainy hot summer and Dry hot summer, respectively (Table 1).

Blood metabolites

Blood metabolites during different seasons is presented in Table 3. Serum glucose was found to be significant ($P<0.05$) higher (80.40 ± 5.04) in Dry weight winter, then showed a significant low level (36.45 ± 6.14) during Rainy season. Uric acid and Creatinine showed the same significance for increased values during Dry hot summer as compared to other environmental and physiological conditions. Total protein a level shows a peak of (9.33 ± 0.15) during Rainy hot summer a slightly higher than Rainy season, which significant increased as compared with total protein concentration during Dry wet winter and Dry hot summer.

On other hand albumin concentration showed a significant variations within seasons and recorded higher value (3.82 ± 0.33)g/dl during Dry wet winter than other seasons.

Concentration of serum enzymes in camels: Glutamic Oxaloacetic Transaminase (GOT) in Dry wet winter was significantly ($P<0.05$) lower as compared to other seasons of the year, this increase continued to reach the peak of

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(3.03 ± 0.57) during Dry hot summer, Glutamic-Pyruvic Transaminase (GPT) also showed significant increase to reach level (16.95 ± 1.61). During Rainy season it goes down with significant decline to reach (2.50 ± 0.20) in Dry hot summer (Table 4).

Concentration of serum minerals in camels: Serum inorganic calcium (Ca+2) during Dry hot summer was significantly higher with other periods. Potassium (K+) concentration augmented significantly during Dry wet winter to reach level (7.19 ± 2.60) and decrease significantly in Rainy season to attain (2.04 ± 0.15) (Table 5).

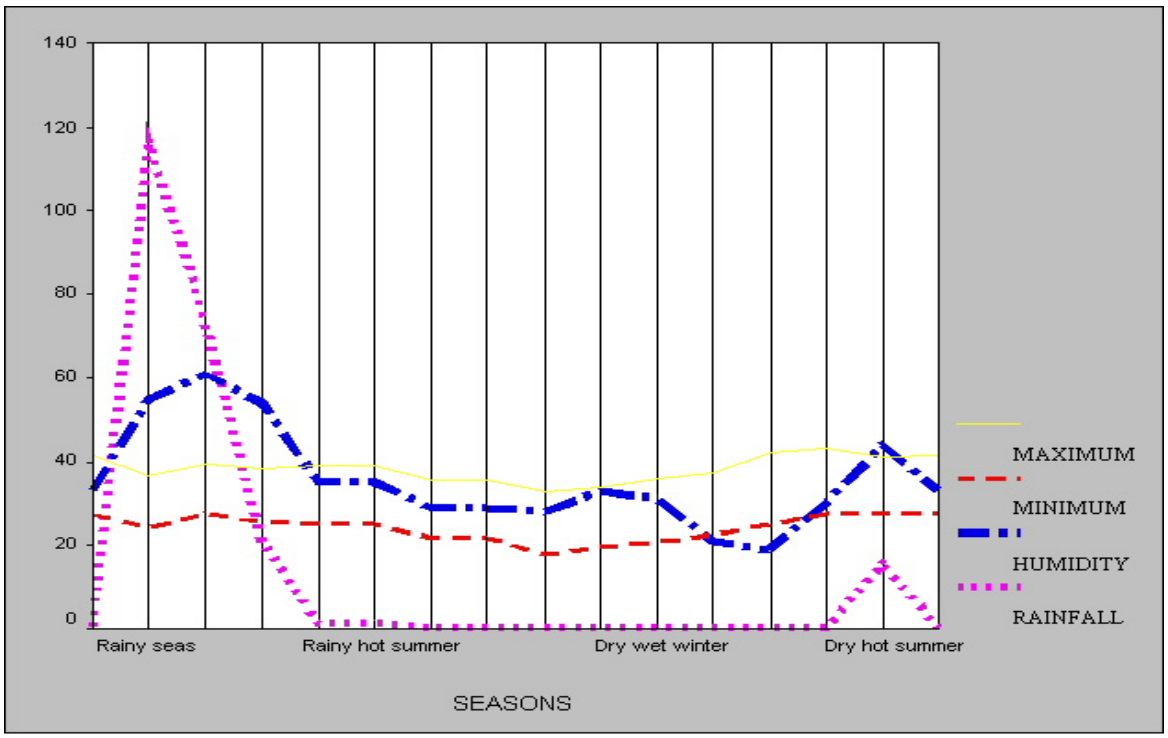

Figure 1 - Meteorological data during the study period at north of White Nile State (El dweem city)

Table 1 - Seasonal variation in the erythrocytes indices of camels (values are mean ± SE)

Parameter	Rainy Season (July) No.=27	Rainy hot summer (September) No.=27	Dry wet winter (October) No.=20	Dry hot summer (April) No.=30
R.B.Cs. (×10⁶ µL⁻¹)	2.96 ± 0.22^{a}	2.25 ± 0.08^{b}	3.29 ± 0.98^{a}	2.92 ± 0.09^{a}
PCV (%)	23.42 ± 1.8^{a}	22.59 ± 1.39^{a}	23.70 ± 1.36^{a}	10.90 ± 0.79^{b}
E.S.R (mm/hour)	2.79 ± 0.31^{a}	2.88 ± 0.25^{a}	2.10 ± 0.34^{ab}	3.03 ± 0.29^{ac}
Hemoglobin (g/dl)	7.98 ± 0.87^{a}	8.59 ± 0.34^{a}	7.47 ± 0.33^{a}	8.27 ±0.54^{a}
MCV (fl)	89.43 ± 9.62^{ab}	103.87 ± 7.88^{a}	72.31 ± 3.86^{b}	39.99 ± 3.16^{c}
MCH (pg)	32.45 ± 4.08^{ab}	38.52 ± 1.07^{a}	23.11 ± 1.27^{b}	28.34 ± 1.74^{b}
MCHC (g/dl)	33.41 ± 5.28^{a}	43.52 ± 3.95^{ab}	33.57 ± 2.46^{a}	47.60 ± 5.21^{b}

$^{a, b, c, d}$ Means with different superscripts in the same raw are significantly different at (P <0.05). No.: Number of camels in season.

Table 2 - Seasonal variation in the differential leucocytes count of camels (values are mean ± SE)

Parameter	Rainy Season (July) No.=27	Rainy hot summer (September) No.=27	Dry wet winter (October) No.=20	Dry hot summer (April) No.=30
Total W.B.Cs (×10³/ µL)	7.25 ± 0.31^{a}	7.99 ± 0.17^{a}	6.54 ± 0.30^{a}	9.11 ± 0.36^{b}
Lymphocytes (%)	40.07 ± 0.99^{a}	47.10 ± 2.06^{b}	41.60 ± 0.92^{a}	40.24 ± 1.03^{a}
Monocytes (%)	12.20 ± 0.46^{a}	10.30 ± 0.60^{b}	10.53 ± 0.39^{b}	10.35 ± 0.66^{b}
Neutrophils (%)	40.40 ± 0.92^{a}	32.90 ± 1.25^{b}	36.67 ± 0.61^{a}	43.82 ± 0.78^{c}
Eosinophils (%)	6.27 ± 0.32^{a}	8.60 ± 0.54^{b}	8.40 ± 0.31^{bc}	4.65 ± 0.37^{d}
Basophils (%)	1.13 ± 0.19^{a}	2.30 ± 0.15^{b}	0.93 ± 0.15^{a}	1.12 ± 0.17^{a}

$^{a, b, c, d}$ Means with different superscripts in the same raw are significantly different at (P<0.05). No.: Number of camels in season.

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Table 3 - Seasonal variation in the concentration of blood metabolites in camels (values are mean ± SE)

Parameter	Rainy Season (July) No.=27	Rainy hot summer (September) No.=27	Dry wet winter (October) No.=20	Dry hot summer (April) No.=30
Glucose (mg/dl)	36.45 ± 6.14^{a}	59.20 ± 4.11^{bd}	80.40 ± 5.04^{c}	58.24 ± 5.95^{d}
Total protein	9.14 ± 0.78^{a}	9.33 ± 0.15^{a}	6.35 ± 0.12^{b}	2.16 ± 0.12^{c}
Albumin (g/dl)	2.08 ± 0.21^{a}	3.30 ± 0.60^{b}	3.82 ± 0.33^{c}	1.78 ± 0.06^{d}
Uric acid (mg/dl)	0.24 ± 0.07^{a}	0.34 ± 0.03^{a}	0.34 ± 0.05^{a}	2.99 ± 0.08^{b}
Creatinine (mg/dl)	0.97 ± 0.10^{a}	0.97 ± 0.06^{a}	0.96 ± 0.05^{a}	1.45 ± 0.13^{b}

$^{a, b, c, d}$ Means with different superscripts in the same raw are significantly different at (P <0.05). No.: Number of camels in season.

Table 4 - Seasonal variation in the concentration of serum enzymes in camels (values are mean ± SE)

Parameter	Rainy Season (July) No.=27	Rainy hot summer (September) No.=27	Dry wet winter (October) No.=20	Dry hot summer (April) No.=30
GOT (U/L)	2.79 ± 4.02^{a}	2.88 ± 1.35^{bd}	2.10 ± 2.19^{c}	3.03 ± 0.57^{d}
GPT (U/L)	16.95 ± 1.61^{a}	3.31 ± 2.31^{b}	10.60 ± 1.41^{a}	2.50 ± 0.20^{b}

$^{a, b, c, d}$ Means with different superscripts in the same raw are significantly different at (P <0.05). No.: Number of camels in season.

Table 5 - Seasonal variation in the concentration of serum minerals in camels (values are mean ± SE)

Parameter	Rainy Season (July) No.=27	Rainy hot summer (September) No.=27	Dry wet winter (October) No.=20	Dry hot summer (April) No.=30
Calcium (Ca^{+2}) (mg/l)	8.40 ± 0.20^{a}	8.17 ± 0.23^{a}	8.52 ± 0.34^{a}	18.61 ± 0.65^{b}
Potassium (K^{+}) (mEq/l)	2.04 ± 0.15^{a}	2.25 ± 0.08^{a}	7.19 ± 2.60^{b}	4.70 ± 0.16^{ab}

$^{a, b, c, d}$ Means with different superscripts in the same raw are significantly different at (P <0.05). No.: Number of camels in season.

DISCUSSION

This study has been conducted to investigate the effect of season on blood constituents of camels (Camelus dromedarius) kept under tropical conditions in White Nile State, Sudan. The results obtained would be useful for establishment of normal hematological indices, normal serum metabolites, enzymes and mineral profile for camels. The period of the year in the current study, described by (Haroon, 2002), classified into: Rainy season (from 12 June to 18 October), Rainy hot summer season (from 10 October to 17 November), Dry wet winter season (from 18 November to 15 February) and Dry hot summer season (from 17 February to 20 June). The meteorological data shown in Figure 1 indicated that in the study period, the camels have been exposed to marked seasonal changes in ambient temperature (T_a), relative humidity (RH) and rainfall.

In the present study, the seasonal variation in blood constituents showed a marked effect on the total red blood cells count (Table 1). The observed decrease in RBC count during the Rainy hot summer could be due to the half-life and survival time of red blood cells during dehydration, similar of that results obtained by (Amin et al., 2007) which is common decline during green season. The RBC count obtained in the present study is slightly lower than that reported for Sudanese adult camels (Abdelgadir et al., 1984; Amin et al., 2007). However, it is within the reference ranges reported by Christiansen et al. (2007). The observed decreased in the PCV during Dry hot summer season (Table 1) could be due to ambient temperature and state of hydration as mentioned by (Bernard et al, 2000).

These results are not agreement with those obtained by (Amin et al., 2007) who reported no difference in the PCV with dry and green season. The PCV count obtained in the present study is within the range that reported for Sudanese adult camels (Abdelgadir et al., 1984; Amin et al., 2007). The observed increased in the E.S.R during Dry hot summer season (Table 1) could be due to dehydrate, asphyxia excitement leads to release of erythrocytes from the spleen (Dukes, 1993), thus, increased the E.S.R in that season. The results obtained in the present study of the E.S.R within the physiological normal for this species (Jain, 1986; Kuleta et al., 1993; Winnicka, 1997). The observed increase in the MCV and MCH during the Rainy hot summer season and the decrease in dry hot summer (Table I) could be due to hypotonic and hypertonic of RBCs to absorb water and hemolyze before their RBCs membrane can accommodate the change (Shimizu et al., 1979; Ogawa et al., 1989); in commonplace the MCHC observed high in Dry hot summer and low in Rainy season could be attributed to the concomitant increase or decrease in Hb concentration and PCV levels. Similarly, Amin et al. (2007) reported an increasing level of MCV and MCH during green seasons in dromedary camels but no discrepancy in MCHC. The mean values of MCV, MCH and MCHC reported in the current study are high of the previous report (Abdelgadir et al., 1 984; Amin et al., 2007).

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However, it is within the normal rang reported by (Christiansen et al., 2007). The observed of Hb in current study show no significance between seasons, the same findings were previously reported by (Amin et al., 2007) who revealed that no difference was detected between dry season (10.67 mg/dl) and green season (10.73 mg/dl) of hemoglobin. consecutively during Rainy hot summer and Rainy season, levels are highly than that of the other seasons of the year as compared with preceding mentioned parameters, these observed changeability could be due to the dromedary camels adapted themselves to ecosystem of dry and arid zones where they are subjected to harsh conditions in addition to the severe fluctuations in the nutritional status, which in turn affect their general performance (Warden, 2004). The pasture quality and quantity are influenced by the seasonal changes in rainfall (Lebon, 1965; Schwartz and Dioli, 1992), which in turn could influence the nutritional status and consequently the blood constituents of camels. The White blood cells (W.B.Cs.) and neutrophils ratio, Lymphocyte, Eosinophils, Basophils and Monocytes reported in the current study are similar of the previous reported (Amin et al., 2007; Alharbi, 2012). However, it is within the normal rang reported by (Christiansen et al., 2007).

Total protein and glucose contents in (Table 3) were in range of other results reported by (Amin et al., 2007; Patodkar et al., 2010; Alharbi, 2012), Similar of that findings were previously reported by (Amin et al., 2007), who showing difference was detected between dry and green season in serum content of total protein, the results showed that glucose levels were significantly higher during Dry wet winter reach the peak level of (80.40 ± 5.04) mg/dl, these results are in agreement with those obtained by (Alharbi, 2012), who reported the higher values during winter season in comparison to the other period of the year, While, (Amin et al., 2007) noted that glucose levels raised during the green season. It was believed that this may be attributed to seasonal effect with relation to nutritional effect for difference of roughs while grazing during different seasons.

Createnine and uric acid levels found in the present work (Table 3) increased significantly during Dry hot summer, were in range as compared to other levels reported by (Amin et al. 2007; Albahrawy et al., 2011); which the Createnine was high in green season and late sprig than the other period of the year, and as a result the uric acid in green season. The observed increase in the concentration of serum Createnine and urea during Dry hot summer season (Table 3) could be attributed to the availability and quality of forage during the green season. Payne (1990) reported a higher level of crude proteins of pasture plants in wet summer. Higher dietary protein in the racing season was reported to increase Blood Urea Nitrogen (BUN) of camels (Salman and Afzal, 2004). Further more, the idling and ruminating times were reported to be higher during growing season compared to the dry season (Kassilly, 2002). It has also been reported that the level of serum urea is related to the forage intake and consequently the energy and crude protein concentration (firings et al., 1991).

Albumin concentrations in the current study show significance variation all the way through the year (table 3), recorded minimum value of (1.78 ± 0.06)g/dl during Dry hot summer and maximum value of (3.82 ± 0.33)g/dl within Dry wet winter, were in range as compared to other levels reported by (Amin et al. 2007; Christiansen et al., 2007), these revolutionize results could be due to dehydration and poor diet as mentioned (Pagana and Pagana, 2002; Fischbach et al., 2004) who explained that High albumin levels may be caused by severe dehydration, Low albumin levels may be caused by a poor diet (malnutrition).

In the present study demonstrate seasonal variation in the concentrations of serum enzymes GOT and GPT in the dromedary camels, The experimental increase in the concentrations of serum GOT and GPT during the Dry hot summer and Rainy season, respectively (Table 4), may be attributed to the availability of plants, Galyean et al. (1981) found that serum GOT concentration was higher in fasted and transported steers than in untreated controls. Moreover, Schaefer et al. (1990) and Schmidt et al. (1970) reported that blood from stress susceptible pigs had greater concentration of GOT than did blood from stress resistant pigs.

The results of the present study showed seasonal variation in the concentrations of serum Ca and k in the dromedary camels, The observed marked increase in the concentrations of serum Ca and k during the Dry hot summer season and Dry weight winter, respectively (Table 5), may be attributed to the availability of plants rich us minerals (ash content) during the wet season (Kuria et al., 2004; Amin et at, 2007). The mean serum Ca and k concentrations reported in this study are within the range of previous reported (Mohamed and Hussein, 1999; Amin et al. 2007).

CONCLUSION

The results obtained in the current study signify that the nutritional status through the period of the year could persuade considerable changes in the physiological responses of the dromedary camel, the higher significant level were Monocytes, total protein and GPT during rainy season; MCV, MCH, lymphocytes, Eosinophils and Basophils in rainy hot summer and within Dry wet winter were: glucose, albumin and k, while in dry hot summer were: MCHC, WBCs, neutrophils, uric acid, creatinine, GOT and Ca. The results also indicate that the fluctuations of seasons were observed in RBCs PCV and E.S.R as lower level. Therefore, it could be beneficial to provide concentrate feed to camels kept under the tropical conditions.

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EFFECTS OF ENZYME (XZYME) SUPPLEMENTATION ON THE PERFORMANCE OF LAYING HENS FED DIETS CONTAINING DIFFERENT LEVELS OF CASSAVA (*Manihot esculenta, Crantz*) LEAF MEAL

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ABSTRACT: *An eight-week feeding trial was conducted to determine the additive effect of enzyme (Xzyme) and cassava leaf meal on the performance of laying hens. The cassava leaf meal (CLM) replaced different levels of fishmeal at levels of 0, 5, and 10% CLM in three iso-nitrogenous diets. One hundred and twenty Lohman strains of layers at thirty-weeks of age were randomly assigned to the three dietary treatments in a completely randomized design (CRD). Each treatment had forty birds, with ten birds per replicate. The initial average liveweight of birds from each replicate was 1.7 kg. Feed and water were offered ad libitum. Data collected included feed intake, liveweight gain, egg production, carcass characteristics, hematology and serum biochemistry. Economics of production was also calculated. Feed intake of birds on the treatment groups with CLM + xzyme was not different from those on the control. Final weight gain of birds on diet with 10% CLM +xzyme was lower than their counterparts on the other diets. Carcass weight of birds was not affected by dietary treatments. There was no difference in egg production, egg weight, shell thickness, Haugh unit and egg mass between dietary treatments. The rate of utilization of feed was reduced with inclusion of CLM in diet, with birds on 5% CLM+xzyme based diet recording the least feed conversion ratio (FCR). Except for heart, kidney, full proventriculus, full and empty gizzard, the other organs showed differences in their weights. All hematological parameters investigated except Mean Corpuscular Hemoglobin (MCH) showed difference in their mean values. The total serum protein (TSP), albumin, globulin and albumin/globulin ratio showed differences. Cost benefit analysis indicated that profit derived from the incorporation of CLM+xzyme in the diets was the same as control diet.*

ORIGINAL ARTICLE

Key words: *Egg Production, Hematology, Layer Diets, Leafmeal, Serum Biochemistry*

INTRODUCTION

Feed supply remains a major constraint in animal production due to high cost of conventional feedstuffs and the competition between man and animal for the same food (Amaefule et al., 2001). Efforts to lower the cost of production have elicited current interest in the search and use of non-conventional feedstuffs that are cheap, readily available and less competed for by man and industry. One of such novel feed resources so far under exploited is the leaves of cassava.

Cassava (*Manihot esculenta, Crantz*) is an all–season crop in several parts of Africa, Asia and Latin America (Ukuchukwu, 2008). In areas where cassava is grown, it is often planted for its tuberous root, leaving the leaves to wither. Meanwhile, leaf meal could be prepared from cassava leaves as a component of livestock feed (Fasuyi, 2005). Plant protein is perhaps the most naturally abundant and the cheapest potential source of protein. Natural resources are available for the synthesis and polymerization of amino acids into less mobile forms and stored as such in plant leaves.

The protein content and nutritive value of cassava leaves are well documented. Cassava leaf contains between 16.7-39.9% crude protein (Yousuf et al., 2007) with almost 85% of the crude protein fraction as true protein (Ravindran, 1991). Results of analyses by Ukanwoko and Ukandu (2011) revealed that cassava leaf meal contains 88.29, 25.81, 16.28, 3.64, 5.74, and 36.82% of dry matter, crude protein, crude fiber, ash, ether extract and nitrogen free extract respectively. Apart from the highly balanced amino acid profile (Wanapat, 2001), it also contains high level of potassium, iron, calcium, sodium, vitamin B1, B2, B6, C and carotenes (Bokanga, 1994).

However, the build-up of the amino acids in cassava leaves is accompanied by some limitations that render it less nutritious for consumption by livestock. Such factors are the high fiber content and anti-nutritional factors such

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as cyanide, tannin and phytin (Aletor and Adeogun, 1995). Stage of maturity is the major factor contributing to the variability in fiber content.

Benefits can however be realized from cassava leaf meal by supplementing poultry diets containing such leaf meals with exogenous enzymes like carbohydrases and other cellulases and proteolytic enzymes as found in Xzyme to improve the nutrient digestibility (Adeola and Olukosi, 2009). Interest in applying biotechnology for enzyme production has led to the production of enzyme preparation for poultry feeds which can improve the utilization of high fiber containing feedstuffs in poultry diets (Aderolu et al., 2007). There has been considerable success in the use of enzymes to improve nutrient utilization (Shivaram and Devegowda, 2004).

The present study was undertaken to evaluate the effects of enzyme supplementation on the performance of laying hens fed diets containing different levels of cassava (*Manihot esculenta, Crantz*) leaf meal.

MATERIALS AND METHODS

Experimental diets and preparation of cassava leaf meal (CLM)

Succulent leaves of cassava (a month old) were harvested from a-month-old cassava stands on a cassava farm near the College of Agriculture, University of Education, Winneba, Mampong-Ashanti, Ghana. The branches were cut and spread out on a clean concrete floor of well ventilated room for a period of 3-4 days until they became crispy. The leaves were separated from the twigs and milled in a hammer mill to obtain the leaf meal.

Chemical analysis of CLM and experimental diets

Samples of the CLM and experimental diets were subjected to proximate analysis using standard methods (AOAC 1990).

Experimental design and statistical analysis

The experiment was conducted with one hundred and twenty thirty-week old Lohman strains of layers for 56 days. Three experimental diets were formulated. CLM was included in the diets at various levels of 0, 5, and 10%. There were three replicates per each treatment, with 10 birds per replicate in a Completely Randomized Design (CRD). The birds were allocated in such a way as to ensure that the average bird weight per replicate was 1.7 kg. Feed and water were provided *ad libitum* and all required managerial practices were the same for each treatment group.

Parameters studied were feed consumption, egg production (hen-day and hen-housed egg production), egg weight, egg quality, yolk colour score and egg shell thickness. Economics of production was also calculated at the end of the study. The data were analyzed using the analysis of variance (ANOVA) technique and differences among means were separated by means of Duncan Multiple Range Test. Statistical significance was determined at P=0.05. The computations were performed using the general linear models procedures of the Statistical Analysis System Institute Inc (1999).

Hematology and blood serum biochemistry analysis

Blood samples were obtained from two birds per replicate making a total of six birds per treatment at the end of the experiment by inserting a new sterilized needle into the wing vein of the birds and collecting 2 ml of blood in labeled sterile test tubes containing Ethylene Diamine Tetra Acetic Acid (EDTA). The blood samples were shaken to mix with the EDTA in order to prevent coagulation. The samples were then analyzed for Red Blood Cells (RBC), Packed Cell Volume (PCV), Hemoglobin (Hb), White Blood Cells (WBC), Corpuscular Volume (MCV) and Mean Corpuscular Hemoglobin Concentration (MCHC), Mean Corpuscular hemoglobin (MCH) and Lymphocytes (LYM) using the Abbott Diagnostics Cell Dyn 3500 (Abbott Diagnostics, Abbott Park, IL) automated hematology analyzer.

Again, blood samples were obtained from each bird by the same procedure into vacuumed capillary tubes to determine the blood cholesterol, triglyceride, high-density lipoprotein (HDL), low-density lipoprotein (LDL) levels, coronary risk, total protein and glucose. After coagulation, blood samples were centrifuged and then serum was collected for analysis. Blood serum biochemistry was determined by using Cobas integral 400 plus chemistry analyzer (Roche Diagnostics Ltd., Switzerland).

Carcass evaluation

Two birds were randomly selected from each replicate at the end of the study. They were weighed and killed by severing the carotic arteries. They were bled and immersed in hot water for 5 minutes to loosen feathers. The defeathered carcass was weighed. After dressing, the following weights were taken: carcass weight, dressed weight, gizzard, liver, heart, neck, shanks, and intestine.

RESULTS

The chemical composition of cassava leaf meal is shown in Table 1 while the nutrient composition of the experimental diets is presented in Table 2. Data on the performance of experimental birds on the various dietary levels of CLM + enzyme are captured in Table 3. Feed intake by birds on the treatment groups with CLM + enzyme was not different from those on the control diet. Final weight gains of birds on CLM + enzyme-based diets were

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lower than their counterparts on the control. Based on the overall egg weight, egg mass, egg shell thickness, haugh unit and egg production, it was apparent that there was no effect of CLM or Xzyme on these parameters. The results of the study also showed that the overall efficiency of feed utilization (FCR) was higher (3.9) in layers on control diet lower (4.3) for birds on diet with 5% of CLM+Xzyme. Carcass weight of birds was not affected by dietary treatments. Records on carcass and organ traits are shown in Table 4.

Except for heart, kidney, full proventriculus, full and empty gizzard, the other organs measured exhibited differences. The weight of both full and empty intestine (small and large intestines, duodenum and ileum) decreased with the inclusion of CLM + enzyme. The hematological and serum indices are summarized in Tables 5 and 6 respectively. All hematological parameters investigated except MCH showed difference in their mean values. Among the serum parameters measured, total serum protein (TSP), albumin, globulin and albumin/globulin ratio showed significant ($P<0.05$) differences.

Table 1 - Proximate composition of cassava leaf meal

Composition	Level (%)
Dry matter	85.0
Crude protein	22.8
Ether extract	5.5
Crude fibre	12.7
Ash content	4.5
NFE	39.5

Table 2 - Composition of experimental diets

Ingredients	Level of dietary CLM (%)		
	0%	5%	10%
Maize	53	53	53
Fish meal (62% CP)	4	4	4
Fish meal (54% CP)	7	6	4
Soya bean meal	8	4	2
Wheat bran	20	20	20
Cassava leaf meal	0	5	10
Oyster shell	7.5	7.5	7.5
Vitamin/mineral premix	0.5	0.5	0.5
Salt	0.5	0.5	0.5
Dicalcium phosphate	0.5	0.5	0.5
Xzyme	0	0.05	0.05
Analyzed composition (%):			
Dry matter	87	87	88
Crude protein	16.4	16.5	16.4
Ether extract	3.0	3.5	3.5
Crude fibre	4.1	4.7	5.2
Ash	13	15.5	14
NFE	53	53	53
Calculated composition (%)			
Calcium	1.2	1.3	1.2
Available phosphorus	0.4	0.38	0.37
Lysine	0.2	0.2	0.2
Methionine	0.2	0.2	0.2
ME (k cal/kg)	2500	2489	2546

**Composition of vitamin/mineral premix per kg: Vitamin E, 25mg; Vitamin A, 6250 IU; Vitamin D3, 1250 IU; Vitamin K3, 25mg; Vitamin B1, 25mg; Vitamin B2, 60mg; Vitamin B6, 40mg; Vitamin B12, 2mg; Elemental calcium, 25mg; Elemental phosphorus, 9mg; Elemental magnesium, 300mg; Iron, 400mg; Selenium 1.0mg, Iodine 20mg, Copper 60mg, Magnesium 100mg, cobalt 10mg, Zink, 150mg; Sodium Chloride, 1.5mg; Choline Chloride, 500mg; Live Lactobaccillus spore, 0.2 million cfu; Niacin, 40mg; Folic Acid, 10mg; d-Biotin, 5mcg*

DISCUSSION

Proximate analysis of cassava leaf meal revealed a crude protein level of 22.8% which is lower than those obtained by Iheukwumere et al. (2008). They obtained 25.10% crude protein in their study. The crude fibre obtained in the present study was however slightly higher than theirs (12.70%). According to NRC (1994), the proximate composition of plant feedstuffs can vary due to various factors such as crop variety, processing methods and soil conditions. The result of feed intake during the experimental period revealed that Xzyme supplementation did not

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stimulate feed intake of birds on diets containing cassava leaf meal. The present study corroborates earlier findings by Abbas et al. (1998) and Naqvi (1996) who noticed no difference in feed consumption among birds fed diets with or without supplementation of enzymes. The results of this study vary with work by Marck and Splitek (1990) and Arora et al. (1991) who observed increased body weight gain in broiler chicks when cellulolytic enzymes was added to their diet containing a higher level of fibre. In another experiment conducted by Iheukwumere et al. (2008) involving 5-week old Anak broilers, daily body weight gain and feed conversion ratio were similar for birds fed diet without cassava leaf meal (control) and those fed diet containing 5% cassava leaf meal. But these parameters reduced at 10% and 15% inclusion levels. The depression in growth at 10% inclusion level of cassava leaf meal as was also the case in this experiment has been reported by many researchers (Ash and Akoh-Detaia 1992; Opara 1996).

Table 3 - Effect of CLM on the performance of experimental birds

Parameter	Level of dietary CLM (%)				
	0	5	10	SEM	Prob.
Mean initial body weight (kg)	1.7	1.7	1.7	-	0.45
Mean final body weight (kg)	1.7[a]	1.7[a]	1.6[b]	0.04	0.01
Mean body weight gain (kg)	0.0	0.0	0.1	0.15	0.40
Mean feed consumption (g)	150	151	151	1.0	0.19
Hen – day egg production (%)	67.0	62.3	62.5	2.68	0.20
Hen – house egg production (%)	67.0	62.3	62.5	2.68	0.20
Mean egg weight (g)	57.3	57.3	59.0	1.58	0.47
Yolk colour score	1.0[a]	5.5[b]	7.0[c]	0.24	0.00
Egg shell thickness (mm)	0.4	0.4	0.4	0.02	0.32
Haugh unit score	88.5	80.0	81.5	5.3	0.28
Egg mass/day (g/hen/day)	38.3	35.6	36.9	1.41	0.21
Feed conversion ratio (kg feed/kg egg)	3.9[a]	4.3[b]	4.1[c]	0.03	0.00
Mortality (%)	0	0	0	-	-
Feed cost (kg/GH¢)	1.00	1.00	1.00	-	-
Total cost of feed over the period (GH¢)	344.00	324.00	301.00	-	-
Price per kg eggs (GH¢)	3.50	3.50	3.50	-	-
Value of egg (GH¢)	0.20	0.20	0.20	-	-
Feed cost/bird/day (GH¢)	0.20	0.20	0.20	-	-
Net revenue (GH¢)	0.00	0.00	0.10	-	-

SEM = Standard error of mean, *Significant difference at P<0.05, (a,b,c) Treatment means with different superscripts within the same row are significantly different at p<0.05.

NOTE: US $ 1.0 = GH¢1.5

Table 4 - Effect of CLM on organ weights of experimental birds

Variable	Level of dietary CLM (%)				
	0	5	10	SEM	Prob.
Liver (g)	39.5[a]	30.5[b]	33.5[b]	3.15	0.05
Kidney (g)	1.0	1.0	1.0	–	–
Heart (g)	8.0	9.0	8.5	0.53	0.22
Crop (Full), g	14.0[a]	25[b]	47.5[c]	7.5	0.01
Crop (Empty), g	9[a]	6.5[b]	8.5[c]	0.58	0.01
Proventriculus (Full), g	16.5	12.5	16.6	3.57	0.01
Proventriculus (Empty), g	10.5[a]	9.0[c]	7.5[b]	0.75	0.30
Gizzard (Full), g	41	42.0	42.5	2.51	0.83
Gizzard (Empty), g	26.5	28.5	28	2.29	0.67
Intestine (full), g	125[a]	93.5[b]	97.0[c]	1.67	0.01
Intestine (Empty), g	102[a]	45.5[b]	49[b]	2.22	0.01
Carcass weight (g)	1560	1381	1429	1293	0.40

SEM = Standard error of mean, *Significant difference at P<0.05, (a,b,c) Treatment means with different superscripts within the same row are significantly different at p<0.05

Data gathered from production performance parameters showed that the laying rate of hens fed CLM+Xzyme based diets led to reduction in egg production compared to those on control diet. This suggests that the amount of Xzyme supplementation in the different levels of CLM+Xzyme diets did not have a noticeable effect on the performance of laying hens. Egg production, egg weight, egg mass, haugh unit, and egg shell thickness were not increased significantly with incorporation of CLM+Xzyme. The results of yolk colour index agree with report by

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Okeke and Oluremi (2003), that incorporation of leaf meal in diets pigments egg yolk. This is as a result of xanthophylls (a pigment that impart a yellow colour to egg yolk) in green leaves.

The findings of the study are at variance with reports that the inclusion of leaf meals in diets of poultry result in increased weight of intestines and gizzard (Borin et al., 2006). According to them, birds fed high fibre diet containing cassava leaf meal recorded high gizzard and intestinal weight but this was reversed when enzyme was added to the diet. Similar observation was also made in this study. In the present study, enzyme supplementation decreased the relative size of liver, crop (empty), proventriculus (empty) and intestines (full and empty). Hajati et al., (2009) in an earlier study recorded higher gizzard and intestines weight when they fed broiler chickens corn-soybean meal-wheat diets supplemented with enzyme. Birds on 0% (control) and 5% CLM recorded higher total serum protein, albumin and globulin. Serum proteins are divided into albumin and globulin. Proteins act as transport substances for hormones, vitamins, minerals, lipids and other materials. In addition, proteins help balance the osmotic pressure of the blood tissue. Total serum protein has been reported as an indication of the protein retained in the animal's body (Esonu et al., 2001), and it depends on the quantity and quality of dietary protein (Iyayi, 1998). This observation is surprising since the experimental diets were formulated to be iso-nitrogenous. The results of hematological variables in this study (except MCH), suggest that the test diets did not precipitate adverse effects on the health status of laying hens. Blood represents a means of assessing clinical and nutritional health status of animals in feeding trial (Adeyemi et al., 2000).

Table 5 - Effect of CLM on hematological parameters

Parameter	Level of dietary CLM (%)				
	0	5	10	SEM	Prob.
WBC ($\times 10^3$/ul)	235^a	242^b	228^c	3.79	0.01
RBC ($\times 10^6$/ul)	2.3^a	2.4^{ab}	2^c	0.09	0.01
HGB (g/dl)	9.4^a	9.6^{ab}	7.7^c	0.28	0.01
HCT (%)	30^a	30.3^{ab}	26.4^c	0.99	0.01
MCV (fl)	128^a	126^{ab}	131^c	2.11	0.07
MCH (Pg)	40	40.1	38.1	0.94	0.02
MCHC (g/dl)	31.2^a	31.8^{ab}	29.2^c	0.78	0.02

SEM = Standard error of mean, *Significant difference at P<0.05, (a,b,c) Treatment means with different superscripts within the same row are significantly different at p<0.05

Table 6 - Effect of CLM on serum parameters

Parameter	Level of dietary CLM (%)				
	0	5	10	SEM	Prob.
Total cholesterol (mmol/L)	2.2	3.1	2.7	0.42	0.16
Total protein (g/l)	52.5^a	52.1^{ab}	46.7^c	3.45	0.21
Albumen (g/l)	17.8^a	18^{ab}	15.5^c	0.95	0.05
Globulin (g/l)	34.8^a	34.6^{ab}	31.2^c	2.74	0.38
Albumin:globulin	0.5	0.5	0.5	-	-
Magnesium (mmol/L)	1.2	1.2	1.2	0.10	0.63
Phosphate (mmol/L)	1.6^a	0.0^b	0.0^b	0.45	0.01
Uric acid (mmol/L)	139	133	109	26.07	0. 52

SEM = Standard error of mean, *Significant difference at P<0.05
(a,b,c) Treatment means with different superscripts within the same row are significantly different at p<0.05

CONCLUSION

The findings of this study showed that CLM could be included up to 10% in the diet of laying hens (30-38 wks old) without any deleterious effects on production performance. Supplementation of diets with Xzyme at 5 and 10% inclusion levels of CLM did not significantly improve egg production.

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RESPONSE OF TWO DIFFERENT BROILER GENOTYPES TO DIETS CONTAINING COCOA POD HUSK

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ABSTRACT: *A total of 300 day old chicks from 2 commercial broiler genotypes were fed diets containing 0, 5, 10, 15 and 20 percent cocoa pod husk (CPH) for 33 days. Thereafter, all the chicks were fed a common finisher diet which was devoid of CPH until 56 days of age. Body weight, feed consumption, feed efficiency and carcass traits (eviscerated, gastro intestinal tract (GIT), feather and liver weights) were measured. Genotype × CPH level interaction was not significant in this study. Body weight of the genotypes differed significantly (P<0.05) at 1, 33 and 56 days but not at 14 days. The different CPH levels however, elicited differences (P<0.05) in the body weight at 15 % and 20 % inclusion rates for ages 14 and 33 days. When fed a common finisher diet at 33 days, recovery in body weight was observed in broilers fed all but 20 % CPH diet by 56 days of age. Feed efficiency which declined beyond 5 % CPH level at 33 days showed an improvement in all broilers except those fed 20 % CPH. Eviscerated carcass, GIT and liver weights showed no differences among the diets. The results suggested that even though growth of chicks deteriorated beyond 10 % CPH by 33 days, advantage should be taken of the tremendous compensatory growth upon CPH withdrawal and thereby increase the starter CPH level to 15 percent.*

ORIGINAL ARTICLE

Key words: *Broiler, Cocoa Pod Husk, Diet, Genotype, Performance*

INTRODUCTION

In recent years, the once prosperous poultry industry in Ghana has taken a downwards turn due to shortage and high cost of inputs, particularly grains, which is a staple for humans. Traditionally, grains are included in poultry feed at levels of up to 60-70% (Teguia et al., 2004). This downwards turn of the poultry industry has created a serious crisis in meat supply and over-dependence on fish which constitutes about 66 % of the per capita daily protein consumption (Ince, 1983; Rhule et al., 2005). There is therefore an urgent need to find cheaper feedstuffs to partially replace grains.

Cocoa is cultivated on a larger acreage than any other tree crop in Ghana and the pod which accounts for 75% of the fruit, currently yields about 554,000 tonnes of dry cocoa husk annually (Rhule et al., 2005). Jahnke (1982) has reported that about 1.032 million metric tonnes of dry matter of cocoa pod was produced annually in tropical Africa. In Ghana, large quantities of cocoa pod husks are left to rot on cocoa farms except for small quantities that are used in the manufacturing of locally made soap. Cocoa could be used as a potential substitute for maize to reduce feed cost and help revive the once vibrant poultry industry.

Atuahene et al. (1985) and Sobamiwa and Longe (1999) have all reported favourable growth and carcass results when 10 % dietary cocoa meal was used to replace maize in broiler starter and finisher rations. Olubamiwa et al. (2002) have also reported that weight gain and feed conversion efficiency were depressed only beyond 10% inclusion rate of cocoa pod husk in starter cockerel diet. Boa-Amponsem et al. (1984) using locally available ingredients included up to 10% cocoa pod husk (CPH) in broiler starter diet with no significant deterioration in growth and carcass traits. All these workers used single breeds in their experiments, yet under extreme conditions of energy dilution, which high CPH levels may cause, genotypes of different growth potentials may react differently (Sorensen, 1985).

With the increase in the annual production of cocoa in the country with its attendant increase in CPH generation, the processing of cocoa pod husk for feeding livestock including poultry may become economical. The objective of this study was to investigate the performance of different commercial genotypes of broilers when fed high levels of dietary cocoa pod husk.

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MATERIALS AND METHODS

Genotypes and management

Three hundred broiler day old chicks (DOCs) were obtained from two commercial hatcheries. Each hatchery provided 150 DOCs of a particular genotype (A and B) for the study. Chicks were wing banded, weighed and brooded for 2 weeks. The brooder house was partitioned into 20 pens and each pen held 15 chicks of each commercial genotype. The 5 feed treatments of CPH (0, 5, 10, 15, and 20%) were assigned randomly to the birds in each of the 20 pens with 2 replications for each treatment. Chicks were then weighed and transferred to wire-floor range pens each measuring 2.04 m × 1.73 m. The stocking density in each range pen was 4 birds per square metre. The commercial genotypes, A and B were not intermingled within each pen.

All chicks were vaccinated against Gumboro, Newcastle and Fowlpox diseases at 1, 2 and 4 weeks of age respectively. Booster vitamins were provided via water medication twice every week. On days 33 and 56, one bird was randomly selected from each pen and sacrificed by cervical dislocation for carcass analysis.

Diets and feeding

Four diets were compounded in addition to the control by replacing 5, 10, 15 and 20 percent of maize from the control diet with CPH (Table 1). CPH was prepared from fresh cocoa pod husk mechanically dried to a moisture level of 10-12%. The five diets which were randomly allotted to 2 pens of each genotype were administered from day 1 till 33 days of age.

Thereafter a common finisher feed devoid of CPH containing 19% crude protein and 2900 kcal/kg (12.1 MJ/Kg) was fed to all genotypes regardless of previous dietary treatment. Both water and feed were provided *ad libitum.*

Table 1 - Composition of treatment diets indicating the varying levels of cocoa pod husk, maize and calculated analysis of ME, CP and CF

Ingredients	Diets				
Cocoa pod husk[1]	0.00	5.00	10.00	15.00	20.00
Maize	56.60	51.60	46.60	41.60	36.60
Fish meal[2]	23.00	23.00	23.00	23.00	23.00
Wheat bran	0.41	0.41	0.41	0.41	0.41
Copra cake	17.00	17.00	17.00	17.00	17.00
Shell	1.00	1.00	1.00	1.00	1.00
Dicalcium phosphate	0.90	0.90	0.90	0.90	0.90
Vit./Min. mix[3]	0.50	0.50	0.50	0.50	0.50
Common salt	0.20	0.20	0.20	0.20	0.20
Choline Cl_2 (50%)	0.22	0.22	0.22	0.22	0.22
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.07	0.07	0.07	0.07	0.07
Calculated Analysis:					
Metabolisable Energy (ME), Kcal/kg	2816	2704	2593	2481	2370
Crude protein (CP), %	22.50	22.40	22.30	22.20	22.10
Crude fibre (CF), %	4.00	5.30	6.60	7.90	9.20

[1]Cocoa pod husk proximate analysis: dry matter (89.13 %), crude fibre (28.4 %), ash (7.48 %), crude protein (7.0 %), ether extract (2.36 %), metabolisable energy (1200kcal/kg); [2]Fish used was local anchovy containing 60 % crude protein; [3]1kg vit/min. mix provided: vitamin A (2 miμ), vitamin D3 (3 miμ), vitamin E(880 mg), vitamin K (250 mg), vitamin B12 (2.2 mg), vitamin B2 (2000 mg), Ca-patothenate (2000 mg), niacin (6600 mg), choline Cl_2 (88000 mg), vitamin B1 (200 mg), vitamin B6 (12 mg), Folic acid (130 mg), biotin (0.2 mg), Zn-bacitracin (1000 mg), ethoxyquin (25000 mg), Mn (3.75 g), Zn (2.2 g), Iodine (0.11 g), Fe (65 g), Cu (0.11 g), Cobalt (0.03)

Measurements, design and statistical analysis

Each chick was weighed at 1, 14, 33 and 56 days of age. Apparent feed intake of chicks from each pen was measured at 33 and 56 days and was the difference between feed supplied and feed weighed back during these periods. Feed efficiency was estimated as grams of body weight gained per gram of feed consumed. Carcass data were obtained on randomly selected birds slaughtered from each pen on days 33 and 56 after starving for 18 hrs (n=20).

Feather weight calculated as the difference between body weight before and after defeathering was obtained. The gastro intestinal tract (GIT) was removed, emptied of its contents and weighed. The weight of the eviscerated carcass and liver were also recorded. Mortality was noted daily for each replicate.

The experiment was factorial, completely randomized design involving 2 genotypes and 5 CPH levels. Data were subjected to analysis of variance with genotype and diet as main effects and their interactions in a fixed effects model. Individual chick data were used for body weight related traits; whereas pen data were used for feed intake, feed efficiency and mortality traits. In case of mortality, subclass cells with zero observations were replaced by 0/4n (Zar, 1984) whilst carcass data were converted to percent of body weight before statistical analysis.

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RESULTS

Body weight and mortality

No significant interaction (P>0.05) was observed between genotype and diet for body weight at any age. Genotype B was significantly heavier (P<0.05) than A at the start of the experiment (Table 2). This significant difference in body weight however, disappeared at 14 days of age. Body weight did not vary among the chicks fed the different CPH diets initially (Table 2). By 14 days, significant effects (P<0.05) of diets on body weight were obvious. Diets with CPH level of up to 10% supported similar growth rates as the control at this age. Neither the differences between 10% and 15% nor 15% and 20% were significant (P<0.05). At 33 days, significant decline (P<0.05) in body weight occurred beyond 10 % CPH level. At 33 days, when the CPH diets were withdrawn, the only difference (P<0.05) in body weight at 56 days was between the control and 20% CPH level (Table 2). CPH had no effect on mortality of the birds fed different CPH levels neither were the genotypes affected (Table 2).

Table 2 - Means of body weight (g) and mortality (%) of the different genotypes fed diets differing in cocoa pod husk levels at various ages

Body weight (g)									
Genotype				Diets (Cocoa pod husk levels)					
Age(days)	A	B	SEM	0	5	10	15	20	SEM
1	34.8^{b}	36.8^{a}	0.1	35.8	35.9	35.9	35.8	35.7	0.1
14	192.2	194.8	3.5	206.1^{a}	207.8^{a}	198.9^{ab}	184.7^{bc}	170.0^{c}	5.5
33	829.4^{b}	878.2^{a}	13.6	955.6^{a}	930.6^{a}	880.6^{ab}	800.2^{c}	693.3^{d}	21.5
Common Finisher Diet									
56	1942.1^{b}	2030.4^{a}	22.8	2058.3^{a}	2038.4^{ab}	1973.1^{ab}	1958.1^{ab}	1895.6^{b}	50.9
Mortality (%)									
33	4.0	6.0	1.1	3.3	8.3	5.0	5.0	3.3	1.8
56	6.7	7.3	1.3	5.0	10.0	8.3	8.3	3.3	2.0

^{a,b,c,d} on means in a row indicate significant difference (P<0.05); SEM – Pooled standard error of the means

Feed intake and efficiency

Feed intake and efficiency of the genotypes and the different CPH diets at the different ages did not interact. The chicks of the different genotypes consumed similar amounts of feed up to 33 days (Table 3). Cumulatively however (0-56 days), the difference between genotypes in the feed intake reached significant levels (P<0.05), the heavier B genotypes consuming more feed.

Dietary CPH level significantly influenced (P<0.05) feed consumption of the chicks to 33 days (Table 3). Those fed 20 % had the highest intake followed by 15% and 10% CPH inclusion. The chicks fed the control and 5 % CPH diets consumed similar amounts of feed. Feed efficiency did not vary between the genotypes at any age (Table 3). Birds fed the control and 5% CPH diets were the most efficient at 33 days whilst those fed 10, 15 and 20 % levels significantly differed (P<0.05) in a declining order. Feed efficiency of birds on 20% CPH diet still lagged behind those of the other levels at 56 days.

Table 3 - Means of feed intake (kg/bird) and feed efficiency (gain: feed) by genotype and diets at different ages

Feed intake (kg/bird)									
Period (days)	Genotype			Diets (Cocoa pod husk level)					
	A	B	SEM	0	5	10	15	20	SEM
0-33	1.80	1.86	0.0	1.72^{c}	1.70^{c}	1.86^{b}	1.85^{b}	2.02^{a}	0.0
0-56	5.08^{b}	5.29^{a}	0.1	5.01^{b}	5.03^{b}	5.19^{b}	5.24^{ab}	5.46^{a}	0.1
Feed efficiency (g/g×100)									
0-33	44.4	44.9	0.7	51.8^{a}	52.8^{a}	45.8^{b}	40.8^{c}	32.3^{d}	1.1
0-56	37.8	37.9	0.6	40.3^{a}	40.3^{a}	38.0^{a}	37.3^{a}	33.5^{b}	1.0

^{a,b,c,d} on means in a row indicate significant difference (P<0.05); SEM – Pooled standard error of the means

Carcass characteristics

Interactions between the main effects were not significant (P>0.05) for the carcass parameters. Genotypes had similar weight of eviscerated carcass at both 33 and 56 days of age (Table 4). The decline in eviscerated carcass weight of chicks fed the different diets at 33 days was not significant (P>0.05). CPH levels did not influence eviscerated carcass weight at 56 days. Genotype B, the faster growing strain had larger GIT than genotype A, at 33 days, but not at 56 days. CPH levels had no significant effect on this trait at any age though an increasing trend was apparent.

Genotypes did not differ in feather percent. However, birds fed the 20 % diet had poor feather development at 33 days, but not at 56 days. Both genotype and CPH level did not have any significant effect (P>0.05) on liver size of broilers.

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Table 4 - Mean (% of body weight) of carcass characteristics of the genotypes fed diets differing in cocoa pod content at various ages

Trait	Age	Genotype			Diets (cocoa pod husk levels)					
	(days)	A	B	SEM	0	5	10	15	20	SEM
Eviscerated carcass	33	67.7	68.2	0.4	68.5	68.8	68.1	67.8	66.7	0.6
	56	77.3	77.6	0.5	77.5	78.9	77.3	76.5	76.9	0.8
GIT	33	12.6^{b}	15.1^{a}	0.7	11.7	13.0	13.9	14.3	16.4	1.1
	56	9.6	9.1	0.4	9.2	8.7	9.4	10.1	9.3	0.6
Feather	33	7.3	7.2	0.1	8.0^{a}	7.8^{ab}	7.5^{ab}	7.0^{b}	6.0^{c}	0.2
	56	6.6	6.6	0.3	6.1	5.7	7.5	7.0	6.7	0.5
Liver	33	2.6	2.7	0.1	2.5	2.6	2.7	2.8	2.9	0.2
	56	1.8	2.1	0.1	1.8	1.8	2.1	2.0	2.1	0.1

^{a,b,c} on different means in a row indicate significant difference (P<0.05); SEM – Pooled standard error of the means

DISCUSSION

The performances of different broiler genotypes on diets containing varying levels of cocoa pod husk were generally similar. In this study, there was no significant interaction between genotype and diet for body weight at any age of broilers. This is in agreement with reports by Cahaner et al. (1987) and Boa-Amponsem et al. (1999) who also reported no significant interaction between cocoa pod meal and genotypes. At day 1, the mean body weight of genotype B was higher than genotype A and this could be attributed to variation in pre-natal growth rate between the two genotypes resulting from either genetic or maternal (egg size) effects. However, this difference disappeared after 14 days suggesting that there was an important maternal effect at play for this trait. Barbato et al. (1983) and Katanbaf et al. (1988) have both observed significant maternal effects in chicken which dissipated within 7 days of rearing. Subsequent differences (P<0.05) in body weight between the two genotypes at 33 and 56 days under similar dietary and husbandry conditions would be genetic. This supports the long held assertion that considerable genetic variation in body weight is still existent between chicken populations (Siegel et al., 1984; Boa-Amponsem et al., 1999).

Significant decline (P<0.05) in body weight that occurred beyond 10% CPH level at 33 days corroborates the findings of Sorensen (1985) who also reported similar growth response of the chicks fed continuously on the higher CPH levels (1% and 20%). Olubamiwa (2002) also reported that body weight gain was depressed beyond 10 % inclusion rate of cocoa husk meal in starter cockerels' diet. The decline in growth rate associated with feeding low density diets (high CPH levels) could be attributed to inadequate intake of nutrients from bulky diets (Boa-Amponsem et al., 1991).

At 33 days, when the CPH diets were withdrawn, tremendous compensatory growth occurred such that at 56 days, the only difference in body weight was observed between the control and 20 % CPH level suggesting that up to 15 % CPH may be included in a broiler starter diet provided CPH is withdrawn at 33 days. This compensatory growth virtually erased differences in feed intake observed at 33 days among chicks fed different CPH levels. The low feed efficiency observed in birds fed 20 % CPH diet as compared with birds fed on other levels of CPH at 56 days agrees with reports from Farrell (1974) and Boa-Amponsem et al. (1991) that greater consumption of low nutrient density diets (e.g. higher CPH diets) is associated with deterioration in feed efficiency.

Most of the carcass characteristics studied in this work were not adversely affected by the dietary treatments. The larger GIT of genotype B, the faster growing genotype, as compared with genotype A at 33 days is in agreement with findings of Lilja (1983) that faster growing birds develop larger GIT at an early age. No toxicity was associated with the feeding of CPH as liver size was not influenced significantly (P>0.05) by the different CPH levels.

CONCLUSION AND RECOMMENDATIONS

The broiler genotypes did not show differential response as the dietary CPH level increased indicating that the fastest growing genotype should be used regardless of the CPH level. The role of the finisher diet in regimes where the starter diet contained high CPH levels has been emphasized. In this trial, the differences between the body weights of birds on the different CPH levels at 33 days practically disappeared at 56 days of age. Thus even though growth of chicks deteriorated beyond 10% CPH levels in the starter diet, advantage could be taken of the compensatory growth from the finisher diet and thereby increase the starter CPH level to 15%.

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DETERMINATION OF NUTRITIVE VALUE OF TOMATO POMACE USING IN VITRO GAS PRODUCTION TECHNIQUE

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ORIGINAL ARTICLE

ABSTRACT: *This study was carried out to the determination of nutritive value of Tomato Pomace (untreated and treated with two levels of urea) using gas production technique. The gas production was measured at 2, 4, 6, 8,10, 12, 16, 24, 36, 48, 72 and 96 h. The gas production of unteated and treated with 1 and 2 leaves of tomato pomace at 72 h were 168.21, 164.21 and 156.66 ml/g DM and there were significant differences (P<0.05). Data showed that Tomato Pomace can be used as a high energy feed in ruminant rations to support growth and lactation, with fewer negative effects on rumen fermentation than starch rich feeds.*

Key words: *Gas production, Tomato Pomace, Treated with Urea*

INTRODUCTION

In Middle East, animals suffer from under feeding and malnutrition due to the shortage of locally produced feeds which are not sufficient to cover the nutritional requirements of the animals. Middle East is facing a shortage of compatible sources in ruminant feeds. Therefore, it is necessary that better use of unusual food sources, which are not considered as human foods. Industrial use of agricultural waste, such as citrus pulp, tomatoes and grape pomace can be an important part of the diet of ruminants (Alipour and Rouzbehan, 2007). Developing food industrial factories consequently produced large amount of wastes and by-products. Damping or burning wastes or agro-industrial by-products causes potential air and water pollution problems. High-moisture wastes are also difficult to burn. Many by-products have a substantial potential value as animal feedstuffs (Aghajanzadeh et al, 2010). Feeding by-products of the crop and food processing industries to livestock is a practices as old as the domestication of animals by humans. It has two important advantages, these being to diminish dependence of livestock on grains that can be consumed by humans (which was almost certainly the primary original reason), and to eliminate the need for costly waste management programs (which has become very important in by-product has increased, particularly in developed countries.

Tomato (*Solanum Lycopersicum*) is one of the most widely cultivated vegetable crops in Mediterranean countries. After the juice is extracted, a residue, tomato pomace, which primarily consists of water, tomato seeds, and peels, is left. The high water content of this by-product limits its length of storage. Because of storage problems, tomato pomace is often dried. Dried tomato pomace has been fed to dairy cows and sheep (Weiss et al., 1997). Dried tomato pomace contains 22.6-24.7% protein, 14.5 – 15.7% fat and 20.8 – 23.5% fiber and this by-product is a good source of vitamin B1, B2 and A (Aghajanzadeh et al., 2010).

The nutrient composition of feeds using chemical analysis is well documented in literature, but this does not provide enough information on the feeds nutritive value. Fermentation characteristics of feedstuffs in rumen fluid can be studied *in vivo*, *in situ*, and *in vitro*. Because in vivo determinations of rumen fermentation characteristics are laborious, expensive, and difficult to standardize, *in situ* and *in vitro* techniques have been developed.

The in vitro gas production system helps to better quantity the nutrient utilization and its accuracy in describing digestibility in animal has been validated in numerous experiments. Although, gases produced during rumen fermentation are colossal waste products and of no nutritive value to the ruminant, but gas production test are used routinely in feed research as gas volumes are related to both the extent and rate of substrates degradation (Akinfemi et al., 2009). This experiment was designed to determine nutritive value of tomato pomace using gas production techniques.

MATERIALS AND METHODS

Sample Collection

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Tomato Pomace samples were collected in Tomato processing CO. All samples were thoroughly mixed, and a composite sample (100g) was taken. Half of samples were treated with 1 and 2% urea and placed in nylon silos until 21d. All samples were dried in an oven at 100°C until a constant weight was achieved. All samples were then ground to pass throught a 2-mm screen in Wiley mill before incubation.

Measured in vitro gas production

In vitro gas production: Rumen fluid was obtained from two fistulated wethers fed twice daily with a diet containing alfalfa hay (60%) and concentrate (40%). Equal volumes of ruminal fluid from each sheep collected 2 h after the morning feeding squeized through four layers and mixed with McDougall (1948) buffer pre warmed to 39° C. The inoculums was dispensed (20 mL) per vial into 100 mL serum vial (containing of 300 mg sample per vial) which had been warmed to 39° C and flushed with oxygen free CO2. The vials were sealed immediately after loading and were affixed to a rotary shaker platform (lab-line instruments Inc, Iran) set at (120 rpm) housed in an incubator. Vials for each time point, as well as blanks (containing no substrate), were prepared in triplicate. Triplicate vials were removed after 2, 4, 6, 8, 10, 12, 16, 24, 36, 48, 72 and 96 h of incubation.

Cumulative gas production data were fitted to the model of Orskov and McDonald, 1979). $P=a+b(1-e^{-ct})$ that a=The gas production from the immediately soluble fraction (mL), b=The gas production from the insoluble fraction (mL), c=The gas production rate constant for the insoluble fraction (b), t=The incubation time (h) and P=The gas production at the time t.

Calculations and Statistical Analysis

Data were analyzed as a completely randomized design using a general linear model (GLM) procedure of SAS, with Duncan's multiple range test used for the comparison of means. Feeds were the only sources of variation considered.

RESULTS AND DISCUSSION

The gas test data are shown in Table 1. Gas production influenced by the microbial activity of rumen fluid may affect the rate of fermentation. Since gas production of treatments was little during the first 36h of fermentation, there were no significant differences between treatments. But processing of in vitro gas production showed that untreated tomato Pomace have a high gas production in other times ($P<0.05$).

Datt and Singh (1995) showed more gas production in feedstuffs can be correlated with high metabolically energy, high fermentable nitrogen for microbial activity, resulting high growth rate and enhanced ruminal biomasses.

Treatment of *Tomato Pomace* with urea increases samples pH due to hydrolysis of urea to NH_3 and has been shown to be effective in preservation of stored samples. The high gas yield in untreated samples probably resulted from high soluble CP, supply of N for growth of microorganism and high ruminal fermentation capacity for structural and nonstructural carbohydrate. Our results were lower than Kim et al. (2007) and Rodrigus et al. (2009). Obtained data showed that increasing soluble CP in feedstuffs, decrease gas production.

Table 1. Means of gas production feeds by incubation at different times in the gas test method (mlLg^{-1} DM)

Feed	Incubation times (h)											
	2	4	6	8	10	12	16	24	36	48	72	96
TP	13.07	24.13	48.03	58.82	66.39	72.64	85.70	105.30	119.51	148.23a	168.21a	178.42
TP + 1% Urea	11.30	25.14	50.03	60.60	67.94	73.75	85.92	104.86	117.51	148.01a	164.21a	172.64
TP + 2% Urea	11.30	22.57	50.03	60.38	67.27	72.64	84.59	105.30	117.95	139.79b	156.66b	170.21
SEM	0.769	0.840	0.736	0.850	1.072	1.033	0.559	0.800	0.666	1.326	2.071	3.472

Means within a column with different subscripts differ ($p<0.05$).

CONCLUSION

Tomato Pomace widely can be used as a high energy feed in ruminant rations to support growth and lactation, with fewer negative effects on rumen fermentation than starch rich feeds.

Treating with urea, increase pH (when product NH_4^+) and that decrease anti-nutritional factors and the end of this process is increasing of ruminal degradation of feeds. Increasing soluble CP in feedstuffs, decrease gas production.

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THE INFLUENCE AN EXOGENOUS ENZYMES-PROBIOTICS COMPLEX ON THE GROWTH PERFORMANCE AND CARCASS TRAITS OF ALBINO RATS FED DIETS CONTAINING UP TO 60% RICE BRAN

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ABSTRACT: *The experiment was conducted to determine the effects of varying levels of rice bran supplemented with Xzyme™ (an exogenous enzyme-probiotic complex) on the growth performance and carcass traits of albino rats. Thirty weanling albino rats with average initial liveweight of 66.9±0.3g were randomly allotted to six dietary treatments in a 3 x 2 factorial design (3 levels of rice bran [20, 40 and 60%] by 2 levels [0 and 250mg/kg of diet] of the Xzyme™). There were 5 rats on each treatment which were housed individually in plastic cages. Feed and water were provided ad libitum and their growth performance monitored for 28 days, after which the rats were slaughtered to collect carcass data.The mean values for total feed intake, weekly feed intake and daily weight gain were similar (P>0.05) for all the various dietary treatments. The addition of the Xzyme™ led to an improvement (P>0.05) in feed conversion ratio (FCR) at each level of the rice bran. Both feed cost and feed cost per 100g weight gain values decreased as the level of RB increased despite the extra cost of the added Xzyme™. The carcass characteristics of the albino rats on all the six dietary treatments were similar (P>0.05). The results suggest that albino rats and probably other mono-gastric livestock species can be fed diets containing 60% rice bran plus Xzyme™ without any adverse effect on health, growth performance and carcass characteristics.*

Key words: *Feed, Fibre, Albino rat, Rice bran, Xzyme™*

ORIGINAL ARTICLE

INTRODUCTION

Maize constitutes the predominant ingredient in most swine and poultry diets (Subramanium and Metta, 2000) and is also considered the most important cereal crop produced in Ghana, because it is the most widely consumed staple food in Ghana (Morris et al*.,* 1999). For that reason, feeding monogastric livestock with high maize diets appears unsustainable in the near future, hence to need to resort to the use of cheaper alternatives. Rice bran is one of such alternative which is already receiving attention from poultry and livestock farmers. It is however being used sparingly because of its high fibre content (Farrell, 1994; Adeola and Cowieson, 2011) and considerable variability.

The fibrous fraction of the animal's diet could offer a significant amount of energy which previously would be unavailable for utilization by the animal because it could not be digested due to the lack of the appropriate digestive enzymes. However, the ability of exogenous enzymes to aid the digestion of high fiber diets have been reported by several researchers (Cadogan et al., 2003; Barrerra et al., 2004; Kiarie et al., 2007; Emiola et al*.,* 2009). According to Adeola and Cowieson (2011), enzymes are used in nonruminant animal production to promote growth, improve the efficiency of nutrient utilization and reduce nutrient excretion. They also forecast a promising future for exogenous enzymes utilization in nonruminant nutrition, especially when their roles in promoting health are further understood.

Xzyme™ is a multi-enzyme complex containing *Lactobacillus spp.* and *Saccharomyces cerevisiae* as probiotic organisms. The benefits of enzymes have been clearly established (Cadogan et al., 2003; Barrerra et al., 2004; Kiarie et al., 2007; Emiola et al., 2009), and probiotics reported to aid in allergy prevention, synthesis and the enhancement in the bioavailability of nutrients (Parvez et al*.,* 2006; Sarkar, 2011).

This experiment was conducted to ascertain how the combined effects of the enzymes and probiotics will influence the growth and carcass characteristics of albino rats (*Rattus norvegicus)* fed diets containing varying levels of rice bran with or without Xzyme™.

MATERIALS AND METHODS

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Location and Duration of Experiment

The study was conducted at the Livestock Section of the Department of Animal Science, Faculty of Agriculture, Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana. The climatic conditions during the period of the experiment were dry, cold and hazy, with temperature ranging between 24 and 31^{o}C, as the country was experiencing the dry (Harmattan) season.

Animals and Experimental Design

Thirty weanling albino rats (12 males and 18 females) were randomly allotted to six dietary treatments (Table 1) in a 3 x 2 factorial design (3 levels of RB [20, 40 and 60%] by 2 levels of Xzyme™ [0 and 250mg/kg of diet]). There were five rats on a treatment and each rat served as a replicate. The six isonitrogenous (18% CP) dietary treatments were 20% rice bran (RB_{20}); 20% rice bran plus Xzyme™ (RB_{20+}); 40% rice bran (RB_{40}); 40% rice bran plus Xzyme™ (RB_{40+}); 60% rice bran (RB_{60}) and 60% rice bran plus Xzyme™ (RB_{60+}). Feed and water were provided *ad libitum* over the four week-period.

Table 1 - Percentage composition of the Six diets

Feed Ingredients	Dietary Treatments					
	RB_{20}	RB_{20+}	RB_{40}	RB_{40+}	RB_{60}	RB_{60+}
Maize	59.75	59.75	40.95	40.95	22.40	22.40
Rice Bran	20.0	20.0	40.0	40.0	60.0	60.0
Fish meal	9.50	9.50	7.80	7.80	6.10	6.10
Soybean meal	9.50	9.50	9.50	9.50	9.50	9.50
Oyster shell	0.50	0.50	1.00	1.00	1.25	1.25
Common salt	0.25	0.25	0.25	0.25	0.25	0.25
Vit. trace mineral premix	0.25	0.25	0.25	0.25	0.25	0.25
Dicalcium phosphate	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100
Calculated composition, %						
Crude protein	18.01	18.01	18.0	18.0	18.0	18.0
Crude fibre	5.0	5.0	7.04	7.04	9.08	9.08
Calcium	0.81	0.81	0.92	0.92	0.94	0.94
Phosphorus	0.89	0.89	1.10	1.10	1.32	1.32
ME (Kcal/kg)	3234.75	3234.75	3104.67	3104.67	2983.14	2983.14

Vitamins, Provitamins (per kg of diet): Vitamin A (8000 I.U); Vitamin D3 (150I.U); Vitamin E (2.5mg) ; Vitamin K (1mg); Vitamin B2 (2mg); Vitamin B12 (5×10^{-3}mg); Folic Acid (0.5mg); Nicotimic Acid (8mg); Calcium Panthotenate (2mg); Choline Cloruro (50mg), Trace Elements: Mg (50mg); Zn (40mg); Co (0.1mg); Cu (4.5mg); Se (0.1mg). Antioxidants: Butylated Hydroxytoluene (10mg). Carrier: Calcium carbonate q.s.p (2.5kg).

Management of Rats

The rats were housed separately in rectangular plastic cages measuring 27× 21.5 ×15cm, each of which was covered with wire mesh to aid ventilation. Circular metallic feeding troughs were tightly fixed at a corner of each container and a nipple drinker was placed on top of the wire mesh to provide water for the rats. Faeces were collected every morning and disposed off, while any feed that had been spilled was gathered and kept until the end of the week when it was weighed. The rats were given feed and water *ad libitum*.

Parameters measured

In the course of the experiment, weekly feed intake and weekly weight gains were recorded and corresponding average daily feed intake and average daily weight gain and feed conversion ratios were calculated. At the end of the 4 weeks, the rats were chloroformed, dissected and carcass data were collected as described by Boateng et al. (2012).

Statistical analysis

The data collected for the growth performance and carcass components of the rats were subjected to analysis of variance (ANOVA) using GenStat Discovery Edition (9.2) and differences between means were separated by Duncan's Multiple Range Test.

RESULTS AND DISCUSSION

Generally, the health status of the rats was good and there was no record of mortality within any of the dietary treatments. The overall performance of the rats with respect to the parameters measured are presented in Table 2. There were no significant (P>0.05) differences in the mean daily weight gain recorded for all the treatments. However, it is worth noting that there was a trend of increasing daily weight gain with mean daily feed intake values recorded for the various dietary treatments suggesting that there may be a positive relationship

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between the feed intake and the mean daily weight gain values. Increases in mean daily feed intake values with increasing levels of wheat bran in growing pigs has been reported by Rosencrans et al. (1970).

It was also observed that the mean daily weight gain for the rats on dietary treatment RB_{20+} (3.24g), RB_{40+} (2.96g) and RB_{60+} (3.07g) were slightly higher (P>0.05) than for those on treatments RB_{20}, RB_{40} and $RB6_0$ which had mean daily weight gains of 2.96, 2.88 and 2.85g respectively. The slightly higher values in the daily gain for the Xzyme™-supplemented treatments suggest that the Xzyme™ may have helped by making available to the rats nutrients that were locked up in the NSP fraction of the diet.

Table 2. Mean Feed Intake, Growth Performance and Economy of Production

Parameter	Xzyme™ level	Level of Rice bran (%)				Factor	LSD	P
		20	40	60	Mean			
Initial weight, g	0	67.0	67.2	67.2	67.1	RB	6.40	0.991
	1	66.6	67.2	67.0	66.9	RB+	5.23	0.937
	Mean	66.8	67.2	67.1	-	(RB x RB+)	9.05	0.998
Final weight, g	0	149.8	147.8	147.0	148.2	RB	14.40	0.785
	1	157.4	150.2	153.0	153.5	RB+	11.76	0.355
	Mean	153.6	149.0	150.0	-	(RB x RB+)	20.37	0.929
Total feed intake, g	0	305[a]	345[b]	344[b]	331	RB	29.4	0.050
	1	323	332	359	338	RB+	24.0	0.564
	Mean	314	338	351	-	(RB x RB+)	41.5	0.496
Mean daily feed intake, g	0	10.9[a]	12.31[b]	12.27[b]	11.83	RB	1.048	0.047
	1	11.54	11.85	12.81	12.07	RB+	0.856	0.564
	Mean	11.22	12.08	12.54	-	(RB RB+)	1.483	0.496
Mean daily gain, g	0	2.96	2.88	2.85	2.9	RB	0.499	0.738
	1	3.24	2.96	3.07	3.09	RB+	0.407	0.324
	Mean	3.10	2.92	2.96	-	(RB x RB+)	0.706	0.913
FCR	0	3.73[a]	4.37[b]	4.43[b]	4.18	RB	0.517	0.039
	1	3.63	4.10	4.19	3.98	RB+	0.422	0.334
	Mean	3.68	4.23	4.31	-	(RB x RB+)	0.731	0.938
Feed cost, GH¢/100g	0	0.0720	0.0580	0.0470	0.0590	RB	-	-
	1	0.0723	0.0583	0.0473	0.0593	RB+	-	-
	Mean	0.0722	0.0582	0.0472	0.0592	(RB x RB+)	-	-
Cost/100g wt gain, GH¢	0	0.269[a]	0.253[a]	0.208[b]	0.243[a]	RB	0.029	<.001
	1	0.263	0.239	0.198	0.233	RB+	0.024	0.388
	Mean	0.266	0.246	0.203	-	(RB x RB+)	0.041	0.957

[a, b,] Means in the same row with different letters differ significantly (P<0.05) different, L.S.D.: least significant difference. RB+: Rice bran levels p x RB+): Rice bran – Xzyme™ interaction, P: P-value

Anukam et al. (2005) recorded increased feed intake when rats were given feed supplemented with a DFM containing lactobacillus strains. Trials in China have shown that multi-enzyme preparations containing amylase, pectinase, cellulase and protease have a beneficial effect on weight gain of weanling pigs (Deng et al., 1993). The addition of the Xzyme™ led to an improvement in FCR at every level of the rice bran (Table 2). There was also a decreasing trend in feed cost (¢/100g) as the level of rice bran increased. The decreasing trend observed as the rice bran levels were increased suggests that it was more economical to obtain a unit gain in live weight in rats using the diets with higher levels of rice bran plus the Xzyme™.

Carcass Characteristics

Table 3 presents a summary of the carcass characteristics of the rats fed the six different experimental diets. The values for the relative weights of the various organs studied were not significantly (P>0.05) different and the values followed no clear trend.

Okyere (1994), working on broiler chickens and using diets containing up to 40% wheat bran but with different type and levels of Optizyme™ observed a similar trend in viscera values. Interestingly these values (Table 3) though not significantly (P>0.05) different, showed a trend towards increases in liver weight as the RB level

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increased. Dietary fibre levels have been shown to affect the size and weight of the gastrointestinal tract as well as that of some internal organs in both pigs and rats (Pond et al., 1988; Anugwa et al. 1989; Hansen et al., 1992).

Table 3. Mean Relative Weights of Viscera, Liver, Spleen and Lungs of the Rats fed Xzyme™ -supplemented diets

Parameter	level	Level of Rice bran (%)				Factor	LSD	P
		20	40	60	Mean			
Relative weight (%)								
Viscera	0	24.47	22.69	22.59	23.25	RB	2.144	0.302
	1	22.85	21.74	24.67	23.09	RB_+	1.751	0.85
	Mean	23.66	22.22	23.63	-	(RB x RB_+)	3.042	0.185
Liver	0	5.8	5.3	4.96	5.36	RB	0.378	0.325
	1	4.99	5.19	5.27	5.15	RB_+	0.309	0.184
	Mean	5.4	5.25	5.12	-	(RB x RB_+)	0.535	0.018
Spleen	0	0.45	0.42	0.31	0.39	RB	0.091	0.178
	1	0.32	0.38	0.33	0.34	RB_+	0.074	0.182
	Mean	0.38	0.4	0.32	-	(RB x RB_+)	0.128	0.31
Lungs	0	0.77	0.87	0.7	0.78	RB	0.173	0.488
	1	0.89	0.75	0.77	0.81	RB_+	0.141	0.728
	Mean	0.83	0.81	0.74	-	(RB x RB_+)	0.244	0.339

L.S.D.: least significant difference. RB_+: Rice bran plus Xzyme™. (RB x RB_+): Rice bran – Xzyme™ interaction, P: P-value

CONCLUSIONS AND RECOMMENDATION

From the results of the experiment, it can be concluded that the various dietary treatments had no significant (P>0.05) effects on the growth performance and carcass characteristics of the albino rats. The rats fed the higher levels of rice bran plus Xzyme™ did equally well as those fed the diets without Xzyme™. Rats on the higher rice bran diets with Xzyme™ also did better in terms of growth though not significantly (P>0.05) different than those on the diets without the supplement. It is concluded that up to 60% rice bran diets with Xzyme™ can be fed to albino rats without any adverse effects on health, growth performance and carcass characteristics. From economic point of view, the same diet (60% rice bran diet with Xzyme™ at 250mg/kg inclusion rate) could be recommended since it costs the least to raise the rats on this treatment. It is however suggested that the inclusion rate for Xzyme™ should be increased in subsequent studies to see of higher levels of the enzyme complex will yield different results.

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COMPARISON OF DRY MATTER DIGESTIBILITY OF THREE VARIETY OF SORGHUM SILAGES WITH SPEED FEED VARIETY BY NYLON BAG TECHNIQUE

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ABSTRACT: *In this study, four types of sorghum silages were tested with nylon bag technique. Tow fistulae Gizel sheep with average BW 50.5±2.5 kg used in a complete randomized design. Ruminal DM disappearance were measured 0,4,8,12,16,24,36,48,72 and 96 h. Dry matter degradability of R161 and R165 at 96h were 66.88 and 62.35%, respectively were higher and lower DM degradability that showed significant differences (P<0.05). Sorghum silages have high DM degradability and its nutritional composition showed that its can used instead of Alfalfa. It can decrease feed price.*

Key words: *Sorghum Silage, Degradability and Nylon Bags*

ORIGINAL ARTICLE

INTRODUCTION

Feeding costs are one of the major problems in the economic balance of the sheep farmers. It has been well established that ruminant animals are capable of utilizing cellulose and hemicelluloses from forages, wood and other complex fibrous carbohydrates (Singh and Kamstra, 1981). Non-traditional by-products must search in order to decrease the relay on traditional resources to fill the gap and decrease feeding costs (Afaf et al., 2009).

Exposure to air during feeding and storage can cause silages to spoil. Yeasts that are able to metabolize lactic acid are the primary initiators of spoilage, which leads to an increase in silage pH. This change in the silage environment allows for the growth of opportunistic bacteria and fungi, causing further spoilage. Predicting the feeding value of feedstuffs as accurately as possible and with methods of low cost and easy to handle is an important economical target. This goal is of particular importance for grazing and browsing ruminants that valorize local resources often of low and variable nutritive value. Chemical composition can give an idea of the nutritive value of feeds, but it is not sufficient (Krishnamoorthy et al., 1995). Biological methods involving microorganisms and enzymes that are sensitive to factors influencing the rate and extent of digestion seem more appropriate in this case than chemical methods. Among them, the most popular are the *in situ* dry matter degradability (Mehrez and Ørskov, 1977).

The *in situ* technique has been widely used to study ruminal digestion kinetics of feeds for cattle. Although in this technique the incubated feed is not subject to mastication and passage, it is no better way to simulate the rumen environment to study ruminal digestion kinetics (Nocek, 1988). This technique has been reported to be well correlated with animal performance (Orskov, 1989; Khazaal et al., 1993), with voluntary feed intake and in vivo dry matter digestibility (Khazaal et al., 1995). In Brazil, researchers have used the *in situ* method to evaluate tropical forages, agricultural residues and industrial by-products for feeding cattle (Vilela et al., 1994; Gomes et al., 1994; Aroeira et al., 1995).

MATERIALS AND METHODS

Animals and feeding

Two yearling (Gizil) wethers (50.5±2.5 kg) were used. At least 30 d before initiation of the experiment, each wether was surgically fitted with a ruminal cannula. The wethers were housed in tie stalls under controlled environmental conditions with continuous lighting and constant temperature (24 to 26°C). All whether were fed a diet containing of 60% hay and 40% concentrate. The feed was fed in equal portions every 8 h to maintain a relatively stable rumen environment.

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Sample Collection

Sorghum samples harvested from Golestan, Research Center field. Samples were collected from at least 7 different areas of field. All 7 samples were thoroughly mixed, and a composite sample (100g) was taken. And all of the samples put inside the rubber bucket to prepare silo environment. After 21 days, all samples were dried in an oven at 100°C until a constant weight was achieved. Samples were then ground to pass thought a 2-mm screen in Wiley mill (model 4, Arthur H. Thomas Co., Philadelphia, PA) before incubation.

Chemical analysis

Feedstuffs dry matter (DM, method ID 934.01), ash (method ID 942.05), ether extract (EE, method ID 920.30) and crude protein (CP, method ID 984.13) were determined by procedures of AOAC (1999). The neutral detergent insoluble fiber (NDF) and acid detergent fiber (ADF) concentrations were determined using the methods of Van Soest et al. (1991), without sodium sulphite. Neutral detergent insoluble fiber was analyzed without amylase with ash included.

Dry matter was determined by drying the treatments at 105°C over night and ashed by igniting the treatments in muffle furnace at 525°C for 8 h. Nitrogen (N) content was measured by the Kjeldahl method (AOAC, 1999). Crude protein was calculated as CP=N×6.25.

In situ degradation

In situ methods procedures was determined using Nocek (1988) and reviewed by Taghizadeh et al. (2005), the ground samples (5g) were placed in Dacron bags (5.5×10 cm;47-µm pore size) and were sealed with waterproof glue. Each feed sample was incubated in 4 replicates (2 replicates for each whether) in the rumen. The incubation times for silage samples were 0,4,8,12,16,24,36,48,72 and 96 h. Nylon bags were suspended in the rumen in a polyester mesh bag (25×40 cm;3mm pore size) and were removed from the rumen at the same time so that all bags could be washed simultaneously. The nylon bags were then removed from the mesh bag and washing until the rinse water remained clear. Samples were then dried in an oven at 55˚C until a constant weight was achieved before determination of DM disappearance. The DM degradation data was fitted to the exponential equation P = a+b (1–e-ct), where P: is the disappearance of nutrients during time t, a: the soluble nutrients fraction which is rapidly washed out of the bags and assumed to be completely degradable, b: the proportion of insoluble nutrients which is potentially degradable by microorganisms, c: is the degradation rate of fraction b per hour and t is time of incubation.

Calculations and Statistical Analysis

Data were analyzed as a completely randomized design using a general linear model (GLM) procedure of SAS, with Duncan's multiple range test used for the comparison of means. Feeds were the only sources of variation considered.

RESULTS AND DISCUSSION

Average of DM disappearance of four sorghum silages were shown in Table 1. Data showed that the R161 were showed higher ruminal degradability in 96h compared with R165 samples. The obtained results for DM degradability were according to NRC (1989). There were differences among levels of disappearance for DM of silages at the different incubation times ($P<0.05$). Since disappearance of DM was little during the first 8h of fermentation, R166 showed lower ruminal disappearance of DM ($P<0.05$), but processing of ruminal DM degradation showed that R165 have a lowest ruminal degradation in other times ($P<0.05$). The chemical composition of silages influenced ruminal degradation process. Sorghum silages have high ruminal DM degradability and recommended to use in ruminant ration.

Table 1 - *In situ* DM disappearance (% of DM)

Silages	Incubation time (h)									
	0	4	8	12	16	24	36	48	72	96
R161	12.03^{a}	18.83^{a}	23.1^{a}	26.59^{a}	40.94^{a}	48.61^{a}	56.71^{a}	63.18^{a}	65.99^{a}	66.88^{a}
R166	7.10^{d}	11.45^{d}	14.33^{c}	21.64^{d}	29.03^{d}	40.46^{c}	51.10^{b}	57.43^{b}	60.70^{bc}	62.68^{c}
R165	9.78^{c}	13.55^{c}	15.75^{b}	23.06^{c}	34.28^{c}	42.20^{c}	51.94^{b}	56.95^{b}	60.09^{c}	62.35^{c}
Speed Feed	11.04^{b}	16.00^{b}	22.52^{a}	24.97^{b}	36.82^{b}	47.05^{b}	54.82^{a}	57.02^{b}	62.34^{b}	65.17^{b}
SEM	0.2011	0.2477	0.2860	0.1878	0.5140	0.4679	0.8092	0.3987	0.5398	0.3546
P-Value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0040	<0.0001	0.0002	<0.0001

Ruminal degradability of sorghum silages were higher than alfalfa or other hays (Taghizadeh et al., 2008). These results showed that sorghum silages can used widely in ruminants rations without metabolic problems and to eliminate the need for costly waste management programs.

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Andrighetto et al. (1993) showed the values of soluble and insoluble fraction for DM of alfalfa about 17.9% and 45.1%, respectively that is higher than the obtained data for a fraction and lower than the b fraction in this experiment. The difference values for degradability's parameters of different hay can be resulted from the variance of growth rate, NDF content, soluble and insoluble fractions and environment temperature. The found data in this experiment showed high values for soluble fraction of DM compared to that the reported by Taghizadeh et al (2008), but the its insoluble fraction lower than finding of mentioned study. The achieved differences can be depended on the differences in variety, drying processing, climate conditions, soil, maturity, sample size: square area in used nylon bag and microbial contamination.

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EFFECT OF SEASON AND DIETARY PROTEIN LEVEL ON IMMUNE RESPONSE OF THREE EXOTIC BROILER STRAINS IN SUDAN

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ABSTRACT: *This study was conducted to investigate the effect of the season (summer versus winter) and dietary protein level (high versus low) using three broiler strains (Ross, Cobb and Hubbard) on immunity; heterophil/lymphocyte ratio and haemagglutination against sheep red blood cells (SRBC). Three hundred and sixty, one-day-old unsexed broiler chicks were used in this study during the summer and winter seasons, 120 from each of Ross strain, Cobb strain and Hubbard strain. Two experiments were executed in a complete randomize design (factorial arrangement 3x2x2). Each strain was divided into two groups, with six replicates (10 chicks per replicate). Group A of each strain was fed on a starter diet containing 23% crude protein for the first four weeks of age, then replaced by a finisher diet containing 21% crude protein. Group B was fed on a starter diet containing 21% crude protein replaced by a finisher diet containing 19% crude protein. Both diet were iso caloric. The results showed that the heterophil/lymphocyte ratio (H/L ratio) increased significantly (P<0.05) during the summer in both Hubbard and Ross strains, but it was not significantly affected by the season in Cobb strain. The total antibody titers against SRBC were decreased during the summer season in the three strains. The level of dietary protein showed no significant effect on H/L ratio in the three strains. Decreasing dietary protein level decreased the total antibody titers against SRBC in both Ross and Hubbard strains. Whereas, it does not affect the total antibody titers against SRBC in Cobb strain.*

ORIGINAL ARTICLE

Key words: *Broiler Strain; Season; Protein Level; Immune Response*

INTRODUCTION

Over the last several decades, genetic selection for faster growth rate, better feed efficiency and higher disease resistance are intensively considered in commercial broiler production. Measures of immunity that have been commonly used and assessed in poultry are antibody response to foreign antigens (Patterson and Siegel, 1998).

The phenotype of an individual represents the complex sum of the effects of genotype and environment. Many studies on interactions between genetic factors and environments (G × E) have been reported for chickens (Ali et al., 2001; Deeb and Cahaner, 2001a, b, 2002; Tixier-Boichard, 2002; Mathur, 2003; Fulton, 2004).

Despite progress that has been made in the areas of health, vaccination and management in the poultry industry, diseases problem still exist that affect the efficiency of the poultry industry. Seasonal cycles of infectious diseases have been variously attributed to changes in environmental conditions, the prevalence or virulence of the pathogen, or the behaviour of the host, but no single theory has proved a satisfactory explanation (Dowell 2001).

Several studies have been conducted on the effects of high temperature on the immune responses of chickens, with variable findings. Thaxton et al. (1968) was the first who demonstrated that high environmental temperature affects the development of specific immune responses in young chickens.

The effect of nutrition on antibody response to Sheep Red Blood Cells (SRBCs) is variable. Tsiagbe et al. (1987) reported a dose related increase in total and immunoglobulin-G (IgG) antibodies against SRBCs when the broiler chicken diet was supplemented with methionine. However, Rao et al. (1999) found no significant differences in humoral response to SRBCs among the chicks fed high, medium and low protein diets. Similarly, dietary protein and energy content have no significant influence on broiler chick responses to SRBCs (Praharaj et al., 1997). Nevertheless, Carlomagno et al. (1980) reported that protein deficiency inhibited antibody production and the development of antibody production cells in response to T-dependent antigens.

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MATERIAL AND METHODS

Two experiments were carried out in the premise of poultry research unit, department of poultry production, Faculty of Animal Production University of Khartoum, Shambat (Khartoum North). The laboratory analyses were carried out at the Department of Physiology, Faculty of Veterinary Medicine and University of Khartoum.

Experimental birds

Three hundred and sixty one-day-old unsexed broiler chicks were used during the summer and the winter seasons, 120 from Ross, 120 for Cobb and 120 for Hubbard strain. The total number of chicks of each strain was divided into two groups, with six replicates (10 chicks per each).

Experimental diets

Group A of each strain was fed a diet containing 23% crude protein and 3000 kcal/kg ME as starter diet for the first four weeks of age, and then replaced by a diet containing 21% crude protein and 3000 kcal/ kg ME as finisher diet. Group B for each strain was fed a diet containing 21% crude protein and 3000 kcal/ kg ME as starter diet for the first four weeks and then shifted to a diet containing 19% crude protein and 3000 kcal/ kg ME as finisher diet. The formulation of the experimental diets is shown in table 1.

Table 1 - Ingredients composition of experimental diet on percent basis

Ingredient	Diet (1)		Diet(2)	
	Starter %	Finisher %	Starter %	Finisher %
Sorghum	61	61.5	61.5	68.5
Groundnut cake	15.8	12	12	7.3
Sesame cake	13	11.3	11.3	9
Wheat bran	4	9	9	9
Super concentrate	5	5	5	5
Limestone	0.9	0.9	0.9	0.9
Nacl	0.25	0.25	0.25	0.25
Lysine	0.04	0.04	0.04	0.04
Methionine	0.01	0.01	0.01	0.01
Total	100	100	100	100

* Composition of supper concentrates BRO-5 (1504.10) Fishmeal, vegetable protein, dicalciumphosphate, limestone, vitamins, trace-elements, antioxidant. * Vitamins and premix minerals per kg of diet

Heterophils / Lymphocyte ratio

Heterophils / Lymphocytes (H/L) ratio was calculated using blood smears after been stained by Giemsa May-Grunwald staining procedure.

Antibody response to SRBC

The Sheep Red Blood Cells (SRBC) were collected and washed three times in normal saline. Birds were injected intravenously with 1 ml of 10 % suspension of packed sheep red blood cells in normal saline at four weeks of age. 11 days later, blood was collected from the heart of each bird. Sera were collected and stored at -20°C. The total antibody titre was determined by haemagglutination test. Briefly, 50 µL of plasma was added in an equal amount of phosphate buffer solution in the first column of a 96-well U-shaped bottom plate and the solution was incubated for 30 min at 37°C. A serial dilution was then made and 50 µL of 2% SRBC suspension was added to each well. Total antibody titers were then read. The reciprocal of the highest dilution showing complete agglutination was expressed as titre (log2).

Statistical Analysis

Haemagglutination antibody titers against SRBC were statistically converted into geometric mean titers. The statistical analysis for the recorded H/L ratio was carried out using analysis of variance for factorial experiment in a completely randomized design by general linear model using (Statistix program, version 9).

RESULTS AND DISCUSSION

The findings of the present study indicated that there was a significant ($P<0.05$) increase in H/L ratio in Ross and Hubbard strains during summer compared to winter season. While, Cobb strain was not significantly affected by heat stress during summer season (Figure1). The stability of H/L ratio in Cobb strain irrespective of the season could be attributed to the high immune response of Cobb compared to the other two strains (Makram et al*.,* 2010). The increased in H/L ratio during the summer might be due to induced stress which release glucocorticoids, causing dissolution of lymphocytes in lymphoid tissues, leading to lymphopenia. However, there is an increase in heterophil released by the bone marrow, thus increasing their number in the circulation, although their phagocytic and bactericidal activities are decreased (Swenson and Reece, 1996; Berne and Levy, 1998). The present finding is in consistent with the previously obtained ones (Zulkifli and Siegel, 1995; Borges, 1997; Altan et al*.,* 2000; Bedenova et al., 2003; Zulkifli et al*.,* 2009).

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The data concerning the effect of broiler strain and season on the antibody titers against SRBC are presented in (Figure 2). The results showed that the heat stress caused a reduction in total antibody titers against SRBC in all strains. However, it was less in Cobb strain. This result is in accordance with the findings of Zulkifi et al. (2000) who found that heat stress caused a reduction in antibody synthesis. This reduction could be indirectly due to an increase in inflammatory cytokines under stress (Ogle et al., 1997), which stimulates the hypothalamic production of corticotropin releasing factor (Sapolsky et al., 1987). Corticotropin releasing factor is known to increase adrenocorticotropic hormone from the pituitary; adrenocorticotropic hormone then stimulates corticosterone production from the adrenal gland. Corticosterone inhibits antibody production (Gross, 1992). Furthermore, heat stress is known to decrease T-helper 2 cytokines (Wang et al., 2001), which are important for antibody production, (Lebman and Coffman, 1988).

The results reflected that, in all strains the level of dietary protein had no significant effect on H/L ratio (Figure 3). This result is in the line with that obtained by Donkoh et al. (1999); Alam et al. (2004) who observed that the level of dietary protein has no significant effect on H/L ratio. Furthermore, feeding birds with diets containing high dietary protein increased the total antibody titers against SRBC. This result is in consistent with those of (Payne et al., 1990) who found that deficiency or excess of dietary protein changes immune responses. Deif et al. (2007) documented that the total anti-SRBCs antibody titers measured post primary and secondary SRBCs-injection for broiler chicks fed a high protein diet are significantly higher than those of other fed a marginal protein diet which is in agreement with the findings of this study.

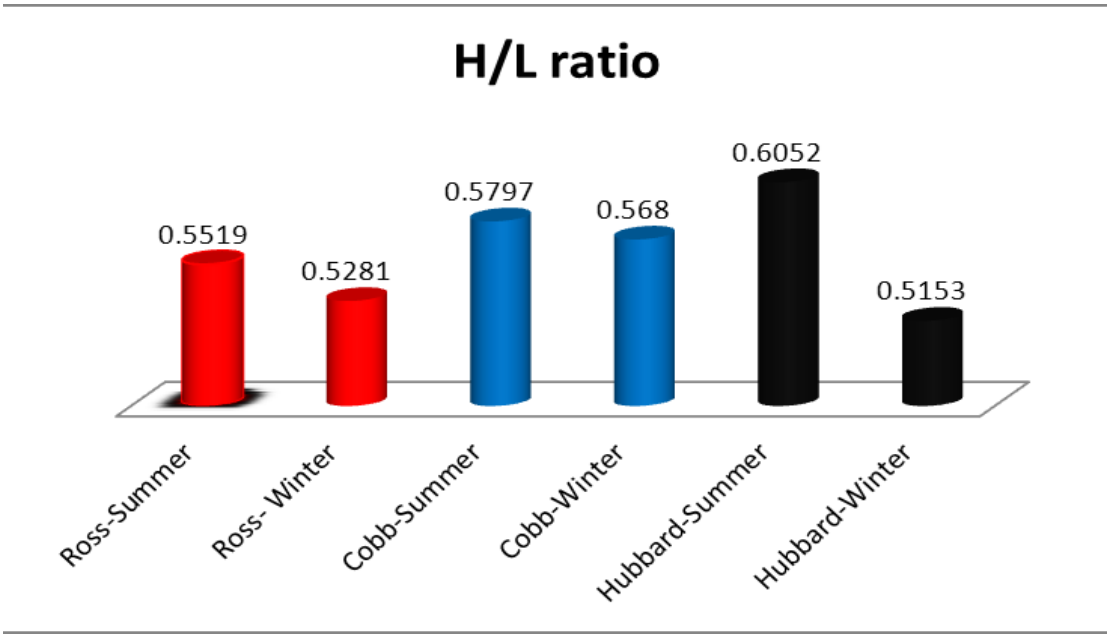

Figure 1 - Effect of broiler strain and season on Heterophils/ Lymphocyte ratio

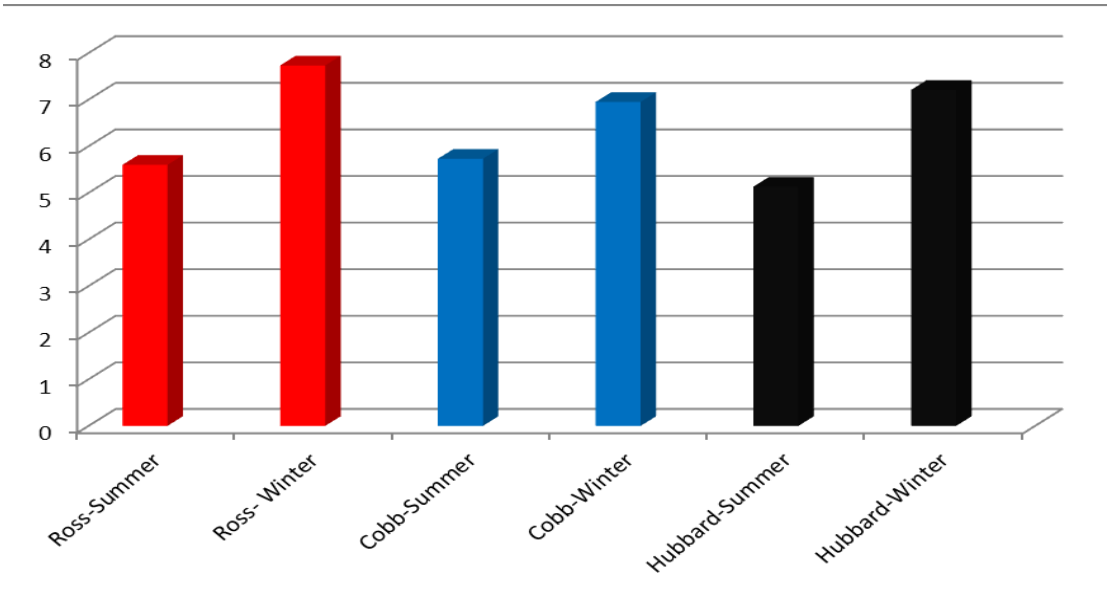

Figure 2 - Effect of broiler strain and season on total antibody titers against SRBC

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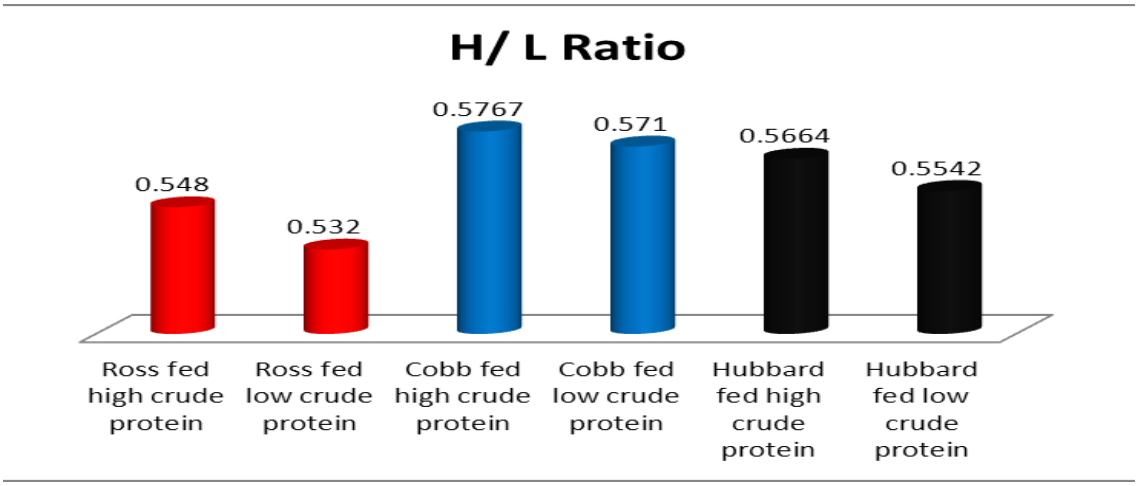

Figure 3 - Effect of broiler strain and dietary protein level on H/L ratio

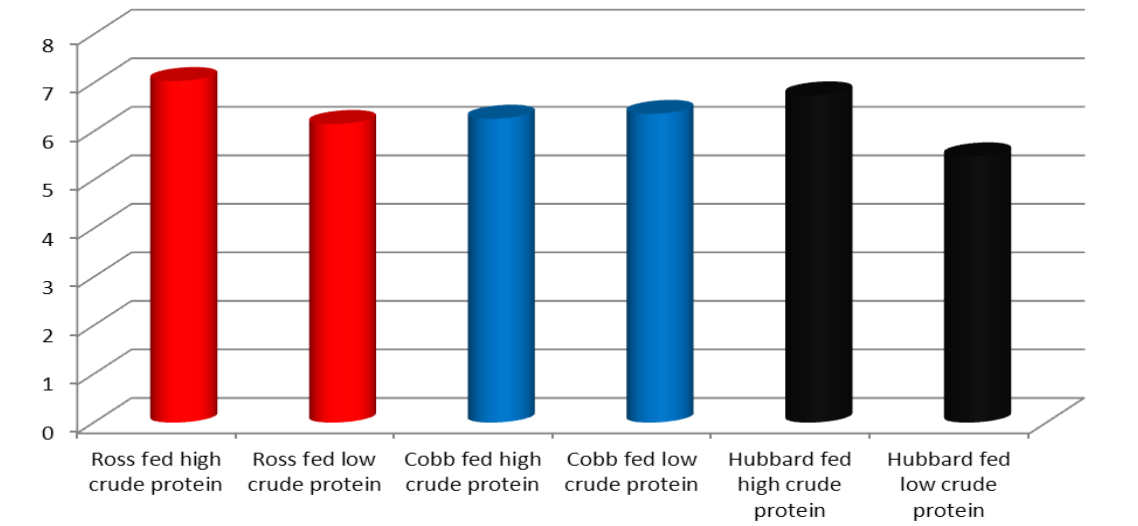

Figure 4 - Effect of broiler strain and dietary protein level on total antibody titers against SRBC

CONCLUSIONS

The physiological responses of genetically improved broiler strains to environment (heat stress) and nutritional (low protein) stresses appeared to be significantly different from each other. Cobb strain seemed to be more tolerance to summer heat stress in tropical areas such as in Sudan (under open-sides system).

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THE DETERMINATION OF NUTRITIVE VALUE OF SOME RANGELAND PLANTS USING NYLON BAGS TECHNIQUE

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ABSTRACT: *In order to determine of nutritive value of pasture forages (Agropyron intermedium Boiss, Coronilla Varia, Ziziphora Tenuior and Scorzonera grossheimii lipsch) using in situ, this study was carried out. In this study two fistulated wetheres (35±1.8 kg) were used in in situ method. Ruminal DM and CP disappearances were measured 0,4,8,16,24,36,48,72 and 96 h. Dry matter degradabilities of Coronilla Varia and Agropyron intermedium Boiss at 48 h, were higher and lower, that showed significant differences (P<0.05). Crude protein degradabilities of Coronilla Varia at 96 h was 78.18 % that were higher and showed significant differences (P<0.05). Pasture forages can used largely as a ruminant feeds.*

ORIGINAL ARTICLE

Key words: *Pasture forages, Gezel sheep, Nylon bag*

INTRODUCTION

Balancing rations for ruminants requires knowledge of the proportion of feed protein that escapes ruminal degradation (NRC, 1985).Fermentation characteristics of feedstuffs in rumen fluid can be studied using in vivo, in situ and in vitro techniques (Cone et al., 1999). The Dacron polyester or nylon bag technique has been used widely for estimating ruminal nutrient degradation because it is a relatively simple, low – cost method compared with methods involving intestinally cannulated animal (Marshal et al., 1997). The in situ nylon-bag technique is widely used to characterize the disappearance of feeds from the rumen. Nylon-bag technique provides a useful means to estimate rates of disappearance and potential degradability of feedstuffs and feed constituents (Paya et al., 2008).

Ruminants require adequate dietary fiber intake for normal rumen function, and dairy animals, in particular, need fiber to maintain normal milk fat content (Santini et al., 1992). Primary factors in the conversion of forage to animal product are intake of dry matter (DMI) or energy (IE), digestibility, efficiency of converting digested energy to metabolizable energy, and efficiency of converting metabolizable energy to net energy in animal product (Waldo, 1986). Feeding costs are one of the major problems in the economic balance of the sheep farmers. It has been well established that ruminant animals are capable of utilizing cellulose and hemicelluloses from forages, wood and other complex fibrous carbohydrates (Singh and Kamstra, 1981). Non-traditional by-products must search in order to decrease the relay on traditional resources to fill the gap and decrease feeding costs (Afaf et al., 2009).

Many factors influence the ruminal degradability of forage CP content including: stage of maturity (Belyea et. al., 1999; Tolera and Sundstol, 1993; Madsen and Hvelplund, 1994), forage species (Hoffman et al., 1993), contents of different specially leaves (Tolera and Sundstol, 1993) and climate condition (Van Soest, 1982) affect hay quality. Decreases in soluble DM and rate of digestion were observed with increasing maturity of forage (Nelson and Satter, 1992). The objective of this study was to determine CP and DM disappearances of some pasture forages in the rumen using in situ technique.

MATERIALS AND METHODS

Animals and feeding

Two yearling (Gizil) wethers (35 ± 1.8 kg) were used. At least 30d before initiation of the experiment, each wether was surgically fitted with a ruminal cannula. The wethers were housed in tie stalls under controlled environmental conditions with continuous lighting and constant temperature (24 to 26°C). All whether were fed a diet containing of 60% hay and 40% concentrate (NRC, 1989). The feed was fed in equal portions every 8 h to maintain a relatively stable rumen environment.

Sample Collection

Pasture forages samples harvested from Parsabad Moghan. Samples were collected from at least 10 different areas of pasture. All 10 samples were thoroughly mixed, and a composite sample (100g) was taken. All

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samples were dried in an oven at 100°C until a constant weight was achieved. Samples were then ground to pass thought a 2-mm screen in Wiley mill (model 4, Arthur H. Thomas Co., Philadelphia, PA) before incubation.

Chemical analysis

DM was determined by drying the samples at 105° C. Nitrogen (N) content was measured by the Kjeldahl method (AOAC, 2005). Neutral detergent fiber and ADF were measured according to the method of Goering and Van Soest (1970).

In situ degradation

In situ methods procedures was determined using Nocek et al. (1988) and reviewed by Palangi (2008), the ground samples (5g) were placed in Dacron bags (5.5×10 cm;47-µm pore size) and were closed using glue. Each feed sample was incubated in 4 replicates (2 replicates for each whether) in the rumen. The incubation times for samples were 0,4,8,16,24,36,48,72 and 96 h. Nylon bags were suspended in the rumen in a polyester mesh bag(25×40 cm;3mm pore size) and were removed from the rumen at the same time so that all bags could be washed simultaneously. The nylon bags were then removed from the mesh bag and washing until the rinse water remained clear. Samples were then dried in an oven at 55˚C until a constant weight was achieved before determination of DM disappearance. The DM and CP degradation data was fitted to the exponential equation $P = a+b\ (1 - e^{-ct})$ (Ørskov and McDonald, 1979), where P: is the disappearance of nutrients during time t, a: the soluble nutrients fraction which is rapidly washed out of the bags and assumed to be completely degradable, b: the proportion of insoluble nutrients which is potentially degradable by microorganisms, c: is the degradation rate of fraction b per hour and t is time of incubation.

Calculations and Statistical Analysis

Data were analyzed as a completely randomized design using a general linear model (GLM) procedure of SAS, with Duncan's multiple range test used for the comparison of means. Feeds were the only sources of variation considered.

RESULTS AND DISCUSSION

Chemical composition

The chemical composition of feeds were shown in Table 1. The obtained data for CP of different *forages* was lower than alfalfa CP, compared to NRC (1989), AFRC (1995), Kleinchmit et al. (2007) and Trater et al. (2001).

The obtained ADF values in this study were more than Kleinchmit et al. (2007) and Broderick et al. (2002). The obtained data for dry matter of test feeds from this study was greater than the values reported by Baumgartel et al. (2007), and Besharati and Taghizadeh (2009). The percentage of crude protein of test feeds showed similar values with the data reported by Baumgartel et al. (2007), also was higher than those values reported by Baumgartel et al. (2007).

There were significant difference in dry matter, crude protein, acid detergent fiber and neutral detergent fiber in test feeds. There were differences between the amounts of acid detergent fiber, neutral detergent fiber, crude protein and ash obtained in this study and the National Research Council (2001). The difference between chemical can be resulted from the variance in variety, climate condition, soil and maturity.

Table 1 - The chemical composition of feedstuffs

Forages	%DM	%CP	%NDF	%ADF	%ADIN
1	95.45^{a}	9.46^{c}	47.60^{b}	30.67^{a}	0.92^{c}
2	89.79^{c}	12.38^{b}	53.10^{a}	24.16^{b}	1.52^{a}
3	92.13^{b}	11.27^{b}	42.78^{c}	21.86^{c}	1.05^{bc}
4	84.02^{d}	14.14^{a}	37.81^{d}	25.27^{b}	1.19^{b}
SEM	0.4149	0.4054	0.5235	0.3901	0.0621

1- Agropyron intermedium Boiss 2- Coronilla Varia 3- Ziziphora Tenuior 4- Scorzonera grossheimii lipsch

In situ ruminal degradability

The degradability parameters of DM and CP are shown in Tables 2 and 3. *Coronilla Varia* showed high ruminal DM disappearance in all of the incubation times there were significant differences (P<0.05) and *Agropyron intermedium Boiss*, showed the lowest ruminal DM disappearance in all of the incubation times (P<0.05). The ruminal CP disappearance of *Coronilla Varia* is higher and the *Agropyron intermedium Boiss* showed lower ruminal CP disappearance there were significant differences (P<0.05). Regarding to increasing of environmental temperature, the lignin content can be enhanced, and then low degradability is expected. Our results for DM were higher than Yousef elahi et al. (2008).

Sallow showed higher CP degradation at the 24h of incubation (P<0.05). CP degradation process in our study is in consist with Waghorn et al (1995)'s reported data. The chemical composition of feeds influenced ruminal degradation process.

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Table 2 - *In situ* DM disappearance (% of DM)

Forages	Incubation time (h)								
	0	4	8	16	24	36	48	72	96
1	23.39^{c}	26.32^{b}	29.71^{b}	45.68^{b}	52.49^{b}	57.18^{b}	61.75^{b}	65.19	66.77
2	26.47^{a}	30.31^{a}	33.75^{a}	49.19^{a}	56.62^{a}	60.37^{a}	63.37^{a}	66.41	67.09
3	25.19^{b}	29.16^{a}	33.63^{a}	48.76^{a}	55.38^{a}	59.31^{a}	62.39^{b}	65.44	66.54
4	21.32^{d}	24.63^{c}	28.67^{c}	44.71^{b}	52.58^{b}	57.69^{b}	61.85^{b}	65.47	66.82
SEM	0.3122	0.3772	0.2650	0.3195	0.4536	0.3923	0.4149	0.3739	0.2448

1- Agropyron intermedium Boiss 2- Coronilla Varia 3- Ziziphora Tenuior 4- Scorzonera grossheimii lipsch

Table 3 - *In situ* CP disappearance (% of DM)

Forages	Incubation time (h)								
	0	4	8	16	24	36	48	72	96
1	18.47^{c}	24.67^{c}	30.66^{b}	40.62^{b}	54.63^{b}	61.54^{b}	67.45^{b}	73.65	77.50
2	20.63^{a}	26.54^{a}	32.70^{a}	41.60^{a}	55.62^{a}	62.63^{a}	68.18^{a}	74.39	78.18
3	19.67^{b}	25.60^{b}	32.59^{a}	41.48^{a}	55.76^{a}	62.43^{a}	68.07^{a}	74.20	78.02
4	17.72^{d}	23.89^{d}	29.94^{b}	40.45^{b}	54.80^{b}	61.35^{b}	67.86^{ab}	73.76	78.00
SEM	0.2059	0.2298	0.2482	0.2531	0.2219	0.2199	0.1647	0.1594	0.1168

1- Agropyron intermedium Boiss 2- Coronilla Varia 3- Ziziphora Tenuior 4- Scorzonera grossheimii lipsch

Pasture forages are a source of digestible energy, rumen degraded and un-degraded protein, vitamins and minerals, thereby reducing requirements for concentrates and reducing feeding costs.

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EFFECT OF FEEDING UNTREATED OR UREA TREATED GROUNDNUT HULL SUPPLEMENTED WITH DIFFERENT PROTEIN SOURCES ON BLOOD PARAMETERS OF SUDAN DESERT LAMBS

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ABSTRACT: *Hematology and serum biochemistry from thirty Sudan desert lambs (of an average body weight and age 18.0 ± 0.5 kg and 4-5 months respectively) fed diets contained untreated (UGH) or urea treated groundnut hull (TGH) with different protein supplementations (groundnut cake (GNC), cotton seeds cake (CSC) and fish byproducts (FBP) were investigated. The lambs given six dietary treatments; diets A, B and C were contained TGH supplemented with GNC, CSC and FBP respectively, while diets D, E and F were contained UGH supplemented with GNC, CSC and FBP respectively. Jugular blood samples were taken at 0, 45 and 90 days. There were significant differences between experimental diets in hemoglobin concentration (Hb), red blood cells (RBC), mean corpuscular hemoglobin (MCH) and mean corpuscular volume (MCV) concentrations, while other parameters were similar. Increasing feeding periods resulted in higher increase in Hb, WBC, MCHC and MCH concentrations, while PCV and MCV concentrations decreased. The same trend was observed in total serum protein, urea and triglycerides concentrations with higher values recorded for lambs fed A, B or C diets, while, no differences were found on serum albumin and globulin concentrations. Serum P, K and Na recorded higher values for lambs fed in A and B diets than other experimental diets. as experimental period increased (from 0 to 45 and 90days) serum K and Na concentrations were decreased significantly, while no significant variations in the values of serum Ca and inorganic P. Ration × period interaction had no significant effects on concentration of serum K and Na from A, B and C diets, while there were significant variations on concentration of serum Ca and P. The study revealed that inclusion of TGH supplemented with GNC, CSC or FBP in the diets of growing Sudan desert sheep had positive effects on the haematological and serum biochemical parameters.*

Key words: *Urea, Crop Residues, Protein Sources, Blood Hematology, Blood Biochemical Profile, Sheep.*

ORIGINAL ARTICLE

INTRODUCTION

Ruminants in the majority of developing countries are reared on fibrous crop residues based diets. The main constraints in utilization of such feedstuffs in animal feeding system are their high cell wall and low nitrogen and mineral content coupled by low intake potential. Out of the several physical, biological and chemical methods tried in Sudan and abroad to enhance the nutritive value of crop-residues, urea-treatment has been found to be the most promising, practicable and users friendly and the extra N it supplies increases the crude protein (CP) concentration of crop residues (McDonald et al., 2003). But urea treatment is not sufficient which may require additional N supplementation (Fadel Elseed et al, 2004). Nitrogen supplementation corrects nitrogen deficiency in the rumen and improves the fermentation and microbial activity, hence enhancing the utilization of fibrous crop residues. Nevertheless, results depend upon the nature of nitrogen in the concentrate as there are many protein sources available to supplement the crop-residues basal diets. Therefore different mechanisms involved in the microbial and animal response to supplementation (Seoane et al., 1993). While it is apparent that a lot of work have been done and reported on the feeding values of urea treated crop residues, little or no work have been reported on the haematological and biochemical parameters of Sudan desert sheep fed untreated or urea treated crop residues supplemented with different protein sources. Since evaluation of the blood profile of animals may give some insight as to the potentials of a dietary treatment to meet the metabolic needs of the animal. According to Church et al. (1991), dietary components have measurable effects on blood constituents such that significant changes in their

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values can be used to draw inference on the nutritive value of feeds offered to the animals. Therefore, The present study is designed to determine the effects of fed untreated or urea treated groundnut hull supplemented with different protein sources in the diets of growing Sudan desert sheep on their haematological and serum biochemical parameters.

MATERIAL AND METHODS

Ammoniation of groundnut hull

Groundnut hull was treated with 4% fertilizer grade urea at 50% moisture level and covered with polythene sheet and was kept air tight at room temperature for six weeks, as described by Dass et al. (1984).

Experimental animals, housing and feeding

Thirty growing male Sudan desert lambs (4-5 months of age, 18.5±2.1 kg average body weight) were randomly divided into six groups on the basis of their body weight. During the experiment, the animals were kept in well ventilated shed with individual feeding and watering arrangements. The animals were offered concentrate mixtures (A, B, C, D, E and F) (Tables 1 and 2 AOAC, (1995). Urea treated groundnut hull (TGH) supplemented with groundnut cake (GNC), cotton seed cake (CSC) and fish by-products (FBP) fed to groups A, B and C respectively, untreated groundnut hull (UGH) with GNC, CSC and FBP fed to groups D, E and F respectively for a period of 90 days. Clean and fresh drinking water was provided *ad libitum* to all the experimental animals.

Table 1 - Percentage composition (by weight) of the experiential diets

	Diets					
Ingredients	**A**	**B**	**C**	**D**	**E**	**F**
TGH	25	25	25	-	-	-
UGH	-	-	-	25	25	25
Groundnut cake	12	-	-	10	-	-
Cotton seeds cake	-	15	-	-	15	-
Fish by-products	-	-	8	-	-	7
Sorghum	16	15	19	16	16	18
Molasses	25	23	26	28	25	27
Wheat bran	20	20	20	17	16	20
Urea	-	-	-	2	1	1
Limestone	1	1	1	1	1	1
Common salt	1	1	1	1	1	1
Total	100	100	100	100	100	100

TGH = urea treated groundnut hull , UGH = Untreated groundnut hull

Table 2 - Chemical composition (DM %) of the experimental diets

	Diets					
Ingredients	**A**	**B**	**C**	**D**	**E**	**F**
Dry matter	89.08	90.68	88.23	87.54	90.07	90.80
Organic matter	77.44	78.62	77.09	74.57	77.52	77.33
Crude protein	15.18	15.09	15.13	15.05	15.23	15.49
Ether extract	1.99	2.39	3.43	2.41	2.74	3.2
Crude fiber	15.02	15.46	15.79	17.19	17.31	17.89
Ash	11.64	12.06	11.14	12.97	12.55	13.47
Nitrogen-free extract	56.17	55	54.51	52.38	52.17	49.95
ME (Mj/kg)	11.05	11.23	11.52	10.74	10.85	10.4

ME of the complete diet was calculated according to the equation: ME (M j/kg DM) = 0.012CP + 0.031EE + 0.005CF + 0.014NFE (MAFF, 1975).

Data collection

Blood samples were taken in (three replicates) from the jugular vein of each animal at 0, 45 and 90 day of the experiment. The blood samples were collected in two sets, one set was collected into plastic tubes containing the anti-coagulant ethylene diamine tetra acetic acid (EDTA) for the determination of hematological parameters, the other set was collected into anti-coagulant free plastic tubes, allowed to coagulate at room temperature and centrifuged for 10 minutes at 3000 rmp. The obtained serum samples were stored in a deep-freezer for subsequent biochemical analysis.

Analytical procedures

Haematological parameters were estimated for packed cell volume (PCV), haemoglobin (Hb) concentration, red blood cells (RBCs) count and total white blood cell (WBCs) count according to the outlined procedures by Schalm et al. (1975). Mean corpuscular haemoglobin (MCHC), mean corpuscular haemoglobin (MCH) and mean

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corpuscular volume (MCV) were calculated from RBCs count, Hb concentration and PCV values as described by Jain (1986). Serum calcium (Ca), inorganic phosphorus (P) and urea concentrations were determined using chemical methods (Thomas, 1998). Serum (Na) sodium and potassium (K) concentrations were determined using flame photometry (Endres and Rude 1999), Serum total protein and albumin concentrations were determined using chemical methods (Tietz, 1994). Serum globulin concentration was calculated by subtracting serum albumin concentration from that of total protein. Serum triglyceride concentration was determined using chemical methods (Rifai et al., 1999).

Statistical analyses

Results obtained were analyzed statistically using statistix9 software package. The obtained results were compared on the basis of the source of protein supplementation and with untreated or urea treated groundnut hull in the concentrate diets, using 2×2 factorial analysis of variance (ANOVA). The differences between means were separated using the Least Significant Difference test (LSD).

RESULTS

There were significant differences in hematological indices and measured biochemical parameters between lambs group fed GH diets and those fed– UGH diets. Although, supplementation with different protein sources resulted in significant affects through experimental period.

Table 3 - Haematological values of lambs fed experimental diets

Parameters	WBC ($10^3/mm^3$)	PCV (%)	Hb (g/dl)	RBC ($10^6/mm^3$)	MCHC (g/dl)	MCH (pg)	MCV (fl)
Diet							
A	7.15	31.38	10.96^{a}	7.65^{ab}	29.21	10.41^{a}	47.77^{a}
B	7.79	29.50	11.5^{a}	7.62^{a}	29.39	10.50^{a}	44.83^{ab}
C	8.88	30.63	10.68^{a}	6.87b	31.04	9.75^{b}	44.83^{ab}
D	7.28	30.94	8.23^{b}	6.35^{b}	30.56	9.04^{b}	43.80^{ab}
E	7.41	30.94	8.45^{b}	6.75^{b}	30.56	9.04^{b}	43.80^{ab}
F	8.33	29.50	8.33^{b}	6.40^{b}	29.39	8.70^{b}	41.68b
S.E.M	0.42	0.91	0.29	0.27	0.88	0.63	1.94
Period							
0 day	7.51^{b}	29.44b	8.09^{b}	7.08	23.22^{c}	11.88^{bc}	51.96^{a}
45 day	8.28^{b}	35.63^{a}	7.01^{c}	7.03	23.81^{c}	10.27^{c}	43.63^{b}
90 day	9.95^{a}	30.75^{b}	10.19^{a}	7.16	39.69^{a}	17.37^{a}	43.76^{b}
S.E.M	0.42	0.91	0.29	0.27	0.88	0.63	1.94
Die t X Period							
A X 0	5.79^{c}	37.75^{a}	7.78^{cd}	6.08^{c}	20.59^{hi}	10.10	63.28^{a}
A X 45	9.05^{ab}	31.00^{bc}	7.50^{cd}	9.28^{a}	24.07^{fgh}	11.09	33.51^{fg}
A X 90	7.39^{bc}	31.00^{bc}	12.30^{a}	6.15^{c}	39.72^{a}	12.33	51.03^{bc}
B X 0	8.10^{abc}	27.74^{b}	6.75^{d}	7.15^{bc}	18.10^{i}	9.73	53.76^{ab}
B X 45	10.20^{a}	37.75^{a}	6.90^{d}	5.93^{c}	24.91^{fgh}	11.65	46.89^{bcd}
B X 90	7.09^{bc}	30.75^{bcd}	11.85^{a}	7.08^{bc}	38.58^{ab}	11.97	43.98^{bcdef}
C X 0	6.03^{c}	34.50^{ab}	8.85^{bc}	7.93^{ab}	26.35	12.17	44.76^{bcde}
C X 45	10.32^{a}	29.25^{cd}	6.75^{d}	6.05^{c}	22.83^{d}	11.11	48.86^{bcd}
C X 90	6.33^{c}	29.00^{cd}	11.85^{a}	7.15^{bc}	40.85^{a}	10.70	40.90^{cdefg}
D X 0	6.13^{c}	32.50^{bc}	9.00^{bc}	7.15^{bc}	27.86^{d}	12.53	46.06^{bcd}
D X 45	6.88^{bc}	29.75^{bcd}	6.90^{d}	6.86^{bc}	23.45^{f}	10.22	45.27^{bcde}
D X 90	7.00^{bc}	32.25^{bc}	12.75^{a}	8.25^{ab}	39.63^{a}	10.48	39.13^{defg}
E X 0	6.67bc	27.54^{b}	6.55^{d}	7.05^{bc}	17.10^{i}	9.73	52.12^{ab}
E X 45	6.55c	30.75^{bcd}	7.78^{cd}	5.08^{c}	17.59^{i}	12.10	63.28^{a}
E X 90	6.33^{c}	25.5d	6.46^{d}	5.43^{c}	23.30f	11.93	44.65 ^{bcd}
F X 0	5.77^{c}	22.34e	6.34^{d}	6.65bc	32.22^{b}	10.87	45.98 ^{bcd}
F X 45	6.54^{c}	21.5e	7.73^{cd}	6.38^{c}	33.29^{b}	11.22	51.34 ^{bc}
F X 90	7.32^{bc}	25.5d	7.30^{cd}	6.35^{c}	33.28^{b}	9.25	54.62 ^{ab}
S.E.M	0.83	1.81	0.58	0.54	1.75	1.25	3.88

A, B and C diet contained TGH. D, E and F contained UGH.(A and D), (B and E), (C and F) were contained GNC, CSC and FBP as source of protein respectively. Above values are means of five animals. SEM: Standard error of mean; a-b means with different superscripts in the same column were significantly different (P <0.05)

Erythrocytic indices

Results of the haematological values obtained from thirty Sudan desert lambs are present in Table (3). There were no significant differences between experimental diets in PCV, WBC, MCHC and MCV concentrations, with higher values of WBC in lambs fed FBP as protein supplementation. While significant (P<0.05) differences were found between experimental diets in Hb, RBC, MCH and MCV concentration, with higher values of Hb and RBC were recorded in diet A, B and C compared to other experimental diets. Although, feeding periods had significant effects

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in heamatlogical parameters except RBC concentration which remain unaffected. Therefore, increasing feeding periods resulted in significant increase in Hb, WBC, MCHC and MCH concentrations. On contrast, PCV and MCV concentrations showed significant decrease while feeding period increases. The values obtained in diet × period interaction were significantly ($P<0.05$) different between the six experimental diets in all the blood parameters measured except for MHC concentration. The higher Hb values were detected in lambs fed diet A, B, C and D in 90th day, while higher values for WBC were obtained with A, B and C diets in 45th day.

Blood minerals profile

The concentration of serum potassium (K), sodium (Na), calcium (Ca) and inorganic phosphorus (P) were significantly affected during the experimental period Table (4). Serum P, K and Na recorded significantly ($p<0.05$) higher values for rations A and B than other groups. as experimental period increased (from 0 to 45 and 90days) serum K and Na values were decreased significantly ($P<0.05$), While no significant ($P<0.05$) variations in the values of serum Ca and inorganic P. Ration × period interaction had no significant ($P<0.05$) effects on concentration of serum K and Na from A, B and C diets, while there were significant variations on concentration of serum Ca and P.

Table 4 - Blood minerals profile of experimental diets

Parameters	K(mmol/l)	Na(mmol/l)	Ca(mg/dl)	P(mg/dl)
Diet				
A	4.43^{a}	167.83^{a}	9.52^{c}	6.67^{a}
B	4.30^{abc}	165.50^{ab}	12.10^{a}	6.47^{ab}
C	4.33^{ab}	162.83^{b}	12.67^{a}	5.95^{bc}
D	3.72^{d}	155.17^{d}	7.83^{d}	5.80^{bc}
E	3.87^{cd}	159.83^{c}	10.78^{b}	5.48^{c}
F	3.93^{bcd}	160.00^{c}	9.63^{c}	6.35^{ab}
S.E.M	0.21	1.78	0.32	0.32
Period				
0 day	4.28^{a}	165.42^{a}	10.04	5.95
45 day	4.13^{ab}	163.58^{a}	10.21	6.03
90 day	3.88^{b}	156.58^{b}	10.02	6.38
S.E.M	0.15	1.26	0.23	0.23
Diet X Period				
A X 0 day	4.50^{a}	167.00^{abcd}	9.25^{gh}	6.45ab^{c}
A X 45 day	4.35^{a}	166.50^{abcd}	8.10^{hi}	6.50^{ab}
A X 90 day	4.45^{a}	170.00^{a}	11.20^{de}	7.05^{a}
B X 0 day	4.20^{abc}	166.50^{abcd}	10.00^{fg}	6.00^{abcd}
B X 45 day	4.45^{a}	168.00^{ab}	13.70^{ab}	6.45^{abc}
B X 90 day	4.25^{ab}	162.00^{bcd}	12.60^{bc}	6.95^{a}
C X 0 day	4.40^{a}	163.00^{bcd}	9.70^{g}	5.50^{bcd}
C X 45 day	4.20^{abc}	164.50^{abcd}	13.50^{b}	6.15^{abcd}
C X 90 day	4.40^{a}	161.00^{d}	14.80^{a}	6.20^{abcd}
D X 0 day	4.20^{abc}	161.50^{cd}	7.00^{ij}	6.25^{abcd}
D X 45 day	3.50^{bcd}	153.00^{e}	10.30^{efg}	5.20^{d}
D X 90 day	3.45^{cd}	151.00^{e}	6.20^{j}	5.95^{abcd}
EX0 day	4.15^{abc}	167.00^{abcd}	11.05^{def}	5.30^{cd}
EX45 day	4.00^{abcd}	164.50^{abcd}	9.35^{g}	5.45^{bcd}
EX90 day	3.45^{cd}	148.00^{e}	11.95^{cd}	5.70^{bcd}
FX0 day	4.25^{ab}	167.50^{abc}	13.25^{b}	6.200^{abcd}
FX45 day	4.25^{ab}	165.00^{abcd}	6.30^{j}	6.40^{abc}
FX90 day	3.30^{d}	147.50^{e}	9.35^{g}	6.45^{abc}
S.E.M	0.37	3.0867	0.56	0.56

A, B and C diet contained TGH. D, E and F contained UGH.(A and D), (B and E), (C and F) were contained GNC, CSC and FBP as source of protein respectively. Above values are means of five animals. SEM: Standard error of mean; a-b means with different superscripts in the same column were significantly different ($P<0.05$)

Blood metabolic profile

The serum concentrations of total protein, albumin, globulin, triglycerides and urea were shown in table (5). The concentrations of total serum protein, albumin, globulin, urea and triglycerides ranged from 5.15 to 6.70 g/dl, 3.10 to 3.75 g/dl, 1.65 to 3.30 g/dl, 42.00 to 66.50 mg/dl and 44.00 to 65.50 mg/dl respectively in all groups during experimental periods. Total serum protein, urea and triglycerides were significantly ($P<0.05$) higher for lambs fed A, B or C diets than those fed D, E or F diets. While, no significant ($P<0.05$) difference were found on serum albumin and globulin concentrations. The effect of the feeding period was obvious on the above parameters; in general, 0 day had the lower values. While, higher values were recorded for 45 and 90 days except for albumin which remain unaffected. There were significant ($P<0.05$) differences in total protein, globulin, urea and triglycerides concentrations among lambs on different diet × period interaction, but lambs on diets A, B and C on 45 and 90 days had recorded higher values compared than those on diet D, E and F for the same periods of

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feeding. Whereas, Serum albumin showed no significant (P<0.05) difference in response to different diet × period interaction. Serum urea concentrations were significantly (P<0.05) increased with increases in feeding period for lambs fed A, B and C diets compared to other tested diets. Differences in urea concentrations between Diets B, D and C were non-significant (P<0.05).

Table 5 - Blood metabolic profile of lambs fed experimental diets

Parameters	T. protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	Urea (mg/dl)	Triglycerides (mg/dl)
Diets					
A	6.20^{a}	3.43	2.77^{a}	55.83a	54.67ab
B	6.13^{a}	3.42	2.72^{a}	53.67a	58.50a
C	6.05^{a}	3.57	2.48^{ab}	53.50a	55.67ab
D	5.47^{b}	3.40	2.07^{ab}	44.17b	52.00bc
E	5.43^{b}	3.50	1.93^{b}	44.50b	48.33c
F	5.43^{b}	3.10	2.33^{ab}	44.00b	49.17c
SEM	0.19	0.23	0.34	1.60	1.97
Periods					
0 day	5.41^{b}	3.37	2.04^{b}	43.67^{c}	48.75^{b}
45 day	5.95^{a}	3.43	2.52^{ab}	49.25^{b}	55.08^{a}
90 day	6.00^{a}	3.41	2.59^{a}	54.92^{a}	55.33^{a}
S.E.M	0.13	0.16	0.24	1.13	1.39
Diets X Period					
A X 0 day	5.55^{c}	3.45	2.10^{abcde}	46.50^{d}	46.50^{fgh}
A X 45 day	6.65^{a}	3.55	3.00^{abc}	54.50^{b}	53.00^{def}
A X 90 day	6.40^{ab}	3.20	3.20^{ab}	66.50^{a}	64.50^{a}
B X 0 day	5.15^{c}	3.50	1.65^{e}	43.00d	46.50^{fgh}
B X 45 day	6.55^{a}	3.25	3.30^{a}	52.50^{bc}	65.50^{a}
B X 90 day	6.70^{a}	3.50	3.20^{ab}	65.50^{a}	63.50^{ab}
C X 0 day	5.30^{c}	3.55	1.65^{e}	43.50^{d}	50.00^{defg}
C X 45 day	6.50^{a}	3.55	2.95^{abcd}	52.50^{bc}	60.50^{abc}
C X 90 day	6.35^{ab}	3.50	2.85^{abcde}	64.50^{a}	62.50^{a}
D X 0 day	5.45^{c}	3.50	1.95^{cde}	42.50^{d}	52.00^{def}
D X 45 day	5.15^{c}	3.35	1.80^{cde}	47.00^{cd}	56.00^{cd}
D X 90 day	5.80^{bc}	3.35	2.45^{abcde}	43.00^{d}	48.00^{efgh}
E X 0 day	5.55^{c}	3.35	2.20^{abcde}	44.50^{d}	53.50^{cdef}
E X 45 day	5.50^{c}	3.75	1.75^{de}	45.00^{d}	54.00^{cde}
E X 90 day	5.25^{c}	3.40	1.85^{cde}	45.00^{d}	50.00^{defg}
F X 0 day	5.45^{c}	3.45	2.70^{abcde}	42.00^{d}	44.00^{gh}
F X 45 day	5.35^{c}	3.05	2.30^{abcde}	45.00^{d}	54.00^{cde}
F X 90 day	5.50^{c}	3.20	2.00^{bcde}	45.00^{d}	49.50^{defg}
S.E.M	0.33	0.40	0.59	2.78	3.41

A, B and C diet contained TGH. D, E and F contained UGH.(A and D), (B and E), (C and F) were contained GNC, CSC and FBP as source of protein respectively. Above values are means of five animals. SEM: Standard error of mean; a-b means with different superscripts in the same column were significantly different (P <0.05)

DISCUSSION

Mean PCV values obtained in this study were within the physiological range of 27.0 – 45.0 % given by Jain (1993), slightly higher than the range of 25–30% reported by Opara et al. (2010). In contrast to this, Taiwo and Ogunsanmi (2003) reported higher values of 36.9% and 35.5% for clinically healthy West African dwarf sheep. The Hb range in this study fell within the range of 9–15 g/dl reported by (Kaneko, 1997; Patra et al., 2003), but higher than the values of 5 to 6 g/dl obtained by Belewu and Ogunsola (2010) for goats fed treated Jatropha curcas kernel cake rations. No effects of different protein sources in WBC, PCV, Hb, MCHC and MCV in this study has indicated that different protein sources at same CP levels have no effect on the blood profile. The results of the present study are supported by Nelson and Watkins (1967), who reported that blood profile, remained unaffected by protein sources indicating that homeostatic mechanism might not be influenced by different protein sources. The RBC counts reported in this study were fell below the range of 9.2–13.5 g/dl reported by Tambuwal et al. (2002), 9.9–18.7 g/dl by Taiwo and Ogunsanmi (2003), and 10.25–12.85 × 10^{12}g/dl) obtained by Ajala et al. (2000). The reduced RBC counts recorded for lambs in the D, E and F diets present a likely susceptibility to anaemia-related disease conditions by these lambs. The WBC counts were similar among the treatment groups and fell within the normal range (5 to 11g/dl) reported by Scott et al. (2006) for sheep. The similar WBC counts obtained imply that, the ability of the lambs was compromised to respond to and eliminate infection. The serum protein concentration indicates the balance between anabolism and catabolism of protein in the body. The serum protein concentration at any given time in turn is a function of hormonal balance, nutritional status, water balance and other factors affecting health. the serum concentrations of total protein in healthy animals normally varies between 6.0 and 7.9 g/dl % and is altered during any liver and kidney diseases Kaneko, (1980).The concentrations of total serum

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protein in this study within the normal range implied that the test diets were able to supply adequate amount of protein needed to maintain normal serum protein levels. However, the serum protein concentrations in this study tended to increase significantly with increasing feeding period; similar trend was reported by Maigandi (2001). The serum urea concentration is closely associated with the break down and deamination of the protein in the rumen and the rate of utilization of NH3 for bacterial protein synthesis. An increase in the serum urea level may reflect an accelerated rate of protein catabolism rather than a decrease in urinary excretion (Kaneko 1980). Higher values in serum urea concentrations detected in lambs fed UTG diets in this study were agree with findings by (Dass et al., 1996) which reported that, supplementation of the basal diet of buffaloes with NPN compounds was resulted in higher serum urea concentrations. Increase of serum urea concentration in this study for lambs fed UTG diets versus GH diets may have resulted from the fact that, the content of rumen degradable protein in UTG is greater than in GH diets, given that a positive correlation exists between levels of N intake and concentration of serum urea (Karnezos et al., 1994). Moreover, this UGH fed animals could access enough dietary protein to maintain an optimal total serum protein concentration compared to lower values in other groups that were deficient in CP intake (Sharma et al.2006). The statistically similar, serum urea concentration in lambs fed A, B and C diets in this study was supported by Carro et al. (2006) and Davies et al. (2007). Serum albumin and globulin in this study ranged from 3.05-3.75 and 1.65-3.3mg/dl respectively, which agrees with Coles (1986). The serum Sodium and Potassium levels in this study were within the range of 147.5-167.83mmol/l for Sodium and 3.3-4.5mmol/l for potassium, which compares with the report of Borjesson (2000) who reported values of 153mmol/l and 4.7mmol/l for Sodium and Potassium, respectively. Serum inorganic phosphate values obtained in this study were within the normal physiological range of 5.0 – 7.3mg/dl given by Kaneko (1989). The higher serum inorganic Phosphate, Sodium and Potassium concentrations in lambs fed A and B diets were more likely related to the source of protein supplementations. These observations were in accordance with the findings by (Oboh and Olumese, 2008). They stated that, serum sodium (Na), chloride (Cl) and potassium (K) concentrations differed in response to different protein supplementation in sheep. In contrast, Davies et al., (2007) and Hatfield et al. (1998) reported that, serum minerals (Ca, P, K, Na, Mg and Cl) levels remained unaffected in lambs fed different protein source diets.

CONCLUSION

Despite the significant differences in the tested hematological and biochemical parameters of lambs fed on urea treated GH diets, their levels remained within the physiological ranges which could indicate that urea treated GH did not have any adverse effect on lambs' health.

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ECONOMIC STUDIES ON IMMUNOSTIMULENTS IN RELATION TO MYCOTOXIN INFECTION IN CULTURED FISH

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ABSTRACT: *Studies in the past decade confirm that the growth of both gram-positive and gram-negative foodborne bacteria, yeast and mold can be inhibited by garlic, onion, cinnamon, cloves, thyme, sage, and other spices. Consumption of mycotoxin contaminated foods has been associated with several cases of human poisoning, or mycotoxicosis, sometimes resulting in death. This study concluded that: When the ration or the fish suffered from fungal infection the addition of black seed, garlic and onion will reduce the infection and improve fish health. In Post mortem lesions the fish suffered from mycotic infection showed severe degenerative changes in internal organs especially in the liver, heart and kidneys. The result cleared that, the blackseed is the best herbs that prevented and improve the aflatoxin effect followed by garlic and onion, respectively. The result also showed that level of RBCs and WBCs, differential leucocytic counts, phagocytosis process, serum protein, biochemical analysis of fish body, body weight and body weight gain improved with addition of blackseed, garlic and onion. The residue of aflatoxin in fish flesh decreased in the groups treated with blackseed, garlic and onion than the control or fish fed on the aflatoxin. The results also showed that, frequent supplementation of fish ration with black seed, garlic and onion can reduce the aflatoxin hazards in the fish. The results also concluded that, the higher economic efficiency measures (total return, total costs, net profit, total returns/total costs and net return to total costs) improved in the groups fed with blackseed, garlic, onion and all of them improved economic efficiency measures than the control groups and when all of them added to the fish treated with aflatoxin diet improved economic efficiency results than the group treated with aflatoxin only.*

ORIGINAL ARTICLE

Key words: *Economic Efficiency, Blackseed, Aflatoxin, Biochemical Analysis.*

INTRODUCTION

The using of synthetic drugs in the therapeutic field may have adverse effects which may be more dangerous than the disease itself (Fluk et al., 1976). From this fact and with the call of "Back to nature", medical plants consider an important target area for several studies to show possibility of its use in a variety of health problems.

The garlic have: Antiviral, antibacterial, antifungal, antiparasitic effect. Garlic is nicknamed Russian penicillin for its widespread use as a topical and systemic antimicrobial agent. Allicin has antimicrobial effects *in vitro* against many viruses, bacteria, fungi and parasites, but dried, powdered and oil preparations of garlic have not been shown to have significant antimicrobial activity. Also, it have antifungal effect thus Garlic enjoys a worldwide reputation as an antifungal folk remedy.

Mona et al. (2011) reported that, Aflatoxine the major toxic metabolites of fungi which are able to induce chronic liver damages. The antioxidant and hepatoprotective effects of Ginseng extract and Nigella sativa Oil 1% on Aflatoxin was investigated. Moreover the liver exhibited some clinicopathological changes and decreased body weight due to the toxic effects of aflatoxin. Both Ginseng extract and Nigella sativa Oil 1% reduced the development of hepatotoxicity by Aflatoxin. Nigella sativa showed more improvement of all enzymes of kidney and liver, and also total lipid and cholesterol were reduced and body weight increased with improvement of economic and productive efficiency of fish production farms (Kim, 2010).

The antifungal activity of green onion on a toxic fungal strain *A. parasiticus*, which can produce aflatoxin, a human carcinogen. In practice, both a solid culture and a liquid culture were attempted because green onion is consumed with various forms of daily food intake. In liquid culture, mycelial growth of experimental group was less

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than that of control group during the incubation period of 15 days. When increasing concentrations of green onion were added to PDA and YES broth, an increasing tendency of inhibitory effect was noted on the growth of the fungal strain (Kim, 2010).

So this study was carried-out to throw the light on using the natural feeds on the improving immunity of the fish *Oreochromis niloticus* and its role in the prevention of aflatoxicosis infection in the fish through study the effect of blackseed (Nagilla sativa), garlic and onion on Body weight and body weight gain of the fish, number of RBCs, WBCs and its differentials, level of serum proteins (Albumin, globulin, total protein and albumin/globulin ratio), Phagocytic activity and phagocytic index as well as the effect of this natural feeds on the constituents of the fish flesh in addition to their effects on the residues of the aflatoxicosis in fish meat.

MATERIALS AND METHODS

A total number of 240 healthy Nile Tilapia (Oreochromis niloticus) were collected from Barseek fish farm at Behera Governorate. Fish were transported alive to the laboratory in plastic bags containing water enriched by air (2/3). Average body weight of fish was about 30 ± 5 gm, of Oreochromis niloticus to aflatoxin B1 and the type of fish that we complete on it the experiment. Fish were kept in prepared glass aquaria (90 x 50 x 35 Cm). These aquaria were used for holding the experimental fish throughout the period of the present study, this aquaria was supplied with cholrine free tap water according to Innes (1966).

The continuous aeration was maintained in each aquarium using an electric air pumping compressors. Water temperature was kept at 22 ± 1 °C. Fish were fed on an ad libitum commercial fish food containing 23-25% crude protein (obtained from Barseek fish feed factory) the diet was daily provided at 3% of body weight as described by Eurell et al. (1978). The daily anmount of food was offered on two occasions over the day (Regular diet), in a ddition to in acute and chronic experiment the feeding design during experiment was as follow:

Aflatoxins: The mycotoxin Afla toxins were kindly provided by Sigma Chemical Co. U. S. A. also by Sigma-Aldrich Chemie Gmbh, Germany.

Yeast strains: The Candida albicans strain was kindly supplied by the Veterinarian Riad H. Khalil. Lecturer, Dept. of poultry and fish diseases, Fac. Vet. Med., Alexandria University.

Experimental design

The Oreochromis niloticus fish used in this study was divided into 8 groups each group of 30 fish for each the design of the experiment was carried-out in the following table.

Table 1 - The design of the experiment

Time	Code	Treatment	Fish No.
4 weeks	1	Black seed	30
	2	Black seed + Aflatoxin	30
	3	Garlic	30
	4	Garlic +Aflatoxin	30
	5	Onion	30
	6	Onion + Aflatoxin	30
	7	Aflatoxin	30
	8	- ve control	30

A total of 240 fish (30±5 gm each) were used in this experiment and divided into 8 groups. Everycontain 30 fish. 4 group of them injected with aflatoxin B1 (10000 ng) (Shehata et al., 1985). All the experimental groups were kept under daily observation for 4 weeks. The clinical signs, mortality and postmortem lesions were recorded. Furthermore, blood parameters, biochemical serum assays, serum electrophoresis, detection of residual level and histopathological examination which were carried-out during acute toxicity were also done in chronic toxicity throughout the 4 week experimental period. Fish weight: During chronic toxicity experiment the fish was weighted weekly and the body weight gain, feed was calculated for every week according to (Osman and El-Barody, 1999). Biochemical Analysis of experimental fish body was performed according to (Shehata et al., 1985). Blood sampling: Blood samples were collected from the caudal artery using disposable tuberculin syringe for the following: a) Haematological picture, b) Determination of phagocytic activity using citrated blood in the ratio of 0.1/1 ml of 3.8% Sod. Citrate solution to 1 ml of blood (Hawk et al., 1965). Serum preparation was done for biochemical determination (Lied et al., 1975). Differential leucocytic count: Blood film was prepared according to the method described by Lucky (1977). Determination of phagocytic activity and phagocytic index: Phagocytic activity was determined according to Kawahara et al. (1991).

Clinico-biochemical analysis

Determination of serum total protein: Serum total protein was determination according to Doumas et al. (1981) using commercial kits produced by Pasteur Lab. Determination of serum albumin: Serum albumin was determined according to Reinhol (1953) using commercially available kits of Chemroy. Determination of serum globulin: Serum globulin was determined by subtracts the total serum albumin from total serum protein according

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to (Coles, 1974). Determination of protein by gell electrophoresis: SDS-PAGE: Sodium dodecyl-sulphate-polyacrylamide gel electrophoresis (SDS-PAGE) of serum sample and high molecular weight markers. The electrophoresis was carried out according to ethe procedure of Laemmli (1970). Preparation of 10% separating gel: In a sterial, clean and dry beaker, the separating gel (10%) was prepared according to Laemmli (1970).

Detection of mycotoxine residue in tissue samples: The detection aflatoxine B1 by Aflatest™ method for samples 3 – 100 ppb. Measures of mycotoxins: Add 1.0 ml of dilute mycotoxine™ Developer (made up fresh daily) to elute in the cuvette. Mix well and measure fluorescence in a callbrated fluorometer. Read aflatoxin concentration after 60 seconds. Readout will be in parts per billion total aflatoxins for the 3-100 ppb sample extracted. Economic efficacy measures that include, total returns, total costs, net return, total return/total costs and net return/total costs were calculated according to the methods implied by (Atallah et al., 1999).

Table 2 - Aflatest™ method for measuring residue

Fluorometer calibration	Green	Red	Yellow
Model FX-100 series 3	-1	24	12±2
Model 450 series-2	0	26	13±2
Model 450 series-1	0	20	10±2
Series 4	-1	22	10-2

Statistical analysis

The data of hematological and biochemical examinations of exposed fish were statistically analyzed using t-test, Duncan-test after ANOVA and simple correlation according to (SAS, 1987).

RESULTS

1- Effect of different natural feeds treated with or without aflatoxins on differential leucocytic counts: The results in Table 3, indicated the significant (P<0.01) differences among different treatment in different weeks on lymphocyte, monocyte, and heterophils. The lymphocyte level decreased from the first weeks, to second week, 3rd week and increased in the 4th week from the experiment. While the monocyte level decreased from the 1st to 3rd week of experiment then it increased in the 4th week of the experiment.

Also, the results showed that the heterophils level levels decreased steadily from the 1st week to the 4th weeks of the experiment, and the heterophils level increased in the groups treated with heterophils, followed by onion treated group with aflatoxin and blackseed + aflatoxin. Our results indicated that, the black seed, garlic and onion improve the fish immunity against aflatoxins than the other treated groups and the addition of black seed to the fish diet improves the fish immunity against the aflatoxicosis, followed by garlic and onion.

2- Effect of different natural feeds treated with or without aflatoxins on T.WBCs and T. RBCs: Table 3, indicated that, there is a significant (P<0.01) differences among different treatment in different weeks on T.WBCs and T. RBCs. The level of T. WBCs increased from week 1 to week 4 of the experiment.

The groups treated with blackseed, garlic and onion of higher T. WBCs and T. RBCs a level than the other groups. And the groups treated with black seed and aflatoxin of higher T. WBCs and T. RBCs than the groups infected with aflatoxin with garlic and aflatoxin with onion all over the period of the experiment.

3- Effect of different natural feeds treated with or without aflatoxins on phagocytic activity and phagocytic index: Table 4, explain the significant (P<0.01) differences among different treatment in different weeks on phagocytic activity and phagocytic index in fish. The phagocytic activity increased progressively from the 1st to 4th week of the experiment. The phagocytic index decreased progressively from 1st to 4th week of the experiment. The results showed that the garlic + aflatoxin treated group, onion and blackseed and garlic treated groups of a higher phagocytic activity and phagocytic index than the other treated groups. And the addition of black seed, garlic and onion to the fish diet improve the phagocytic acitivity and index against the aflatoxicosis.

4- Effect of different natural feeds treated with or without aflatoxins on total proteins, albumin, globulin and albumin/globulin ratio: Table 4, explain the significant (P<0.01) differences among different treatment in different weeks on total protein, albumin, globulin and albumin/globulin ratio. The results showed that, the total protein increased progressively from the 1st weeks to the 4th week of the experiment. While the globulin level decreased progressively from the period extended from 1st to 4th week of the experiment. Our results indicated that, the groups treated with blackseed, garlic and onion of a higher total protein, albumin, globulin and albumin globulin ratio than the other treated groups. Also, aflatoxin causes decrease of the serum protein level but by addition of natural feeds as black seed, garlic and onion improve the serum protein level.

5- Effect of different natural feeds treated with or without aflatoxins on body composition of fish:

Table 5 explains the significant (P < 0.01) differences among different treatment on DM content of the fish meat. Crude protein, ether extract and ash content in fish meat showed insignificant difference among different groups. The level of DM content of the fish meat increased in the groups treated with blackseed and garlic. Crude protein content of all treated groups showed numerical increase than those of aflatoxin treated groups only.

6- Effect of different natural feeds treated with or without aflatoxins on body weight of fish at different weeks: Table 6, explain the significant (P<0.01) differences among different treatment in different weeks on body

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weight fish. The body weight showed an increasing level from the 1st week to 4th week of the experiment. The groups feeds aflatoxin achieved the lowest body weight, and the body weight improved when we added blackseed, garlic and onion to them. The higher body weight observed in the groups treated with black seed, garlic and onion.

7- Effect of different natural feeds treated with or without aflatoxins on body weight gain of fish at different weeks: Table 6, explain the significant (P<0.01) differences among different treatment in different weeks on body weight gain fish. The groups feeds aflatoxin achieved the lowest body weight gain, and the body weight gain improved when we added blackseed, garlic and onion to them. The higher body weight gain observed in the groups treated with black seed, garlic and onion.

Table 3 - Effect of different treatments of black seed, garlic and onion with aflatoxicosis on differential eucocytic counts, T.WBcs and T.RBc

Time	Treatment	N	lymph	Mono	Hetero	T.WBCs	T.RBCs
			Mean±Std. Error	Mean±Std. Error	Mean±Std. Error	Mean Std. Error	Mean Std. Error
1st week	1	3	45.00±0.58C	8.67±0.33C	35.67±0.33A	25.00±0.58A	26.33±0.33A
	2	3	43.67±0.33G	9.33±0.88B	35.67±1.20A	23.33±0.33C	25.33±0.33B
	3	3	44.67±0.33D	10.33±0.33A	34.00±0.58B	25.00±0.58A	25.67±0.88B
	4	3	46.67±0.33BD	10.00±0.58A	31.67±1.20D	23.00±0.58C	25.00±0.58B
	5	3	44.33±0.33F	10.33±0.33A	34.67±0.67B	24.67±0.88B	25.67±0.33B
	6	3	47.00±0.58A	8.67±0.33C	33.00±0.58C	25.33±0.33A	25.33±0.33B
	7	3	44.00±0.58E	9.33±0.33B	34.67±0.88B	24.00±0.58B	23.00±0.58C
	8	3	46.67±0.33B	10.33±0.33A	32.33±0.88C	25.00±0.58A	23.33±0.33C
2nd week	1	3	46.33±0.33A	7.67±0.33C	36.00±0.58B	27.33±0.33A	22.33±0.33D
	2	3	46.67±0.33A	8.67±0.33B	33.67±0.33E	27.00±0.58A	22.00±0.58D
	3	3	44.33±2.03C	9.67±0.33A	35.67±2.33C	26.33±0.33B	23.67±0.33C
	4	3	46.33±0.33A	8.33±0.33B	34.67±0.67D	25.00±0.58C	22.33±0.88
	5	3	42.00±0.58D	9.33±0.33A	37.33±1.86A	25.33±0.33C	23.00±0.58C
	6	3	42.33±0.88D	9.67±0.33A	37.00±1.15A	26.33±0.33B	25.67±0.33B
	7	3	42.00±0.58D	9.67±0.88A	37.67±0.67A	27.00±0.58B	26.67±0.33A
	8	3	45.67±0.33B	8.33±0.33B	34.67±0.67D	27.33±0.33B	26.00±1.00A
3rd week	1	3	42.00±0.58C	10.00±0.58A	38.33±1.76B	25.00±0.58A	22.67±0.33C
	2	3	45.67±0.33A	10.33±0.33A	33.00±1.15C	24.00±1.15B	25.33±0.33A
	3	3	41.33±0.33D	8.33±0.33C	38.67±0.88B	22.67±0.33D	25.00±0.58A
	4	3	41.33±0.88D	9.67±0.33B	39.00±2.08A	23.67±1.45C	25.00±0.58A
	5	3	41.33±0.33D	8.67±0.67C	39.33±0.67A	24.00±0.58B	22.00±0.58C
	6	3	44.00±0.58B	8.67±0.33C	38.67±0.67B	22.67±0.88D	22.33±0.88C
	7	3	42.00±0.58C	8.67±0.33C	39.67±1.20A	21.67±0.33E	24.33±0.33B
	8	3	45.00±0.58A	10.67±0.33A	33.00±1.53C	25.00±0.58A	25.33±0.33A
4th week	1	3	38.33±1.45E	10.33±0.33A	41.00±1.15B	30.00±0.58A	21.67±0.33D
	2	3	40.33±0.33D	9.33±0.33B	39.00±0.58C	28.33±0.88C	23.33±0.33B
	3	3	43.00±0.58B	10.33±0.33A	36.00±0.58E	28.33±0.33C	22.33±0.67C
	4	3	44.33±0.88A	10.33±0.33A	34.67±1.45F	29.33±0.33B	23.00±0.58B
	5	3	43.00±0.58B	9.33±0.33B	36.33±0.88E	30.67±0.33A	21.67±0.33D
	6	3	41.33±0.33C	9.67±0.67B	38.33±0.88D	24.33±0.33F	23.00±0.58B
	7	3	41.00±1.15C	10.33±0.33A	38.33±2.33D	26.33±0.33E	22.67±0.33C
	8	3	36.67±0.33F	10.33±0.33A	44.33±0.33A	27.00±0.58D	25.00±0.58A

For each week: Treatments means within the same column of different litters are significantly different at (P < 0.01).

Residue of aflatoxin

Table 6, cleared that, the aflatoxin residue in fish muscle differ significantly (P<0.01) among the different treatments. The lower level of aflatoxin observed in the groups treated with blackseed, garlic and onion. While the groups that we added to them blackseed + aflatoxin, Garlic + aflatoxin and onion + aflatoxin showed also the lower aflatoxin residue while the higher level observed in the groups treated with aflatoxin. Our results indicated that the addition of blackseed, garlic and onion to the ratio of fish decreased the residue of aflatoxin in the fish muscle. According to the results observed in Table 7, the economic efficiency measures differed significantly among different immunostimulants added to the fish diet, the higher economic efficiency results (total return, total costs, net profit , total returns/total costs and net return to total costs) improved in the groups fed with blackseed , garlic, onion and all of them improved economic efficiency measures than the control groups and when all of them added to the fish treated with aflatoxin diet improved economic efficiency results than the group treated with aflatoxin only.

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Table 4 - Effect of different treatments of black seed, garlic and onion with aflatoxicosis on Phagocytic activity, Phagocytic index and serum proteins

Time	Treatment	N	P.A	P.I	Total protein	Albumin	Globulin	Albumin / globulin ratio
			Mean± Std. Error	Mean± Std. Error	Mean± Std. Error	Mean± Std. Error	Mean± Std. Error	Mean± Std. Error
1st week	1	3	24.00±0.58C	20.00±0.58E	5.6±0.6A	3.7±0.3A	1.9±0.3AB	1.95±0.5A
	2	3	29.00±1.15B	21.00±0.58D	5.1±0.1B	3.3±0.3B	1.8±0.4AB	1.83±0.3B
	3	3	32.00±0.58A	19.67±0.88G	5.4±0.4A	3.1±0.2B	2.3±0.3A	1.35±0.3C
	4	3	30.33±0.33B	19.33±0.33G	5.6±0.6A	3.4±0.3B	2.2±0.5A	1.55±0.5C
	5	3	30.33±1.45B	20.67±0.33F	5.1±0.5B	3.6±0.2A	1.5±0.3B	2.4±0.2A
	6	3	31.33±0.33AB	23.00±0.58B	5.4±0.4A	3.3±0.3B	2.1±0.2A	1.57±0.2C
	7	3	30.67±1.76B	22.67±1.20C	5.5±0.5A	3.4±0.4B	2.1±0.4A	1.62±0.2C
	8	3	29.67±0.88B	24.33±0.33A	5.6±0.6A	3.7±0.3A	1.9±0.4AB	1.95±0.5A
2nd week	1	3	25.33±2.03E	21.00±0.58C	4.9±0.4C	3.2±0.3C	1.7±0.4AB	1.88±0.4
	2	3	26.33±0.88D	20.67±0.33D	6.1±0.6A	4.2±0.4A	1.9±0.5A	2.21±0.2C
	3	3	27.00±0.58C	23.33±0.33A	5.6±0.5B	3.6±0.3B	2±0.2A	1.8±0.3D
	4	3	24.67±0.33F	20.67±0.88D	5.4±0.4B	3.6±0.3B	1.8±0.4A	2±0.2C
	5	3	29.67±0.88A	21.00±0.58C	5.3±0.3B	3.4±0.4B	1.9±0.3A	1.79±0.5D
	6	3	30.00±0.58A	20.67±0.33D	5.4±0.4B	3.9±0.3A	1.5±0.2B	2.6±0.2B
	7	3	28.00±1.53B	22.33±0.33B	5.6±0.5B	3.7±0.3B	1.9±0.2A	1.95±0.5B
	8	3	28.67±0.88B	20.33±0.33D	4.9±0.4C	3.8±0.3AB	1.1±0.01B	3.45±0.3A
3rd week	1	3	30.00±0.58C	22.33±0.33B	5.3±0.3B	3.9±0.4A	1.4±0.03B	2.79±0.2A
	2	3	27.67±1.76D	22.33±0.67B	5.1±0.5B	3.4±0.3	1.7±0.3B	2±0.2C
	3	3	33.00±0.58A	21.67±0.33C	5.6±0.6A	3.5±0.3B	2.1±0.1A	1.67±0.1D
	4	3	32.00±2.65B	20.67±0.33D	5.4±0.4AB	3.6±0.4B	1.8±0.2AB	2±0.2C
	5	3	31.67±1.86C	23.00±0.58A	5.3±0.3B	3.7±0.5AB	1.6±0.3B	2.31±0.2B
	6	3	33.33±0.33A	23.33±0.33A	5.1±0.5B	3.8±0.3A	1.3±0.1B	2.92±0.2A
	7	3	30.33±0.33C	21.33±0.33C	5.2±0.2B	3.6±0.4B	1.6±0.2B	2.25±0.2B
	8	3	29.00±1.15C	21.00±0.58C	5.6±0.5A	3.9±0.4A	1.7±0.2B	2.29±0.2B
4th week	1	3	32.00±0.58C	20.67±0.33B	5.4±0.4B	3.9±0.4A	1.5±0.1B	2.6±0.2
	2	3	30.00±0.58D	20.67±0.33B	5.2±0.3C	3.6±0.3B	1.6±0.3B	2.25±0.2C
	3	3	33.00±0.58C	21.33±0.33A	5.1±0.4C	3.4±0.4B	1.7±0.2B	2±0.1D
	4	3	28.33±1.45E	20.33±0.33B	5.6±0.5A	3.3±0.3B	2.3±0.2A	1.43±0.1F
	5	3	32.67±0.88C	19.67±0.33C	5.7±0.7A	3.9±0.3A	1.8±0.3B	2.17±0.2C
	6	3	36.67±0.88A	19.00±0.58C	4.8±0.4C	3.7±0.4AB	1.1±0.1C	3.36±0.3A
	7	3	35.00±0.58B	19.33±0.33C	4.9±0.5C	3.6±0.5B	1.3±0.3C	2.77±0.2B
	8	3	32.33±0.88C	18.67±0.33D	5.3±0.5B	3.4±0.4B	1.9±0.2A	1.79±0.1E

For each week: Treatments means within the same column of different litters are significantly different at ($P < 0.01$).

Table 5 - Effect of different treatments of black seed ,garlic and onion with aflatoxicosis on DM, crude protein ether extract and ash percentage in the last week

Treatments	DM%	CP%	EE%	Ash%
T1	26.55±0.39a	60.00±0.73	20.00±0.01	20.00±0.21
T2	24.36±0.23c	58.40±0.45	19.90±0.26	21.70±0.01
T3	26.00±0.01a	59.40±1.08	19.50±0.96	21.10±0.80
T4	25.04±0.11b	58.40±1.06	19.70±0.36	22.90±0.20
T5	25.55±0.27b	59.00±0.67	20.00±0.45	21.00±0.13
T6	25.84±0.65b	58.10±0.51	19.30±0.30	22.60±0.18
T7	24.61±0.50c	57.58±0.18	19.62±1.10	22.80±0.16
T8	25.68±0.43b	60.15±0.18	19.15±1.00	20.70±0.01

Treatments means within the same column of different litters are significantly different at ($P < 0.01$). DM = dry matter; CP = crud data; EE = ether extract

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Figure 1

Figure 2

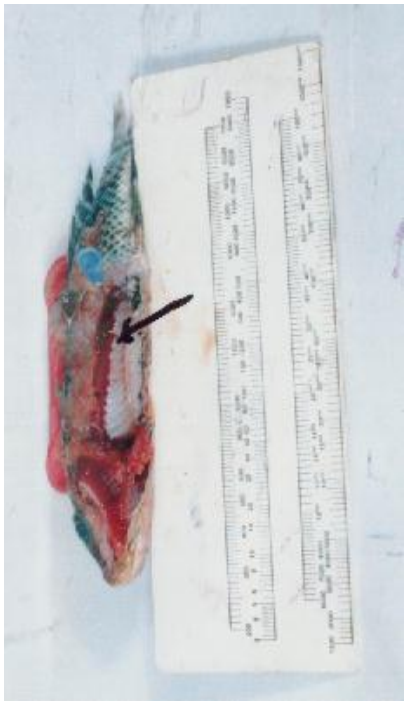

Figure 3

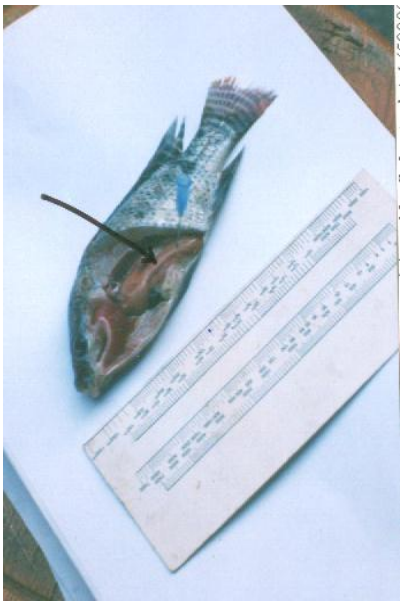

Figure 4

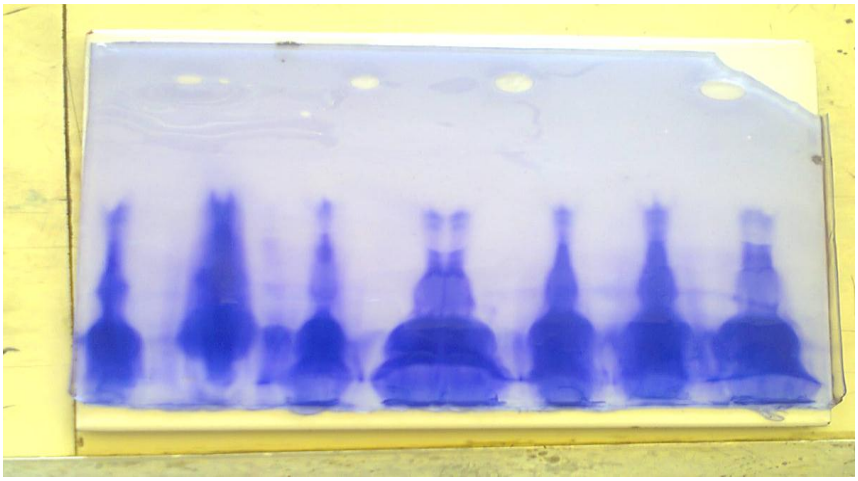

Figure 5

Figure 1. *O. niloticus* exposed to (AFTB1), showing fin erosions, eye cataraca and petechial heamorrhages distributed over the body.

Figure 2. *O. niloticus* exposed to (AFTB1) showing fin erosion and corenal opacity as well as rusty spots formation on belly and dorsal region.

Figure 3. *O. niloticus* exposed to (AFTB1), showing severe congestion of gills and kidney (Arrow).

Figure 4. *O. niloticus* exposed to *(AFTB1),* showing spots of gongested areas in the periphery of the liver. As well as planes of liver (Arrow).

Figure 5. Electrophoretic pattern of different groups exposed to immunostimulents during the experiment in the 4th week.

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Table 6 - Body weight and body weight gain of fish at different treatments among different weeks and aflatoxin residue in the last week

Groups	N	week1	Week2	Week3	Week4	Gain1	Gain2	Gain3	Gain total	AF in Fish Ms. (ppb)
		Mean Std. Error	Mean Std. Error	Mean Std. Error	Mean Std. Error	Mean Std. Error	Mean Std. Error	Mean Std. Error	Mean Std. Error	Mean Std. Error
1	30	Ad 21.50±0.52	Ac 25.90±0.46	Ab 28.30±0.42	Aa 33.70±0.83	Ac 4.40±0.81	Ad 2.4±0.50	Ab 5.4±1.03	Aa 12.20±1.04	0.58±0.01F
2	30	A 21.40±0.43	Dc 21.50±0.52	Eb 23.10±0.60	Ea 24.20±0.68	Dd 0.10±0.01	Db 1.60±0.85	Ec 1.10±0.01	Ea 2.80±0.013	22.79±2.33D
3	30	Ad 21.50±0.54	Bc 23.60±0.43	Bb 25.70±0.70	Ba 28.20±0.44	Bc 2.10±0.80	Bc 2.10±0.75	Cb 2.50±0.87	Ba 6.7±0.45	0.66±0.03F
4	30	Ad 21.50±0.31	Dc 21.60±0.40	Fb 22.40±1.28	Fa 23.80±0.36	Dd 0.10±0.005	Fc 0.80±0.07	Db 1.40±0.04	Fa 2.30±0.35	36.45±3.45C
5	30	A 21.30±0.37	C 22.50±0.93	C 24.30±0.47	C 27.00±0.52	Cd 1.20±0.07	Cc 1.80±0.03	Bb 2.70±0.05	Ca 5.70±0.56	0.69±0.03F
6	30	Ad 21.70±0.45	Dc 21.80±0.37	Fb 22.60±0.43	Ga 23.90±0.28	Dd 0.1±0.05	Fc 0.80±0.05	Eb 1.30±0.07	Ga 2.20±0.47	51.55±0.05B
7	30	Aa 22.00±0.42	Eb 21.00±0.82	Gc 20.00±0.75	Hd 18.60±0.27	E b -1.00±0.01	Gb -1.00±0.07	Da 1.40±0.08	Hc -3.40±0.44	89.48±2.44A
8	30	Ad 21.40±0.34	Cc 22.40±0.43	Db 23.80±0.33	Da 24.30±0.40	Dc 1.00±0.04	Eb 1.40±0.54	Ed 0.50±0.43	Da 2.90±0.56	2.89±0.02E

Capital litters: Indicated that means within the same column of different litters are significantly different at ($P < 0.01$)
Small litters: Indicated that means within the same row of different litters are significantly different at ($P < 0.01$)

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Table 7 - Econonomic efficiency measures of different immunostimulants

Groups	N	Total return (L.E)	Costs of immunostimulants	Feed cost	Fixed costs and price of fry	Total costs	Net profit	Total return/ Total costs	Net return/ Total costs
		Mean Std. Error	Mean Std. Error	Mean Std. Error	Mean Std. Error	Mean Std. Error	Mean Std. Error	Mean Std. Error	Mean Std. Error
1	30	A 8.08±0.08	A 0.90±0.04	A 1.26±0.02	A 3	A 5.16±0.05	A 2.92±0.02	A 1.57±0.01	A 0.56±0.05
2	30	D 5.80±0.05	A 0.90±0.03	A 1.26±0.02	A 3	A 5.16±0.05	G 0.64±0.04	E 1.13±0.01	E 0.12±0.02
3	30	B 6.76±0.06	C 0.45±0.04	A 1.26±0.02	A 3	C 4.71±0.04	B 2.05±0.02	B 1.44±0.03	B 0.43±0.02
4	30	F 5.52±0.05	C 0.45±0.04	A 1.26±0.02	A 3	C 4.71±0.07	F 0.81±0.02	D 1.17±0.03	E 0.17±0.03
5	30	C 6.48±0.06	D 0.56±0.05	A 1.26±0.02	A 3	B 4.82±0.03	C 1.66±0.04	C 1.35±0.03	C 0.34±0.04
6	30	E 5.73±0.05	D 0.56±0.05	A 1.26±0.02	A 3	B 4.82±0.03	E 0.91±0.03	D 1.18±0.03	D 0.18±0.03
7	30	G 4.46±0.04	-	A 1.26±0.02	A 3	D 4.26±0.04	H 0.20±0.02	E 1.04±0.04	F 0.04±0.01
8	30	D 5.83±0.05	-	A 1.26±0.02	A 3	D 4.26±0.02	D 1.57±0.05	C 1.36±0.03	C 0.36±0.03

Means within the same column of different litters are significantly different at ($P < 0.01$)

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DISCUSSION

Effects of the presence of these spices / herbs can be seen in food products such as pickles, bread, rice, and meat products. The fat, protein, water, and salt contents of food influence microbial resistance. Thus, it is observed that higher levels of spices are necessary to inhibit growth in food than in culture media (Van Houten, 2006).

Our results showed that, the lymphocyte, monocytes and heterophils level increased in the groups treated with black seed, garlic and onion and all of them higher than that of the control group. While, the groups treated with blackseed+Alflatoxin, garlic + aflatoxin and onion + aflatoxin of lower differential leucocyte level.

Our results cleared that, the groups treated with blackseed, garlic and onion of higher T. WBCs and T. RBCs level than the other groups. And the groups treated with black seed and aflatoxin of higher T. WBCs and T. RBCs than the groups infected with aflatoxin with garlic and aflatoxin with onion all over the period of the experiment. Our results indicated that, the black seed , garlic and onion improve the fish immunity against aflatoxins through improving the T. WBCs and T. RBCs level than the other treated groups and the addition of black seed to the fish diet improve the fish immunity against the aflatoxicosis, followed by garlic and onion. Our results indicated that, the black seed , garlic and onion improve the fish immunity against aflatoxins through improving the T. WBCs and T. RBCs level than the other treated groups and the addition of black seed to the fish diet improve the fish immunity against the aflatoxicosis, followed by garlic and onion.

The improvement in the hemaogram may be due to the effects of Blackseed, garlic and onion to over come the necrosis and basophilia of hepatocytes, enlargement of blood sinusoids in the head kidney (congestion, shrinking of glomeruli and melanosis were observed), accumulation of iron pigments in the intestinal mucosaepithelium, and necrosis of gastric glands done by AFB1 (Marzouk et al., 1994).

Our results indicated that, the results showed that the garlic + aflatoxin treated group, onion and blackseed and garlic treated groups of a higher phagocytic activity and phagocytic index than the other treated groups. And the addition of black seed, garlic and onion to the fish diet improve the phagocytic acitivity and index against the aflatoxicosis. Our results also agreed with those of Salem et al. (2010) where they concluded that, from the feeding experiment that aflatoxin contamination of fish diets caused many drastic effects in all tested parameters and it is very dangerous from the view point of fish production and public health. It could be recommended for the use 1% herbs as Piper nigrum L or 1% Coriandrum sativum to alleviate the toxic effects of AFB1 contaminated diets. Moreover, we need a lot of scientific efforts in this trend to use of the natural agents to detoxify of mycotoxins (particularly aflatoxin) in diets of fish.

Our results indicated that, the groups treated with blackseed, garlic and onion of a higher total protein, albumin, globulin and albumin globulin ratio than the other treated groups. Also, aflatoxin causes decrease of the serum protein level but by addition of natural feeds as black seed, garlic and onion improve the serum protein level .

Also, our results cleared that, the moisture content, total solids, fat and total protein content level improved in the groups treated with blackseed, garlic and onion treated groups of a higher moisture, total solids containt, fat, total protein while, the groups treated with aflatoxin of lower moisture and total solids containt and the addition of black seed, garlic or onion improve the moisture, total solid, total protein content, fat level in fish meat . Our results agreed with those of Aly and Mohamed (2010) where they concluded that, garlic (G) supplemented diets has immunostimulant for tilapia (Oreochromis niloticus) and improved the RBCs, WBCs and its differentials, serum proteins, glucose, triglycerides and Hb, PCV, PA and PI, urea, creatinin, in addition to the serum enzymes than the groups fed on diet with aflatoxins . In accordance with the present findings, Abdelhamid et al. (2002b) reported that the aflatoxic diets significantly ($P<0.01$) reduced the fish flesh crude protein content but increased its fat and ash contents proportional to the dietary levels of the aflatoxin . Also, our results cleared that, the ash level increased in the groups treated with aflatoxin group, while the groups treated with aflatoxin in addition to blackseed, garlic and onion the ash containt returned to its normal level during treatment of this group. The level of carbohydrate increased in the groups treated with aflatoxin and decreased in the groups treated with blackseed, garlic and onion.

Our results cleared that, the aflatoxins causes decreasing of body weight, body weight gain and feed conversion but by the addition of blackseed, garlic and onion to them improve of body weight, body weight gain and food conversion of the fish. And the groups treated with blackseed, garlic and onion of a high body weight, body weight gain and feed conversion.

Also, our results agreed with those of Yossef and Ashry (1999) who reported that methanolic extract of N.S. seed given partial protection against aflatoxin B1-induced hepatotoxicosis in rats and this evidenced by decrease serum AST and ALT with improvement of RBCS, WBCs, serum urea, creatinine, glucose, triglycerids and serum protein. Our results agreed with those of Aly and Mohamed (2010) where they concluded that, garlic (G) supplemented diets has immunostimulant for tilapia (Oreochromis niloticus) and improved the feed intake, body weight and body weight gain than the groups fed on diet with aflatoxins.

Our results cleared that, the lower level of aflatoxin observed in the groups treated with blackseed, garlic and onion. While the groups that we added to them blackseed + aflatoxin, Gralic + aflatoxin and onion + aflatoxin showed also the lower aflatoxin residue while the higher level observed in the groups treated with aflatoxin . Thymoquinone, the most abundant constituent of black seed essential oil, has been shown to be the active principle responsible for many of the seed's beneficial effects. In addition *N.sativa* seeds contain fixed oils and

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volatile oils, which are rich sources of quinines, unsaturated fatty acids, amino acids and proteins and contain traces of alkaloids and terpenoids (Gali-Muhtasib et al., 2007).

Chung (2006) Antioxidant properties of garlic compounds representing the four main chemical classes, alliin, allyl cysteine, allyl disulfide, and allicin, prepared by chemical synthesis or purification were reported . The results of onion agreed with those of Kim et al. (2010) where they investigate the inhibitory effect of green onion produced on the growth of *A. parasiticus*, a toxigenic strain. The addition of green onion to the media showed inhibiting the fungal growth after three days of cultivation. The 1.0% concentration of green onion significantly reduced growth with improvement of WBCS, RBCs, serum enzymes, serum protein, urea and creatinine with improvement of body weigh and gain and economic and productive efficiency of fish production farms.

This study concluded that the addition of blackseed, garlic and onion to the fish diet improved the immunity of the fish against different fish diseases especially aflatoxins in addition it will improve the economic returns of the fish production farms.

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EFFECT OF CINNAMON AND GINGER COMPARED TO DOXYSTIN (ANTIMICROBIAL DRUG) ON SERUM LIPID PROFILE IN BROILER CHICKS

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ABSTRACT: *The aim of this study was to assess the effect of the medicinal plants cinnamon (Cinnamomum verum) and ginger (Zingiber officinale), as natural feed additives in comparison to (Doxystin) ("Doxycycline HCl 50 mg and Colistin sulfate" , known antimicrobial growth promoter) on the serum lipid profile of broiler chicks. One hundred and sixty (one day-old) broiler chicks were assigned to four groups of the same mean weight, each with four replicates of ten chicks. The first group was used as control group and fed broilers basal diet, the second group fed the basal diet supplemented with the (Doxystin) as 0.5%, the third and fourth groups fed basal diet mixed with C. verum, and Z. officinale as 2% of the diet respectively. The experimental diets affected all parameters measured follows, total cholesterol and serum (low density lipoprotein) LDL-C concentration was significantly (P<0.05) decreased in groups received spices diet compared to Doxystin and control groups. Whereas, the (high density lipoprotein) HDL-C concentration showed significantly (P<0.05) lower levels in the two spice treated groups compared to the control group only, and the antibiotic treated animals showed similar level to that observed in spice treated groups. Triacylglycerols and the VLDL-C fraction showed clearly reduced values in all treated groups compared to the control group, though the difference was not significant but it was more pronounced in the spice treated groups, as they reported half the level of the control group. It can be concluded that inclusion of C. verum and Z. officinale as feed additives acted as natural hypocholesterolemic agents in broiler chicks in particular and reduced blood lipids in general.*

ORIGINAL ARTICLE

Key words: *Lipid, Cholesterol, Cinnamon, Ginger, Broiler, Chicks*

INTRODUCTION

The spread of drug resistant pathogens is one of the most serious threats to successful treatment of microbial diseases. Down the ages essential oils and other extracts of plants have evoked interest as sources of natural products. They have been screened for their potential uses as alternative remedies for the treatment of many infectious diseases (Tepe et al., 2004). Essential oils have been shown to possess antibacterial, antifungal, antiviral, insecticidal and antioxidant properties (Burt, 2004). Alam khan et al. (2003) found that *C.verum* bark powder at different doses 1, 3 and 6 g/day prevents hypercholesterolaemia and hypertriglyceridaemia and lowers the levels of free fatty acids and triglycerides in plasma of type 2 diabetic subjects by its strong lipolytic activity. Cinnamate, a phenolic compound found in *C.verum* bark and other plant materials, lowers cholesterol levels in high fat-fed rats by inhibiting hepatic 5-hydroxy-3-methylglutaryl-coenzyme A (HMG-CoA) reductase activity (Lee et al., 2003).

Z.officinale is used for a large variety of illnesses, including sickness, respiratory and gastrointestinal disorders. Anti– ulcer activity is attributed to the volatile oil, especially the 6-gingesulfic acid content (Heinric, 2004). Kamal et al. (2009) cited that, the Z.*officinale* is documented as good hypolipidaemic as well as antioxidant natural agents. Z.*officinale* was found to be significant in lowering the level of serum total cholesterol, serum triglycerides, serum LDL-cholesterol, serum VLDL-cholesterol and in increasing the level of serum HDL-cholesterol in patients of primary hyperlipidaemia. The objective of this study was to evaluate the effect of *C.verum and Z.officinale* as natural plants compared to antibiotic on serum lipid profile of broiler chicks.

MATERIAL AND METHODS

The present study was carried out at the Animal House of the poultry Production Department, Faculty of Animal production, University of Khartoum. It included 160 unsexed white broilers (Cobb – strain). The birds were

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kept in an open sided poultry house for six weeks. The bird fed starter diet from day 1-21days and finisher diet form 21-42 day of age (Table 1).

Table 1 - Composition and calculated analysis of the basal diet fed to the experimental birds

Ingredients As percentage	% (1-3wks) Starter Control	% (4-6wks) Finisher Control	% (1-3wks) Starter Spices	% (4-6wks) Finisher Spices
Sorghum	65.1	66.5	63.1	64.5
Groundnut meal	18.7	13.5	18.7	13.5
Sesame meal	10	12.7	10	12
Super concentrate*	5	5	5	5
Lime stone	0.9	0.9	0.9	0.9
Salt	0.25	0.25	0.25	0.25
Lys	0.04	0.06	0.04	0.06
Meth	0.01	0.01	0.01	0.01
Vegetable oil	0	1.08	0	1.8
Spices	0	0	2	2
Total (100%)	100	100	100	100

*Broiler Super concentrate contains (%): CP 40, CF 1.5, ME 2122Kal/kg, fat 3,Lysine13.5, Methionine 5.9, Methionine+cystine6.25,P 4.6, Ca 6.8, Na 1.5. Vitamins supplied per Kg of diet: Vit. A, 250 000 IU; Vit. D3, 60 000 IU; Vit. E, 800 mg; Vit. K3,60 mg; Vit. B1, 30mg; Vit. B2, 100 mg; Vit. B6, 50 mg; Vit. B12, 300 mg; Vit. C, 4000 mg; Niacin, 800mg; Folic acid,30mg; Biotin, 30mg;Choline chioride,3000mg; Copper, 30 mg; Iron, 100mg; Manganese, 160mg; Zinc,100mg; Iodine,1.3mg; Selenium, 5mg; Cobalt, 1.2mg; Fytase enzyme, 15000; Antioxidant.

The spices were brought from Khartoum local market then cleaned, dried and powdered. The antibiotic which has been used in this treatment was the Doxystin. Each gram of the Doxystin contains: (Doxycycline HCl 50 mg) and (Colistin sulfate 400 000 IU).

The experimental diet was formulated from local ingredients and formed as follow: Group (A) fed basal diets only and kept as control. Group (B) fed basal diet plus the antibiotic (Doxystin) as 0.5%. Group (C) fed diets plus *C.verum* powder as 2%. Group (D) fed diets plus *Z.officinale* powder as 2%. Water and diet were freely accessed.

At 42 days the blood samples were collected from the birds at slaughter in to clean tubes and allowed to clot. Then the samples were centrifuged at 3000 r.p.m for 5 minutes and sera were separated, then they were collected into plain containers and used in the evaluating blood parameters. The lipid profile parameter evaluated were total cholesterol, HDL, LDL and Triglyceride.

High density lipoprotein-cholesterol (HDL-c) in the sample was determined according to the precipitation method described by Friedwald et al. (1972).

The cholesterol concentration was estimated by an enzymatic method which measures the total cholesterol concentration in the serum as described by Richmond, (1973).

Low density lipoprotein- cholesterol (LDL-c) was estimated in (mg/L) the following formula is used:

LDL cholesterol = Total cholesterol –Triglycerides/5 - HDL cholesterol

Triglycerides (TG) in the sample were determined according to the enzymatic colorimetric method described by Bucolo and David (1973).

The data were analyzed by one way ANOVA procedure according to SPSS computing software program. Each test was conducted at 5% level of significant.

RESULTS

The effect of inclusion of 2% dietary powdered spices and 0.5% doxystin on broiler chicks serum total cholesterol concentration is presented in Table 2. There was significant ($P<0.05$) decrease in the mean values of serum total cholesterol concentration in *C.verum* and Z.*officinale groups* compared to doxystin and control groups. The results also showed no significant difference within the spices groups for the serum total cholesterol concentration, but there was a numerical decrease in the total cholesterol concentration of *C.verum* group compared to Z.*officinale* group.

Also there was a significant ($P<0.05$) decrease observed in LDL concentration in all spices treated groups compared to the doxystin treated group.

The results showed significant ($P<0.05$) decrease in the level of HDL concentration in the experimental groups compared to the control with no significant difference within the experimental groups when compared together.

There was no significant change reported between the experimental groups and control on broiler chicks' serum triglycerides (TG) and Very low density lipoprotein cholesterol (VLDL) concentrations. But there was a numerical decrease observed in the mean values of TG and VLDL concentrations in all treated groups compared to the control group.

This effect was clear in the groups treated with Z. *officinale* and *C. verum,* respectively where the level of the TG and VLDL were just half the level in the control group.

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Table 2 - Effect of inclusion dietary powdered spices and doxystin on broiler chicks serum lipid profile

Parameters \ Groups	Control	Doxystin	*C.verum*	Z.*officinale*
Cholesterol (mg /dl)	314.72^{a}±19.42	287.23^{a}±54.56	128.14^{b}±10.73	159.96^{b}±15.25
HDL (mg/dl)	179.69^{a} ±8.02	69.26^{b}±11.27	103.03^{b}±25.05	111.44^{b}±5.57
LDL (mg/dl)	128.51^{a}±18.61	160.76 ^{a}±40.06	42.59^{b}±8.91	54.06^{b}±11.61
TG (mg/dl)	53.59±15.57	42.45±8.55	29.62±10.06	27.55±7.04
VLDL (mg/dl)	10.72±2.7	8.49±1.48	5.92±1.77	5.51±1.22

^{a,b,c} : Row means with no common superscript differ significantly at (P<0.05).

DISCUSSION

The results showed significant (P<0.05) decrease in the mean values of serum total cholesterol concentration in spices treated groups compared to doxystin treated and the control groups. *C.verum* treated group showed the lower numerical value compared to the Z. *officinale* group this result is in agreement with results obtained by AL-Kassie (2009) who reported that, the supplementation of 200 ppm oil extract derived from *C.verum* in broiler diets for period of 6 weeks, significantly (P<0.05) decreased serum cholesterol level. This considered to be related to the cinnamic acid significantly inhibit activity of hepatic HMG-CoA reductase, a key enzyme involved in regulating cholesterol metabolism and decrease serum total cholesterol level (Lee et al., 2007).

Agoreyo et al. (2008) studied the effect of aqueous extract of *Z.officinale* on plasma cholesterol concentration in cholesterol-induced albino rats. They found that, *Z.officinale* revealed a statistically significant (P<0.05) decrease in plasma cholesterol in comparison with the control group. There are several mechanisms by which plant products may lower cholesterol and triglyceride levels, either by increase removal of VLDL by peripheral tissues (Harris et al., 1984) or increased excretion of bile in the feces (Balasubramaniam et al., 1985). Kamal et al. (2009) interpreted that the *Z.officinale* (Zanjabeel) is documented as good hypolipidaemic natural agent. The level of serum LDL-c decreased significantly (P<0.05) in broiler chicks after feeding 2% powdered *C.verum*, and Z.*officinale* compared to the control group. There was also significant (P<0.05) decrease in the level of serum LDL-c concentration in spices treated groups compared to doxystin treated group.

The effect found in the *C.verum* treated group in the present work agrees with Raza et al. (2005) who found that, the level of plasma LDL-c of the hypercholesterolemic was decreased significantly after administration of 1.5 gms *C.verum* for 40 days, compared to the control. Z.*officinale* treated group results also agrees with Kamal et al. (2009) who cited that, the Z.*officinale* (Zanjabeel) is documented as good hypolipidaemic natural agents. Z.*officinale* (Zanjabeel) was found to be significant in lowering the level of serum LDL-c in patients of primary hyperlipidaemia. There was a significant (P<0.05) decrease in the level of HDL concentration in the experimental groups compared to the control but with no significant difference within the experimental groups. Similar effect was observed in the previous studies treated by the same types of spices. Ali, (2009) found that, oral administration of *C.verum* decreased significantly the concentration of plasma HDL-c. But disagrees with Raza et al. (2005) who found that, the level of plasma HDL-C of the hypercholesterolemic patients was increased significantly after administration of 1.5 gms *C.verum* for 40 days, compared to the control.

In study carried by Bhandari et al. (2005) the serum HDL-cholesterol concentration was not altered either by the high-fat diet or by *Z. officinale* treatment. The reason for this variability was suggested to be due to the differences in the kind of experimental disease models used.

The effect of inclusion of 2% dietary powdered spices and 0.5% doxystin on broiler chicks, showed no significant change between the experimental groups and control group serum triglycerides (TG) and Very low density lipoprotein cholesterol (VLDL) concentrations. But there was a numerical decrease observed in the mean values of TG and VLDL concentrations in the experimental groups compared to the control group. These finding agrees with previous studies. Ali, (2009) reported that, oral administration of *C.verum* decreased insignificantly the concentration of plasma TG and VLDL-C when compared to untreated control .

Kamal et al. (2009) interpreted that the Z.*officinale* (Zanjabeel) is documented as good hypolipidaemic as well as antioxidant natural agents. Z.*officinale* (Zanjabeel) was found to be significant in lowering the level of serum TG and serum VLDL-cholesterol in patients of primary hyperlipidaemia.

The antimicrobial drug the Doxystin does not lowered the LDL-C (the bad cholesterol) in the experimental animals but reduced the HDL-C (the good cholesterol) significantly and reached a very low level compared to the control group. This observation is in favor for the use of spices as food additives as it will lower blood bad cholesterol without lowering the good one.

CONCLUSIONS

Findings in the present work showed clear cut information that Z.officinale and *C.verum* reduced serum total cholesterol and its fractions LDL_C and the HDL_C in broiler chicks. The VLDL_C fraction and the triacylglycerols were not significantly reduced. The antimicrobial drug the Doxystin does not lowered the LDL-C but reduced the HDL-C significantly in the experimental animals.

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NON REGULATORY CONSTRANTS AFFECTING PIG INDUSTRY IN ZIMBABWE

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ABSTRACT: *This study was done to review the status of pig industry in Zimbabwe and find out the non-regulatory constraints to production and marketing using a value chain approach. The study used literature and secondary data from stakeholders and service providers as well as primary data collected through key informant interviews and focus group discussions. Data were analyzed mainly by value chain mapping and descriptive statistics. There are key players and service providers in the pig industry who play various roles from input supply, production, processing until the product is available to domestic and international consumers. Pork production has been going down over time from a record high of 20000 sow units in 2007 to about 10000 sow units in 2010. Pork production is further threatened by weak demand for meat estimated at 8.7kgs per capital. Key internal and external non regulatory constraints identified with percentage scores were poor breeding stock (84%), electricity gap (70%), abattoir fees (73%), skills gap (67%), shortage of abattoir facilities (57%), low production capacity (64%), low yield levels (64%), finance (61%) and low demand for pork (47%). These factors were noted as inhibiting growth and development in the sector. This paper will conclude by indicating that there is a need for a serious review of the operating environment of the industry in order to ensure the smooth running of business in the pig industry in Zimbabwe given the volume of issues identified by stakeholders in the pig value chain. It is recommended that further detailed research and inquiry be made around the various issues identified to provide hard evidence on the impact of such operating environment on the performance of the industry. With this evidence, stakeholders will gain more understanding of the need to create a favorable operating environment that will see growth and development in the pig industry.*

Key words: *Literature, Secondary, Primary, Performance, Evidence, Business, Stakeholders*

ORIGINAL ARTICLE

INTRODUCTION

Over years, Zimbabwe has experienced significant decrease in agricultural production and exports. Agriculture Gross Domestic Product (GDP) decreased from approximately 21% in 2001 to less than 10% in 2008. Even though the agriculture sector contribution to the GDP increased by 15% in 2009, 34% in 2010 and 20.4% in 2011, the levels were still far below those achieved prior to 2000. Since 2002, Zimbabwe has experienced general decrease in livestock population. Between 2002 and 2005, cattle population on large scale farms declined from about 25% of the national herd to less than 13% of the national herd (Anseeuw et al., 2011) and to less than 21,689 (less than 1%) in 2009. Dairy herd also declined from 104483 in 1994 to 43159 in 2004 and to 22000 in 2009, leading to decline in milk production and the national sow unit decreased from over 18 000 to just 8000 between 2001 to 2008 (Pig Industry Board or PIB, 2010). By 2009, the livestock population of Zimbabwe consisted of 5.1 million cattle, 21689 dairy, 397800 sheep, 3.2 million goats and 202234 pigs (Ministry Of Agriculture, Mechanization and Irrigation Development or MoAMID, 2010). According to Moyo (2012) on City Press, the declines in crop and livestock production and yields were largely due to the shortages of inputs that affected all the categories of farmers, rising input costs, and inadequate credit, incomes, savings and wage remittances. The low yields are also due to the increasing frequency of droughts.

FAO projections in food demand suggest that food demand will increase by almost 50% towards 2050 (FAO, 2003). This is in line with the expected increase in population over time, the past 100 years have seen the world's human population increasing by nearly fourfold (UN, 2007); and it is projected to increase from 6.7 billion (2006) to 9.2 billion by 2050. To increase crop and livestock production in line with increasing demand for food, three primary factors should be considered and these are; increased cropland and rangeland area (15% contribution in 1961–1999); increased yield per unit area (78% contribution); and greater farming intensity (7% percent contribution)

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(FAO, 2006). Thus for food production to keep pace with population demand, there is a need to invest in more efforts to increase yields, continued expansion of cropland by conversion of natural habitats, or by optimizing food or feed energy efficiency from production to consumption.

Prompted by the need to strategically position themselves in the meat industry, especially after economic stability brought about by dollarization and formation of government of national unit by early 2009, stakeholders in the livestock industry in Zimbabwe have been airing several views in various forums about critical issues that could hamper competitiveness, growth and development in the sector. Simply defined, competitiveness is the ability of a firm or a nation to offer products and services that meet the quality standards of the local and world markets at prices that are competitive and provide adequate returns on the resources employed or consumed in producing them (http://www.businessdictionary.com/definition/competitiveness.html). Competitiveness is affected by both endogenous (capacity/ability, key factors of production such as climate, land, capital, labour and technology, efficiency of farm operation, sustained quality production etc.) and exogenous factors (policy environment, services, market demand, prices, market access, infrastructure development, research and development etc.).

Thus this study was designed to bring out key internal and external non regulatory factors affecting pig industry in Zimbabwe in order to assist stakeholders in strategizing for industry development given the downward trends noted earlier in production. Other factors such as the regulatory issues were dealt with in another paper to simplify the work and provide the focus on non-regulatory issues. The evidence produced from this work will be useful to various key stakeholders in the industry in terms of strategizing for issues they need to deal with internally and externally to improve the performance of the industry.

MATERIALS AND METHODS

This study was carried out in Zimbabwe and major elements of the study were stakeholders and service providers in the pig industry. The key stakeholders considered included pig commercial farmers, pig breeders such as Pig Industry Board (PIB) and other individual breeders, stock feed manufacturers, abattoirs, processors and butcheries (wholesale and retail). Service providers consulted were meat inspectors, animal health service providers and farmer organizations such as Pig Producers association of Zimbabwe, Livestock and Meat advisory Council of Zimbabwe among others.

The study used literature review, secondary data from stakeholders and service providers as well as primary data collected through key informant interviews and focus group discussions. Stakeholders were asked to identify and jointly prioritize by scoring constraints using a well-defined criterion that considered eexpected impact and risk, action required, responsible organization, time dimension, and resources required. Data were analyzed mainly by value chain mapping, and descriptive statistics to summarize the data obtained into meaningful form for the purpose of this study.

RESULTS

Key players and service providers in the pig industry value chain

The study revealed that there are key players and service providers in the pig industry in Zimbabwe working as a network of interconnected units to ensure delivery of pork and pork products for consumption in the domestic and international markets. The value chain consists of input supply, producers, stock feed manufacturers, abattoirs, processing wholesalers, retailers and consumers. Service providers include other players who facilitate activities along the value chain to ensure product delivery such as farmer organizations (LMAC and PIB), veterinary services, health inspectors and others. Details of the various players and service providers are indicated in Figure 1 below.

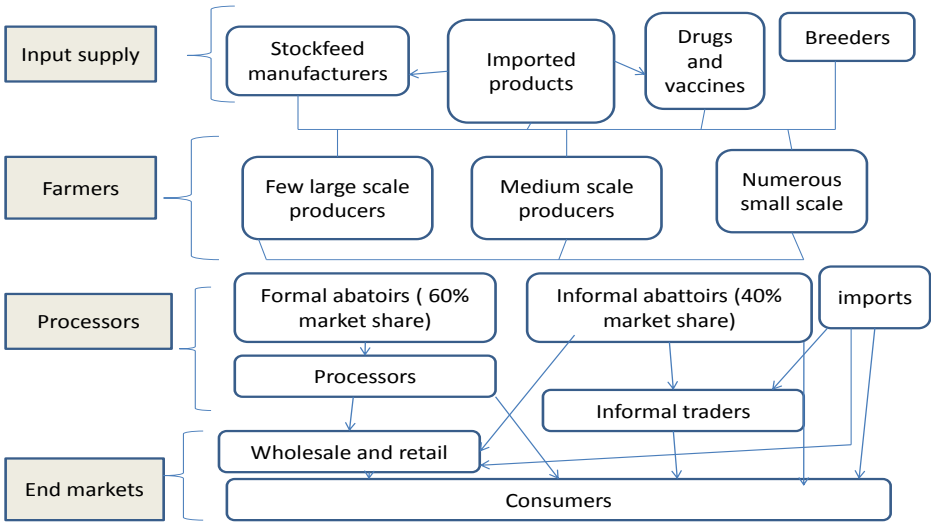

Figure 1. Pig industry value chain; Source: USAID, 2010 and Field survey

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Players in the Pig Industry in Zimbabwe

The input supply sector provides the various inputs needed in the pig industry, these include pig breeders, feed manufacturers and veterinary services. Production sector consists of a few large scale commercial farmers (Gilt edge, Daveport, Tripple C), a number of medium scale produces and numerous small scale semi substance producers. Abattoirs are registered slaughter facilities, operating in accordance with given standards that buy and slaughter livestock from the farmers for price based on the dressed weight and grade. They sell raw and processed pork meat to wholesalers and retailers. The other abattoirs like Koala, Montana Meats, Caswell Meats and Surrey (Meat Graders data base) are into pig and other livestock slaughtering for retail customers. In addition, there are numerous, unregistered and small slaughter providing pig meat at irregular times for the fresh meat market. Wholesale and retail sectors of pork consists of numerous butcheries, numerous supermarkets who buy mainly processed (tinned, beacon, polony, chops, ribs, sausages etc.) pork from colcom and mainly raw pork from other abattoirs for sale to consumers.

Besides key player as indicated in the value chain, there are service providers who include, Pig Industry Board (PIB), Veterinary services, Meat graders, farmer organizations, stakeholder organizations, transporters and cash providers and others who play several facilitation roles along the commodity chain.

Pig Production in Zimbabwe

Pig production has been fluctuating up and down over the past decade. Zimbabwe national commercial sow herd peaked at nearly 20000 sows in 2007 from 15500 in 2005, then dropped by half to about 8000 in 2008 (USAID, 2010). To date the numbers is believed to be rising steadily and expected at about 10 000 sow herd (Figure 2). These figures exclude the pigs in the smallholder sector, which are estimated to comprise about 80% of the total pig population in Zimbabwe with the main function of ensuring food security and as a store of wealth with a very low off take.

The industry currently supplies approximately just above 100000 animals per year for slaughter and processing, equivalent of about 5000 MT of meat according to Meat graders data base. This is a major increase from a record low of 40000 animals in 2008. Figure 3, below show the slaughter figures over time.

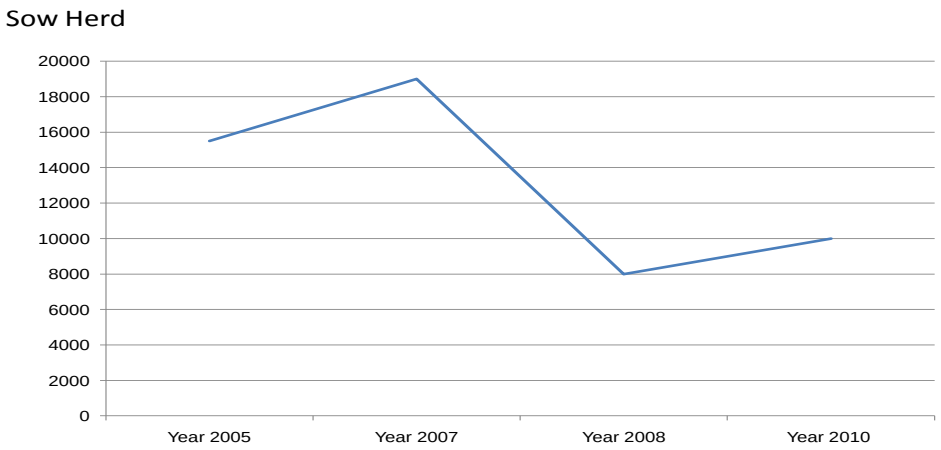

Figure 2. Trends in national sow herd

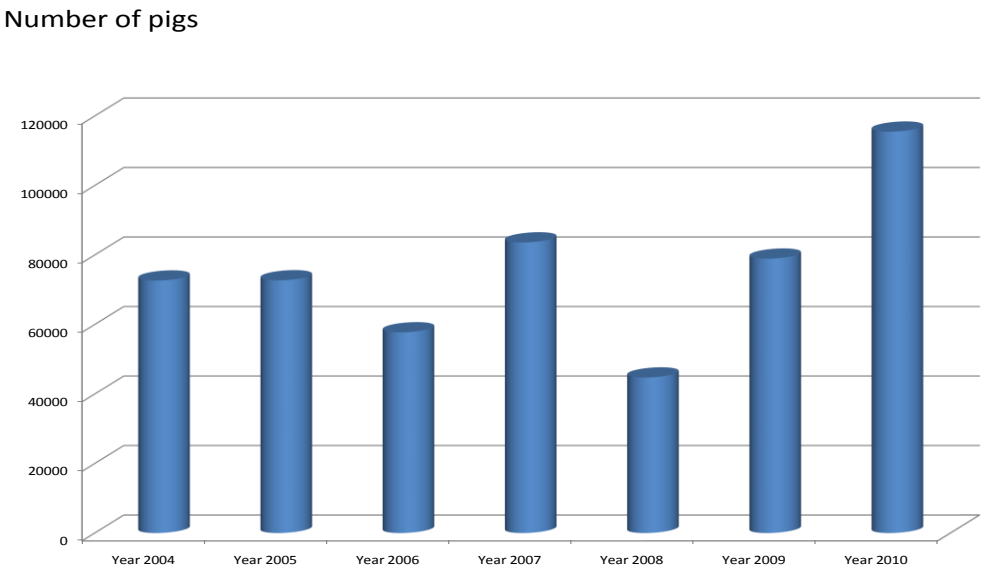

Figure 3. Annual slaughter figures

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Classification of pork produced

According to DRSS Meat Graders data base, the classification of pig meat produced in Zimbabwe's registered pig abattoirs currently over 50% porkers, 30% baconers and the remainder being under porkers, general and manufacturing classes. There has been an increase in the proportion of porkers and a decrease in the proportion of baconers over the years as indicated by the Figure 4 below.

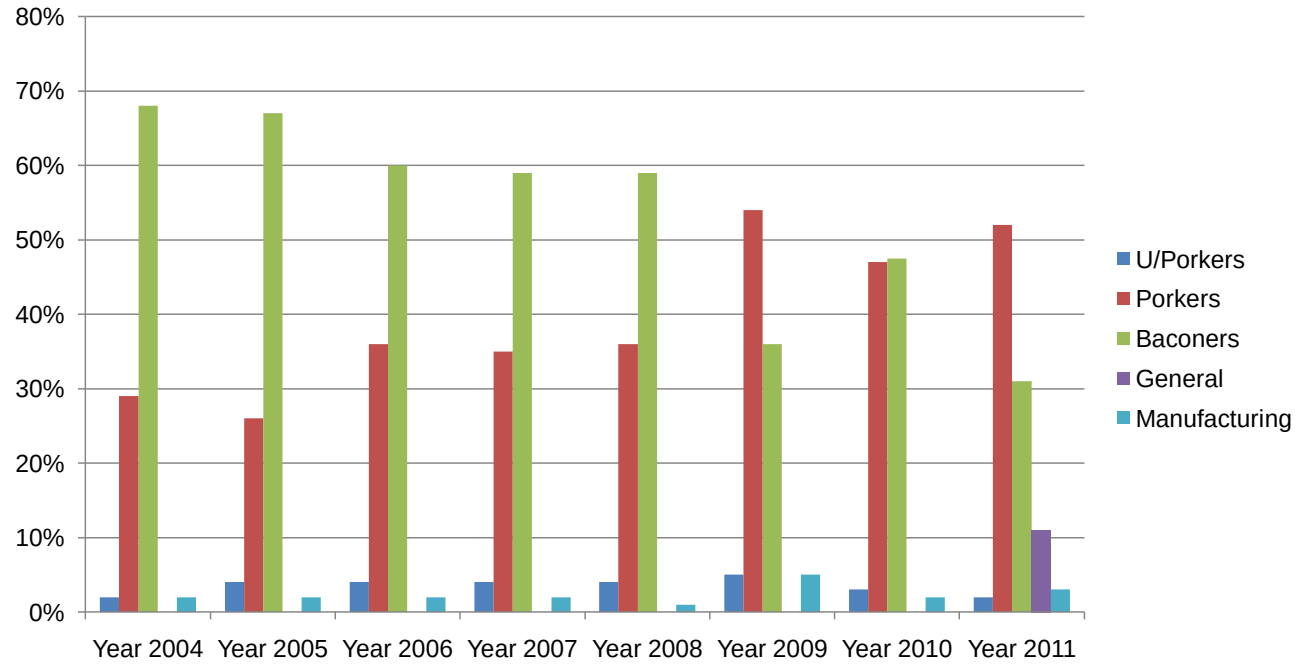

Figure 4. Classification of slaughtered pigs over years

Productivity at farm level versus theoretical standards

Results shows that farm production was performing below theoretical standards in areas such as litter size, litter per year, farrowing rate, dead weight feed conversion, mortality rate and age at 90kg weight mainly for small and medium scale farmers (Table 1).

Table 1 - Productivity at farm level versus theoretical standards

Traits	Benchmark	Farm category			Average Weighted
		Small	Medium	Large	
Proportion (%)	-	28	29	43	-
Litter Size	12+	6	9	11	9
Number of farrowings/year	2.24	2	2	2.24	2
Litter per year	27+	12	18	24.64	18
Farrowing rate (%)	88+	80	85	100	100
Growth rate in five months (kgs)	100+	50	85	100	78
Dead weight feed conversion efficiency	3.5-	4.3	4	3.8	4
Mortality rate (%)	3-	10	8	5	7
Age at 90kgs	150	270	159	135	188

Demand for meat in Zimbabwe

It is estimated that overall meat demand is currently between 6000 MT and 7000 MT per month, with beef demand around 1000 MT, chicken 3500 MT, and other meats, pork inclusive 2000 MT (USAID, 2010). Prior to the hyperinflationary environment period (2001-2008), meat consumption in Zimbabwe was estimated to range between 8000 MT and 10000 MT per month: 4500 MT of beef, 2500 MT of chicken, and 3000 MT of pork, fish, goat, sheep and other poultry. The proportionate demand for pork and other meats is believed to have fallen by 20% after 2008 compared to before hyperinflationary environment (USAID, 2010). In general assuming a population size of nine million people, Zimbabwe's per capital meat consumption is about 8.7 kgs per year.

Non regulatory constraints to pig production

Stakeholders identified key non regulatory constraints such as poor breeding stock, electricity gap, abattoir fees, skills gap, shortage of abattoir facilities, low production capacity, low yield levels, finance and low demand for pork as serious issues affecting the performance of pig industry in Zimbabwe in order of decreasing importance (Figure 5).

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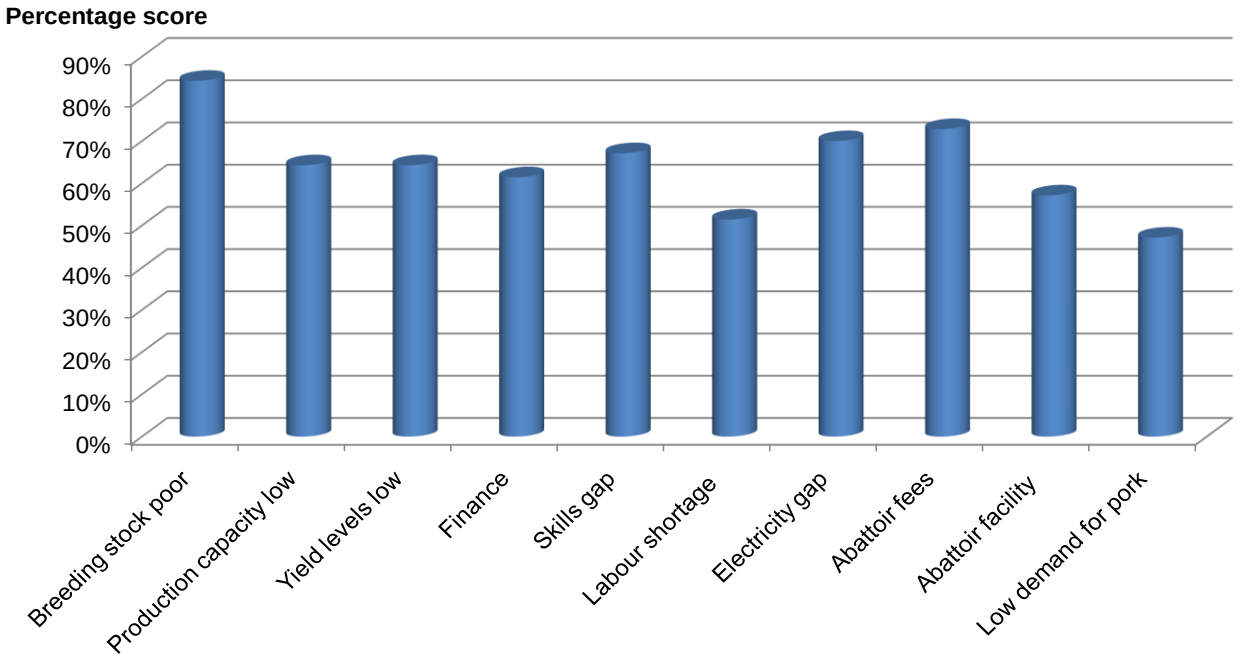

Figure 5. Non regulatory constrains in pig industry value chain

DISCUSSION

The results from this study show that there are a number of non-regulatory constraints that need attention in order to improve the operating environment of pig industry in Zimbabwe. The quality and availability of breeding stock was sited as a serious constraint in pig production in Zimbabwe. There are few and under capacitated breeders resulting in farmers using mainly retained gilts in production systems. The Pig Industry Board research station in Arcturus is responsible for breed testing and certification among other duties such as nutrition, training, extension and development. However the institution is confronted with limited financial resources to the extent that it cannot effectively deliver its services. Over the years, there has been outflow of breeders from the industry following the land reform programme that have seen a number of them losing their farms and the viability problems experienced during the first decade of the 21st century. Currently there is only one breeder producing breeding stock for farmers but without testing and certification by PIB as the parastatal is struggling with resources limitations. Plans to expand breeding capacity at PIB by 2008 have not been successfully completed due to resource constraints and the Foot and Mouth Disease outbreak in South Africa where grand parent stock were to be imported from were hampered the importation of good quality breeds from Topigs. Without an improvement in the quality of breeding stock, the industry will lag behind in terms of productivity. There is a need for stakeholders in the pig industry to invest in improved breeds for sustainable production in Zimbabwe.

According to informed sources, the electricity sector in Zimbabwe is characterised by a demand of 2 100 megawatts against a domestic capacity of only 1 130 megawatts. This creates a deficit gap. Half of this deficit of 970 megawatts could be met domestically if non-functional thermal power stations in the country could be returned to service. As it stands, electricity is has to be imported from Mozambique, South Africa and DRC, but financial constraints do not allow for imports to fill the gap completely. The supply of electricity is costly and erratic in some areas while there is no supply in remote areas as a result of shortages. Some farmers will need up to 4500 litres of diesel per week to make up for ZESA shortfalls (energy needed for pumping water, heating, milling the feed, refrigeration in abattoirs and lighting). Electricity charges sometimes not reflective on consumption, too high and not justifiable. Zimbabwe has the highest charges of electricity in the region. There is a need for stakeholders to consider alternative, reliable and cheaper sources of electricity such as sola and small localized power stations to mitigate against this crisis.

According to specification on health and safety standards, slaughter of animal for commercial market is supposed to be in registered abattoirs under veterinary and health inspectors. This condition is necessary to ensure that the necessary health and safety standards are observed for quality and safe products for international and local markets. Commercial farmers are thus mandated to take their livestock to these registered abattoirs for slaughter. The abattoir and slaughter fees at 15-20c per kilograms were noted as too high thus eroding farmer margins and in some cases discouraging farmers from using the abattoirs, slaughtering under informal unregistered facilities that can compromise health and safety standards. Further to this issue, shortage of abattoir facilities especially in remote areas where there are no registered slaughter facilities resulting in many resorting to slaughtering under unregistered facilities.

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The issue of skills gap was also noted as a serious challenge, following the land reform programme in Zimbabwe. In the former agricultural system, over 40% of agricultural land was being utilized by experienced and trained commercialized farmers who were producing mainly for the market. The new occupants of over 90% of the farming community now comprised mainly non-experienced, semi-commercial farmers who are not so market-oriented. The new farmers need to be trained adequately in technical aspects of agricultural production to ensure that a good farmer is produced. There is a need to avail farmer training facilities at grassroots and provide adequate human resources to train the newly resettled farmer. The skills and management gap implies that there are production and productivity losses accruing to poor management and handling of pigs. Further to this, farmers are not so unionized, with a low turnout by stakeholders in supportive associations such as the Pig Producers Association (PPA) and the Livestock and Meat Advisory Council (LMAC) in the value chain. Lack of awareness was cited as the cause of such a situation by farmers. As a result of the non participation in unions, stakeholders are not benefiting from various benefits such as collective action, information sharing and facilitation in required services.

The availability and cost of stockfeeds was noted as an important challenge attributable to low production capacity of maize and soybeans in the local market, GMO restrictions and poor yield levels of maize and soybeans in the country. This has contributed to mushrooming of informal and unreliable stock feed industry that is causing a lot of harm to the sector, there is thus a need to invest in productivity increases at farm level, capacity utilization to ensure availability of stock feed raw materials.

The liquidity crisis currently experienced in Zimbabwe has resulted in unavailability of appropriate and cheap credit for farmers. Pig production is a medium to long term investment requiring credit facilities of the same nature. Currently only short term credit suitable for short term (one season) agricultural activities is available in the market. Furthermore, the cost of credit is not favourable to borrowers in Zimbabwe with interest rates ranging from 15%-30% per annum. This situation is resulting in farmers and other players experiencing serious limitations in infrastructure development, acquisition of breeding stock, staff housing, stock feeds and working capital. Further to this the land tenure system currently in place cannot be used as collateral resulting in problems in credit worthiness.

Finally, the low demand for pork in the local market means that if external markets cannot be secure, production levels has to be kept minimal with industry stakeholders compromising on the advantages of economies of scale. As indicated in the background information, pork is a weakly preferred protein choice, way low below beef and chicken. There is a need to establish why the demand for pork is low and how this demand can be stimulated.

CONCLUSIONS

This paper will conclude by indicating that there is a need for a serious review of the operating environment of farmers in order to ensure the smooth running of business in the pig industry in Zimbabwe given the volume of internal and external non regulatory challenges identified by stakeholders in the pig value chain. It is recommended that further detailed research and inquiry be made around the various issues identified to provide hard evidence on the impact of such operating environment on the performance of the industry. With this evidence, stakeholders will gain more understanding of the need to create a favorable operating environment that will see growth and development in the pig industry.

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EFFECT OF HERBAL SUPPLEMENT ON GROWTH RESPONSE AND FAECAL EGG COUNTS OF COCKERELS

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ABSTRACT: *This study was carried out on 180 day-old cockerels to determine their growth response and faecal egg counts to herbal supplement administration. The birds were brooded and allotted to four treatment groups of 45 birds with three replicates of 15 birds each. The experimental treatment was based on the frequency of administration of the herbal supplement: Control, Weekly, Fortnightly, and every three weeks. Data on growth response and microbial counts were taken. Data obtained were subjected to One-way Analysis of Variance in a Completely Randomised Design. Herbal supplement had significant (P<0.05) effect on the bacteria and oocyst count of cockerels. Bacteria count was highest in the control treatment, while values were significantly similar in cockerels administered with herbal supplement. Oocsyt count was significantly (P<0.05) influenced with highest values obtained in control with lowest values statistically similar in treatment 2, 3 and 4 respectively. The effect of herbal supplement on the growth response of cockerels revealed that most parameters were not significantly (P>0.05) influenced by herbal supplement except Feed: Gain and average weight gain. The best Feed: Gain value and average weight gain was obtained in birds administered the herbal supplement weekly (treatment 2). Conclusively, herbal supplement (extracts) can serve and be used as antibiotic alternatives in poultry for better performance and utilization of feed in terms of feed: gain and weight gain particularly to control the growth of harmful bacteria.*

Key words: *Herbal Supplement, Growth Response, Faecal Egg Count, Bacteria Count, Oocsyt Count.*

ORIGINAL ARTICLE

INTRODUCTION

Antibiotics have been used for more than half a century in poultry feed for improving performance, reducing some pathogenic microorganisms and increasing some useful microorganisms in intestinal tract of these birds (Gibson and Fuller, 2000). The use of herbal feed supplements for poultry is popular worldwide. Herbal preparations composed of single or multiple plant ingredients that are used in poultry for various indications (Waghmare et al., 2006; Ramnath et al., 2008). Many of the herbal supplements are based on the earlier compilations of various traditional medicine systems and are used for medicinal and non medicinal purposes (Okitoi et al., 2007).

One alternative to antimicrobial feed additives is essential oils derived from herbs and spices. Today, this practice is receiving much attention particularly in broiler chickens (Alçiçek et al., 2003, 2004; García et al., 2007) and laying hens (Çabuk et al., 2006). Herbal essential oils assist in colonization of the beneficial microbial population within the gastrointestinal tract to more balanced levels (Jang et al., 2007). Besides their antimicrobial properties (Ultee et al., 2002), they also exhibit antioxidant (Basmaciolu et al., 2004), antifungal (Shin and Lim, 2004), digestion-stimulating, and enzymatic (Jamroz et al., 2003, 2005; Hernandez et al., 2004) activities.

The benefits of essential oils from herbs and species in poultry diets have been recently demonstrated, not only in terms of improving performance traits but also in inhibiting pathogenic bacteria and reducing residue hazard of meat and egg products (Hertrampf, 2001). These nutrient-sparing and health-promoting effects are most likely attributable to the effects of essential oils within the gastrointestinal track on improving the balance of gut microflora and improving nutrient digestion and absorption (Jamroz et al., 2005).

However, experimental studies indicated that essential oils, either individually or in specific blends, were able to produce benefits comparable to traditional growth promoters including antibiotic, organic acid, prebiotic, and probiotic in maintaining general health status and performance of broilers (Alçiçek et al., 2003; Zhang et al., 2005) and laying hens (Çabuk et al., 2006). In comparison with the vast number of research papers published on the essential oil mixture (EOM) and plant extract supplementation to broiler diets in the past decade (Alçiçek et al., 2004; Hernandez et al., 2004; Jamroz et al., 2005), there is relatively little published data on laying hens (Ma et al.,

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2005; Çabuk et al., 2006) and broiler breeders (Ather, 2000), which demonstrated antioxidant, immunostimulator, and performance enhancer aspects.

The prevention of diseases and enhancement of growth, FI and feed efficiency are critical factors in modern broiler production. With the removal of antibiotic and growth promoters from poultry diets in different areas of the world, it is of interest to investigate potential alternatives to maintain good growth performance and good intestinal microbial populations, particularly to control the growth of harmful bacteria. Therefore, study was carried to determine the effect of herbal supplements on growth response and microbial counts of cockerels.

MATERIALS AND METHODS

Experimental site

The research work was carried out at the poultry unit of Teaching and Research Farm Directorate (TREFAD), Federal University of Agriculture Abeokuta (FUNAAB), Ogun state, Nigeria. Located on latitude7° 15'N, longitude 3° 26' E and its 76m above sea level (Google Earth, 2010). The research site is located in the derived savannah zone of south-west Nigeria with relative humidity in the rainy season (late March - October) and dry season (November – early March) ranged between 63 - 96% and 55 – 84% respectively. It has a mean annual precipitation of 1,037mm and with a mean annual temperature of 34.7°C (Google Earth, 2012).

Experimental birds and management

A total of 180 day-old cockerels (Oba's black strain) were obtained from Obasanjo Farms Holdings, Nigeria, for the study. The birds were floor brooded for the first week and were raised on deep litter system from 0-8 weeks (chicks phase). Feed and water were supplied *ad libitum*.

Experimental treatment

Superliv®, a liquid herbal mixture produced by Ayurvet India and marketed in Nigeria by Animal Care Konsult was applied in water at the recommended dosage of 5ml/100 birds/day (chick's stage). Each 10ml of the herbal supplements contains (in mg): *Achyrantes aspera*- 192.77; *Aphanamixis polystachya*-120.48; *Andrographis paniculata* 192.77; *Azadirachta indica*- 192.77; *Boerhavia diffusa*-216.87; *Citrullus colocynthis*-120.48; *Convolvulus alsinoides*- 48.19; *Eclipta alba*- 192.77; *Fumaria indica*- 72.29; *Ichnocarpus frutescens*- 144.58; *Phyllanthus niruri*- 192.77; *Phyllanthus emblica*- 90.36; *Picrorrhiza kurroa*- 48.19; *Solanum nigrum* -192.77; *Sida cordifolia* -120.48; *Tephrosia purpurea*- 72.29; *Terminalia arjuna*- 120.48; *Terminalia chebula*- 144.58; *Tinospora cordifolia*- 24.10; Aqeous base q.s to – 10.00ml.

The experimental treatments was based on the frequency of administration of the herbal supplement viz Control (treatment 1), Weekly (treatment 2), Fortnightly (treatment 3), every three weeks (treatment 4), as illustrated in the figure 1.

Table 1 - Active ingredients of the herbal supplement and their percentage level of composition

Serial Number	Active ingredient (Chemical structural name)	% Composition
1	1,2,4, Triazolo (1,5-a) pyrimidine	83.39
2	Tricyclo[4.4.0.0(3,9)]decan-4-ol Stereoisomer	2.99
3	1-Aminopyrene	2.6
4	Tricyclo(4.4.0.0(3,9))decan-4-ol,stereoisomer	1.63
5	4-Acetyl-6-methoxy-2(1H) quinolinone	1.36
6	Lanosta-8,2 4-dien-3-ol,acetate	1.31
7	24-Noroleana-4(23),12 diene	1.22
8	Tricyclo(5.2.1.0(2,6) decan-3-one	0.96
9	6-oxabicyclo(3.1.0)hexane-3-carbonitrile	0.93
10	4-n-Butylthiane, S,S-dioxide	0.88
11	Tetrazole	0.45
12	6-oxabicyclo(3.1.0)hexane-3-carbonitrile	0.37
13	Ethanone	0.34
14	1,3-Diphenyl-2-hydroxy-4-ethoxycarbonyl-4H-pyridazino(6,1-a) isoquinoline	0.26
15	Trans-1,4-cyclohexanedicarbonitril 4H-Thiopyran-4-one	0.25
16	Exo-Norbornyl alcohol	0.24
17	Trans-1,4-cyclohexanedicarbonitril	0.20
18	Cyclohexane	0.19
19	Cyclopentane	0.18
20	Acrolein	0.15
21	1-(4-Amino-furazan-3-yl)-5-methyl-1H-(triazole-4-carboxylic acid amide	0.10

Experimental design

The birds were randomly allotted to the four treatments of 90 chicks each and further divided into three replicates of 30 chicks each. Each replicate was housed in a cubicle measuring 2 x 3 m^2 in an open sided poultry house.

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Experimental diets

Chicks mash containing 18.71% CP and 10.32MJ/Kg was supplied in this trial. The feed formulation is presented in Table 2.

Figure 1 - Weekly administration of treatments (herbal supplement) to experimental birds

Weeks	Treatment 1	Treatment 2	Treatment3	Treatment4
1	—	⌞	⌞	⌞
2	—	⌞	—	—
3	—	⌞	⌞	—
4	—	⌞	—	⌞
5	—	⌞	⌞	—
6	—	⌞	—	—
7	—	⌞	⌞	⌞

Key: — : not given herbal supplement. ⌞ : herbal supplement given.

Table 2 - Diet Composition (%) for chicks' phase (0 – 8wks)

Ingredients	Chick starter
Maize	40.00
Fish meal	2.00
Soybean meal	18.00
Palm kernel cake	10.00
Wheat offal	25.00
Bone meal	2.00
Oyster shell	2.00
Lysine	0.25
Methionine	0.25
vit./min. premix[1]	0.25
Salt	0.25
Total	100.00
Determined analysis (%)	
Crude protein	18.71
Ether Extract	5.09
Crude fibre	4.56
Ash	3.58
Calcium	1.62
Phosphorus	0.93
Lysine	0.73
Methionine	0.28
Energy (MJ/Kg)	10.32

[1]Vit./Min. Premix contains B_1 1g; B_2 6g; B_{12} 0.02g; K_3 3g; E, 30g; biotin, 0.05g; folic acid, 1.5g; choline chloride, 250g; nicotinic acid, 30g; Ca-Pantothenate, 15g; Co, 0.4g; Cu, 8g; Fe, 32g; I, 0.8g; Zn, 40g; Mn, 64g; Se, 0.16g, BHT, 5g.

Data Collection

The following data were collected over the 56-day experimental period;

Performance Characteristics: The daily feed intake and the weekly weight gain was monitored and recorded. Records of daily mortality were also monitored in all phases of the experiment. Feed conversion ratio was computed on weekly basis in all the phases of the study. Protein and energy intake was also determined. The weight gain was determined by weighing birds in each replicate at the beginning of the experiment and subsequent weighing was done on weekly basis, afterwards, the difference in the body weights of two consecutive weeks for each replicate was recorded, thus; Weight Gain = Final Weight-Initial weight (g/bird/day); Average Weight Gain = Final weight- Initial weight (g/bird/day); Feed intake = Feed given-Feed left (g/bird/day); Feed : Gain = Amount of Feed Consumed/Weight Gain

Collection of faeces from experimental birds for bacterial count: At day old, fourth and eighth week of experiment, faecal samples was aseptically collected from the experimental birds with sterile swab sticks from three birds per replicate.

1g of faeces from the experimental bird was suspended in 9mls of sterile normal saline and serially diluted from test tube 1 to test tube 8, then discard 1ml from test tube 8.

MacCunkey agar medium was prepared by suspending 47g in 1 litre of distilled water. This was brought to boil to dissolve completely and then sterilized by autoclaving at 121^{o}C for 15minutes. After cooling to about 55^{o}C, it was poured into Petri-dish in which 1ml of serially diluted faecal suspension in sterile normal saline was dispensed. The inoculated plate was then incubated at 37^{o}C for 24hrs.

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The colonies on the plate were counted using a colony counter. The bacterial count was carried out at the microbiology laboratory of the college of veterinary medicine, University of Agriculture, Abeokuta.

Oocyst count: The method used for the oocyst count, known as McMaster method and it was as follows: 1- Weigh 3.0g of faeces or, if faeces are diarrhoeic, 3 teaspoonfuls; 2- Break up thoroughly in 42ml of water in a plastic container. This can be done using a homogenizer if available or in a stoppered bottle containing glass beads; 3- Pour through a fine mesh sieve (aperture 205μm. or 100 to 1 inch); 4- Collect filtrate, agitate and fill a 15ml test tube; 5- Centrifuge at 2000 rpm for 2 minutes; 6- Pour off supernatant, agitate sediment and fill tube to previous level with flotation solution; 7- Invert tube six times and remove fluid with pipette to fill both chambers and of McMaster slide. Leave no fluid in the pipette or else pipette rapidly, since the eggs will rise quickly in the flotation fluid; 8- Examine one chamber and multiply number of eggs or larvae under one etched area by 100, or two chambers and multiply by 50, to arrive at the number of eggs per gram of faeces (epg):

If 3g of faeces are dissolved in 42ml
Total volume is 45ml
Therefore 1g 15ml
The volume under etched area is 0.15ml
Therefore the number of eggs is multiplied by 100
If two chambers are examined, multiply by 50 (Urquhart et al., 1997).

The oocsyt count was carried out at the Parasitological laboratory of the College of Veterinary Medicine, Federal University of Agriculture, Abeokuta.

Statistical analysis

Data obtained were subjected to one-way analysis of variance in a Completely Randomised Design (CRD). Significant differences between means were separated using Duncan's Multiple Range Test (Duncan, 1955) as contained in SAS (2010).

Experimental model

$Y_{ij} = \mu + T_i + \varepsilon_{ij}$

Y_{ij} = Observed Yield observed value of the level of herbal supplementation, i and the replication, j within the level of the treatment. μ = Overall mean value; Ti = Effect of herbal supplementation; ε_{ij} = Random residual error.

RESULTS

The effect of herbal supplements on the bacteria count (Colony Forming Unit per ml) and oocyst count (Oocyst per Gram) of cockerel is presented in Table 3. Herbal supplement had significant ($P<0.05$) effect on the bacteria and oocyst count of cockerels. Bacteria count was highest in the control treatment, while values were significantly similar in cockerels administered with herbal supplement weekly, Fortnightly (treatment 3) and every three weeks (treatment 4). Oocsyt count was significantly ($P<0.05$) influenced with highest values obtained in control with lowest values statistically similar in treatment 2, 3 and 4 respectively.

The effect of herbal supplement on the growth response of cockerels in Table 4 revealed that most parameters were not significantly ($P>0.05$) influenced by herbal supplement except Feed: Gain and average weight gain. The best Feed: Gain value and average weight gain was obtained in birds administered the herbal supplement weekly (treatment 2). Though there was significant trend in the other parameters, however, there was a slight increase in percentage mortality was observed as the level of herbal administration was adjusted across the row of treatment.

Table 3 - Effect of herbal supplement on bacteria and oocyst count of cockerels

Parameters	Treatment 1	Treatment2	Treatment3	Treatment4	SEM
Bacteria count (cfu/ml)	42.00^{a}	27.33^{b}	23.17^{b}	29.67^{b}	8.20
Oocyst count(opg)	22500.00^{a}	13200.00^{b}	13800.00^{b}	13900.00^{b}	2040.36

$^{a, b}$: Mean values in the same row by factor with different letters (a, b) differ significantly ($P<0.05$); SEM standard error of means

Table 4 - Effect of herbal supplement on the growth performance and percentage mortality rate of cockerels

Parameters	Treatment1	Treatment2	Treatment3	Treatment4
Initial weight (g/bird)	33.75±0.59	36.25±1.77	36.50±1.76	36.58±2.95
Final weight (g/bird)	347.50±3.54	386.31±101.86	342.86±60.61	407.14±10.10
Total feed intake (g/bird)	249.10	239.05	248.37	244.45
Average feed intake (g/bird/day)	31.1±2.37	29.9±7.18	31.05±4.2	30.56±1.90
Average weight gain(g/bird/day)	5.40±0.29^{b}	6.26±1.23^{a}	5.40±0.07^{b}	6.12±0.74^{ab}
Feed : Gain	5.72±0.13^{a}	4.77±0.19^{b}	5.75±0.74^{a}	5.05±0.93^{a}
Mortality (%)	2.50±0.70	2.50±0.71	3.50±2.12	4.50±0.71

$^{a, b, c}$: means on the same row with different superscripts are significantly ($P< 0.05$) different.

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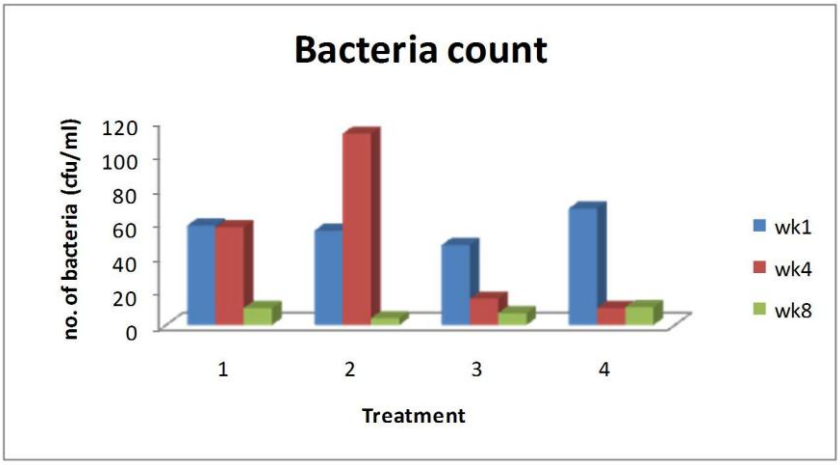

Figure 2 - Effect of herbal supplement on the bacteria count of cockerels

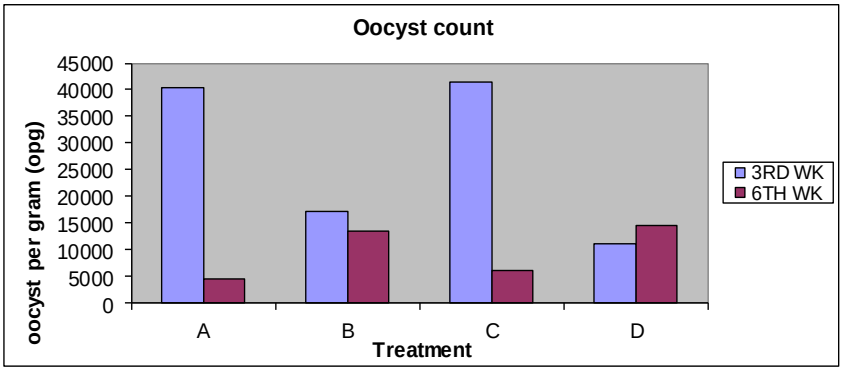

Figure 3 - Effect of herbal supplement on the oocyst count of cockerels

DISCUSSION

Recent scientific articles regarding dietary supplementation with etheric oils and the extracts of some plants indicated encouraging initial results (exhibited growth promotion, nutrient digestibility enhancement, and feed efficacy mechanisms in broiler chickens without affecting bird mortality; Alçiçek et al., 2003, 2004; Hernandez et al., 2004; Jamroz et al., 2005; Çabuk et al., 2006; Garcia et al., 2007). However, published data were not found in the scientific literature regarding the effect of oral herbal supplementation with essential oil on the growth rate of cockerels. The average weight gain of treated group of birds was higher than that obtained in the control group. This affirms the report of Sundermanna and Seshadri (1996) and Singh et al. (2009) who opined that provision of herbal and alternative essential oils as supplement to birds was capable of advancing growth and development of birds. There was similar improvement in weight gains of chicks compared to control groups by administering herbal products which corroborates the report of Narahari (1995) and also asserts report of Khan et al. 2008 who used herbal mixtures containing some of the herbs present in Superliv(R).The total feed consumption of the treatment groups demonstrated an insignificant difference ($P>0.05$) among treatment groups indicating that the supplementation of herbal product do not influence feed intake in birds as depicted in Table 4. The Feed: Gain of treatment 2 was significantly ($P<0.05$) lower than the values obtained and statistically similar in the control group and other treatment groups. This reveals the effectiveness of herbal supplementation in improving the feed utilization which results in improvement in growth and developmental processes. The results of present study are in concomitance with those reported by Narahari (1995) and Prajapati (1997) who stated that the use of herbal growth promoters improved feed conversion ratio and feed efficiency. Herbal supplements and alternatives are known to have stomachic, demulcent and tonic activity in addition to anabolic, adaptogenic, immunostimulant (because of the presence of antioxidants which are effective because they are willing to give up their own electrons to free radicals) and rejuvenative functions in the body.

Oocyst count was significantly influenced by the herbal supplement, a reduced amount of oocyst was recorded in the birds given the herbal supplement than in the control and this was affirmed by Allen et al. (1998) who reported that herbs reduces oocyst yield. However, the least value was obtained in treatment 2 where herbal supplement was given weekly. The results are also in line with Misra et al. (1993), who reported that herbal anticoccidial is effective to reduce feacal oocyst output. The herbal supplement had no significant antimicrobial in-vitro effect on the gram positive and gram negative bacteria at the manufacturers recommended dosage. However at an increased concentration of 60 -100% it had inhibitory growth effect on both the gram positive and negative bacteria The reduction in the counts is an indicant of efficacy of the herbal administration in the reduction of bacteria loads and cross infections in poultry.

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CONCLUSION

In conclusion, the performance of the birds was almost similar in response to herbal supplementation but with better values in treatment 2 for feed:gain and weight gain.. Bacterial and oocsyt count values were lowest in treatment 2. It can be recommended that herbal supplement (extracts) can serve and be used as antibiotic alternatives in poultry for better performance and utilization of feed in terms of feed:gain and weight gain particularly to control the growth of harmful bacteria.

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CHEMICAL COMPOSITION OF OILSEED CAKES AND DEOILED CAKES IN NEPAL

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ABSTRACT: *A study was conducted at Probiotech Industries laboratory from March 2011 to September 2012 A.D to access the qualities of MCs (Mustard cakes), MDOCs (Mustard deoiled cakes) and SDOCs (Soy deoiled cakes) available in different parts of Nepal. Oilseed cakes and deoiled cakes commonly used in livestock and poultry feed in Nepal are MC, MDOC and SDOC. Laboratory findings showed wide variation in chemical composition of these feed ingredients. Mustard Cake contained 91.42% dry matter (DM), 30.12% crude protein (CP), 5.98% crude fibre (CF), 9.29% ether extract (EE), 6.73% total ash (TA) and 1.58% acid insoluble ash (AIA). Mustard deoiled cake varied greatly in DM content ranging from 84.42% to 94.76% with a mean value of 89.84% DM. The mean CP, CF, EE, TA and AIA content in MDOC was 35.65%, 10.28%, 0.69%, 7.61% and 1% respectively. The mean DM content in SDOC was 87.24% but it ranged from 6.23% to 19.26%. Soy deoiled cake contained 44.85% CP, 7.16% CF, 1.03% EE, 7.74% TA and 1.49% AIA on an average though there was marked variation in these parameters. About 32.6% of SDOC samples contained CP above 46%. Since there is quite variation in composition of these oilseed cakes and DOCs, it is suggested that the feed millers and nutritionists of Nepal test each samples before using it for feed formulations.*

Key words: *Mustard Cake, Mustard Deoiled Cake, Soy Deoiled Cake, Nutrient Composition, Quality*

ORIGINAL ARTICLE

INTRODUCTION

Nepal is self-sufficient in poultry products and poultry feeds, but it still relies heavily on raw materials such as grains and protein meals from India (Sharma, 2012). Protein meals such as oilseed cakes and deoiled cakes commonly used in livestock and poultry feed in Nepal are mustard cake (MC), mustard deoiled cake (MDOC) and soy deoiled cake (SDOC). Nepal imports hundred percent soybean seeds from India and there are three solvent extraction plants in Nepal that crush soybean and mustard seeds to produce de-oiled cakes (DOCs) and crude oil for the local market (Sharma, 2012). About 30 to 40 percent of mustard cakes are locally produced from these crushing industries. All the crushing plants in Nepal use solvent extraction method for producing deoiled products. These locally produced oilseed cakes and DOCs are not enough to meet the total daily requirements to make compound feeds for livestock and poultry. So, a large volume of oilseed cakes and DOCs are imported from India (Sharma, 2012)

The oilseed cakes and DOCs available in Nepali market may vary in chemical composition due to varietal differences, varying sources, different processing conditions, adulteration with similar ingredients with little nutritive value, adulteration with sand silica, hulls, etc. Very few crushing industries, suppliers or traders provide reliable information to the farmers and feed industries regarding nutrient composition of these products. Only limited information on composition of oilseed cakes has been documented (Tiwari et al., 2006 and Upreti, 2006). There is therefore an urgent need to access the actual nutritive values of these oilseed cakes and DOCs available in the market.

The aim of the study was to assess the nutritional composition of MCs, MDOCs and SDOCs available in different parts of Nepal.

MATERIALS AND METHODS

Sampling Method

Samples of mustard cakes (31), mustard DOCs (43) and soy DOCs (136) were collected in a polythene bag from crushing plants, traders and suppliers from various parts of Nepal between March 2011 to September 2012

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A.D and sent to Probiotech Industries Pvt. Ltd. Birjung laboratory for analysis. The samples were ground and measured in a small cuvette using MPA-FT-Near Infrared Reflectance Spectrometer (NIRS) in the 12,500-4,500 nm wavelength range to determine moisture contents, dry matter (DM), crude protein (CP), ether extract (EE), crude fibre (CF), total ash (TA), nitrogen free extract (NFE) and sand silica (SS) contents. Calibration databases used in NIRS included enough samples from all over Nepal to cover most of the possible spectral variability encountered during routine analysis.

Statistical Analysis

The data generated through NIRS were compiled using Microsoft Excel 2007 and analysis of these data was carried out by using descriptive statistics tool available in MS Excel 2007.

RESULTS AND DISCUSSION

The chemical composition of MC, MDOC and SDOC are presented in Table 1. There were wide variation in nutrient contents of MC, MDOC and SDOC. Crude protein content in mustard cake was more and CF content was almost half than that reported by Tiwari et al. (2006). He again reported 27.48 CP%, 91.88 DM%, 8.72 TA% and 11.60 CF% in mustard cake. Oil content in mustard cake was below 10% whereas acid insoluble ash as high as 3.23% was recorded with a mean value above 1.5%.

Table 1 - Chemical composition of mustard cake and deoiled cakes (% as fed basis)

Composition		Mustard Cake	Mustard DOC	Soy DOC
Number of Samples		31	43	136
DM	Minimum	90.03	84.42	80.74
	Maximum	93.46	94.76	93.77
	Mean	91.42	89.84	87.24
	SE	0.16	0.30	0.18
CP	Minimum	27.32	33.54	39.07
	Maximum	34.31	36.97	48.37
	Mean	30.12	35.65	44.85
	SE	0.28	0.14	0.18
CF	Minimum	4.40	9.68	4.29
	Maximum	7.85	11.55	11.41
	Mean	5.98	10.28	7.16
	SE	0.16	0.15	0.10
EE	Minimum	8.12	0.30	0.07
	Maximum	11.20	0.99	3.58
	Mean	9.29	0.69	1.03
	SE	0.18	0.02	0.03
TA	Minimum	5.79	6.48	4.69
	Maximum	8.37	9.63	11.56
	Mean	6.73	7.61	7.74
	SE	0.10	0.12	0.09
NFE	Minimum	34.03	30.21	21.08
	Maximum	40.52	38.35	31.80
	Mean	37.39	33.68	26.34
	SE	0.30	0.57	0.19
AIA (Sand/Silica)	Minimum	0.16	0.40	0.24
	Maximum	3.23	1.93	4.34
	Mean	1.58	1.00	1.49
	SE	0.15	0.06	0.07

Note: DM- dry matter, CP- crude protein, CF- crude fibre, EE- ether extract, TA- total ash, NFE- nitrogen free extract, AIA- acid insoluble ash, DOC- deoiled cake

Mustard deoiled cake varied greatly in moisture content ranging from 5.24% to 15.58%. The mean CP content in MDOC was 35.65% and oil content was recorded less than 1% in all the samples. Mean AIA in MDOC was 1% and the maximum value recorded was below 2%.

There was wide variation in nutrient content of SDOC. Moisture content ranged from 6.23% to 19.26%. However, only 4.35% of the samples contained moisture above 16% and 26% of the samples contained moisture above 14%. Below 12% moisture content was recorded in 24.63% of the samples. Recommended moisture level in raw materials is usually below 10% or 12%. Similarly, 32.6% of the samples contained CP above 46% and CP was found in the range of 44 to 46% in 34% of the samples. However, only 34% of the samples contained CP equal to or more than the value given by NRC, (1994) of 44% for solvent extracted SDOCs with hulls. Less than 44% CP was found in 33.4% of the samples.

The mean crude fibre content in SDOC was found to be 7.16% which is higher than that reported by NRC (1994) of 7% in solvent extracted SDOC with hulls. In current findings, 50.37% of the samples contained CF above

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7% and 49.63% of samples contained CF below 7%. Crude fibre below 6% and above 8% was found in 13.33% and 17.03% of the samples respectively. Acid insoluble ash as high as 4.34% was recorded in SDOC. Acid insoluble ash above 1.5% was recorded in 44.45% of the samples and above 2% was found in 19.26% of the samples. Only 28.14% of the samples contained AIA below 1%.

CONCLUSION

There was a wide variation in chemical composition and quality of oilseed cakes and DOCs found in Nepal. Low protein and high crude fibre content in most of the SDOC samples is due the presence of hulls. Since there is quite variation in composition of these oilseed cakes and DOCs, it is suggested that the feed millers and nutritionists of Nepal test each samples before using it for feed formulations.

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PREVALENCE OF ENTERIC BACTERIA ISOLATES FROM AQUARIUM SNAIL (*Ampullaria Spp.*) IN ABIA STATE, NIGERIA

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ABSTRACT: *The freshwater snail (Ampullaria spp.) was evaluated to determine the presence of enteric-pathogens commonly present. The fresh aquarium snail samples were collected from 5 different open markets where they were displayed for sale at Aba and Umuahia. They were processed in the veterinary laboratory of Michael Okpara University of Agriculture Umudike. Different bacterial ranging from salmonella, pseudomonas, Escherichia coli, Proteus, Shigella, Aeromonas, Enterobacter, Klebsiella and Staphylococcus were isolated. The presence of these pathogenic organism showed that Ama-ogbonna and Umungasi market recorded the highest isolate while New market, Ekeakpara and Umuahia central market recorded the least in that order: Escherichia coli, Proteus spp. and Salmonella spp. 30 (25.00%), 26(23.33) and 21(17.50%) recorded the most frequently isolated bacteria while Aeromonas and Staphylococcus spp. recorded the least frequently isolated bacteria 4(3.30%) and 4(3.30%). Due to the fact that these bacteria isolate present health related challenges on consumption of snail, there is the need for snails to be properly washed and cooked before eating.*

ORIGINAL ARTICLE

Key words: *Freshwater Snail, Bacterial Ranging, Cooking, Eating*

INTRODUCTION

The two prominent snail species found abundantly in the world are the edible giant land snail. Achatina achatina and Archachatina marginata (Ajayi et al., 1980). They are found majorly in southern parts of Nigeria, North African coast area, central and South Africa where the weather is most favourable for their proliferation (Herbert et al., 2001). It has been observed that edible snails obtained from swamps in North African coast for consumption in North America carry with them Salmonella species (Andrews et al., 1975). Snail meat is a delicacy in diets of people in Southern Nigeria (Ebenso and Ebenso, 2011). Mollusc has been reported to implication as vehicles for human infections caused by *E. coli.* The *E. coli* have been reported to have long-term survival in manure, soil and pasture (Fenlon et al., 2000). Agbonlahor et al. (1994) while investigating the bacteriology of edible African snails in the town of Ekpoma, Irrua, Iruekpen and Benin city all in Edo State, Nigeria isolated various Enterobacterceae organism thereby creating awareness on the possible public health risks that may result in the consumption of improperly processed snail meat. These organisms may remain in snails not as pathogens but as normal flora, but they can also cause diseases if eaten raw or improperly cooked. According to WHO (2009) estimates 200,000 deaths from food borne pathogens (especially *salmonella* and *E.coli*). There is a very close association between snails and microbes because of their habit filth, sewage and rotten materials. It is therefore not surprising the high level of microbial interaction with water snails, making them to become naturally contaminated with pathogens from filth in which they live (Fagburo et al., 2006). Significant numbers of aquarium snails are sold to the public and if carrying salmonella, these snails may present a public health risk similar to that presented by the aquarium turtles. It was reported that food safety and public health officials attribute a rise in the incidence of food borne illness to changes in demographics and consumer life style that affect the way food is prepared and stored (Collins, 1997). The objective of this study is to evaluate the snails for presence of enteric pathogens and inform the public the health implications associated with consumption of poorly cooked snail meat.

MATERIALS AND METHODS

A total of 120 samples of snails were purchased from 15 retail outlets in Ama-ogbonna market, Umungasi market, Umuahia central market, New market and Ekeakpara market all in Aba and Umuahia, Abia State. The snails were purchase from these markets and kept in a plastic container thereafter the samples were transported

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to the laboratory and processed immediately. The snail samples weighed from 4.5 to 64.2g, with mean weight of 12.2g. The outer shell of the snails were swabbed with sterile cotton wool swab sticks and then washed in running water using a thin brush, afterwards thoroughly washed with sterile water to remove all surface contaminants.

Processing and Culture

The shell was separated from the snail by careful dissection. The mouth and foot parts of the snail was used while the intestine was discarded. They were homogenized using mortal and pistle and diluted using sterile saline added to them. Following seriel dilution it was inoculated on selenite-F, nutrient agar and MarcConkey agar. This was incubated for 24hr at 37^{o}C. Cowan and steels method was used as prescribed Barrow (1993).

Identification and bacteria enumeration

Following incubation, the bacterial colonies obtained where sub-cultured for purity purposes. Various biochemical test including methyl red, mortility, indole, oxidase, catalase, voges-Proskauer, citrate, sugar fermentation and Gram reaction test was carried out for identification. The bacteria count of the snail was obtained by adding 9.0ml of peptone water to 1ml of each snail sample to obtain a 1:10 dilution 10^{-1} to $10^{-10,}$ 0.1ml of the 10^{5} dilution was spread on MacConkey agar and incubated for 24hr at 37^{o}C. The colonies present on the plate was counted and the total viable number was calculated using the dilution factor. Total viable count (cfu/gm)=colonies counted X reciprocal of dilution factor N X 10^{-5}.

RESULTS

Escherichia coli bacterial isolates was highest (30) while *Aeromonas spp* was the lowest (4) as represented above from various snail sample in Aba and Umuahia. The number of positive samples showed that conformed enterococci was 43 while the mean count was $6.8x10^{4}$. The fecal coliforms only presented 12 positive samples. The frequency of isolation of enteropathogenic bacteria shows that *Escherichia coli* has the highest frequency of isolation (25.00%) while *Aeromonas* and *Staphylococcus spp* has the least frequency of isolator (3.30%).

Table 1 - Sample types, range and location of snail

Sample type	Code range	Source
Redbase snail	M_{1-24}	New market
Brown snail	B_{25-49}	Umungasi market
Brown snail	B_{50-74}	Umuahia central market
Dark snail	D_{75-99}	Ekeakpara market
Dark snail	$D_{100-120}$	Ama-ogbonna market

A total of one hundred and twenty snail samples from different market; M – multi colour shell snail; B – Brown shell snail; = Dark shell snail

Table 2 - Bacterial isolates distribution of snail from various locations

ORGANISMS	Ama Ogbonna mkt	New Mkt	Umungasi Mkt	Umuahi Central Mkt	Ekeakpara Mkt
Escherichia coli	5+	3+	8+	4+	10+
Staphylococcus spp	-	2+	+	+	-
Aeromonas spp	-	2+	-	-	2+
Pseudomonas spp	6+	4+	3+	-	2+
Salmonella spp	7+	-	4+	3+	7+
Klebsiella spp	3+	+	4+	-	-
Enterobacter spp	2+	+	-	2+	+
Shigella spp	-	+	2+	-	+
Proteus spp	6+	12+	4+	6+	+

- = None; + = degree of presence; Mkt = market

Table 3 - Total count of most common bacteria in aquarium snails

Assay	No of samples tested	No of samples	Mean (cfu)	Range (cfu)
Fecal coliforms	54	12	$1.4x10^{5}$	$2.8x10^{3}$ – $4.5x10^{5}$
Confirmed enterococi	43	43	$6.8x10^{4}$	$2.6x10^{3}$ – $2.8x10^{5}$
Completed coliforms	54	54	$1.8x10^{8}$	$8.4x10^{3}$ – $3.0x10^{9}$

Table 4 - Frequency of bacteria isolation from snail (Ampullaria spp)

(30) 25.00%	*Escherichia coli*
(4) 3.30%	*Aeromonas spp*
(4) 3.30%	*Staphylococcus spp*
(15) 12.50%	*Pseudomonas spp*
(21) 17.50%	*Salmonella spp*
(6) 5.00%	*Enterobacter spp*
(5) 4.16%	*Shigella spp*
(26) 23.33%	*Proteus spp*
(7) 5.83%	*Klebsiella spp*
Total 100.00%	

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DISCUSSION

The results of this study shows that the bacteria load of enterococci present in snail is reasonably high, the bacteria flora in each of the snail sample range from 5-8 organisms/g. and are capable of causing health risk. An infective dose of up to $10^4 cfu^{-g}$ especially of salmonella is dangerous for humans when consumed via contaminated snail food, this is in agreement (Giaccone et al., 2012). It will be unhealthy for consumers to eat snail meat that is not properly cooked first and dried since it is known that *salmonella spp* survive in dry products this was supported (Urabe et al., 2008).

The study shows that *E. coli* presented the highest volume of enterobacteria organism present in snail. The high occurrence of *E. coli* was supported (Sprosten et al., 2006). These organisms of the family Enterobactericaea are found in the intestinal tracts of humans and animals in the soil and can be pathogenic to man. The results suggest that contamination of snail with fecal material, feeding of decaying matter, fecal contaminations of water, sell in the open market without covering them, poor handing are several factors that contribute to snail being carrier of enterobacteria organism, this was in agreement with (WHO, 2007). The result in Table 3 shows that enterococci count ($P<0.05$) range from $2.60\text{-}2.80x10^{-4} cfu^{-g}$ while the fecal coliform ranged from $2.8\text{-}4.5x10^4$ cfu^{-g}. These volumes are above the recommended $10^{-2} cfu^{-g}$ limits of HPA, (2009). The association of *pseudomonas spp* with aquarium snails may also have public health significance and this fact indicate that aquarium could be another source of nosocomial infections. These pathogenic organisms isolated from the five market visited have serious health implication to man. The risk of food borne illness is on the increase and the need to provide effective way of managing this condition is of immerse significance. This is supported by FDA (2011) which reported that heat application (90^oC for 10 minutes) is an effective way of eliminating pathogens from food.

CONCLUSION

Several pathogenic organisms were isolated from water snail, the methods presently being used for commercial production of water snails sold to the public need to be thoroughly examined to reduce the microbial load accumulated by the snails. Further studies need to be carried out to determine the best way necessary to eliminate these pathogenic microorganisms in snails.

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OBSERVATIONS CONCERNING HAEMATOLOGICAL PROFILE AND CERTAIN BIOCHEMICAL IN SUDANESE DESERT GOAT

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ABSTRACT: *Blood samples were collected from 30 (15 male and female) apparently healthy Sudanese desert goats ranging under the same field conditions from North Kordofan State, Sudan. This study had analyzed the hematological profile of goats and the influence of sex on the hematological and some biochemical values. On the Erythrocyte parameters sex had any influence: The mean of red blood cell (RBCs) {(12.10 ± 0.53) (×106 /µL) } and the mean corpuscular hemoglobin concentration (MCHC) (35.69 ± 2.94) in males were higher than females {(12.27 ± 0.74) (×106 /µL), 36.45 ± 2.49)%}, while the hemoglobin (HB), packed cell volume (PCV), mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH), were high in males than females. In leukocytary series: Total W.B.Cs, Monocytes (%) and Neutrophils (%) were higher in females, while Lymphocytes (%) and Eosinophils (%) high in males. Neutrophils (%) average was smaller than normal (23.67 ± 1.96) % and mean of Monocytes (%) was higher, which may be interpreted as a potential infection or hermetic aggression. In biochemical: Glucose was elevated in females goats, while total protein and urea higher in male animals. Ever Since the animals are apparently healthy, any value may be regarded as possible infection or metabolic and nutritional disorder.*

ORIGINAL ARTICLE

Key words: *Haematological Profile, Biochemical Indices, Blood, Desert Goat.*

INTRODUCTION

In Sudan goats are estimated to be about 42.5 million head which is a very large population compared to other African countries (Yousif and Fadl El-Moula, 2006). This population composed of four major local breeds, Nubian, Desert, Nilotic and the Dwarf, distributed throughout the country (Wilson, 1991). The Desert goat is characterized by the long drooping (lop) ears, as in the Zaraibi of Egypt and Nubian of the Sudan. Similar types of goats are heavily represented in the atlas region of north Africa, western Mediterranean region as well as in Syria, Iraq and India. At present their major breeding area is considered to be in India. However, no traces of this type of goats (Zaraibi, Damascus, Jamnapari, etc.) have been found in the Indus valley or west of it. The ancestral stock might have evolved either in India subsequent to the Indus valley civilization, or west of India, possibly Iran, from where it spread to Syria and Egypt in the west. It also appears from the occasional occurrence of homonymous screw-like horns in Zaraibi and Jamnapari bucks, that this goat type was evolved from the screw-horned goats common throughout the ancient world from India in the east to Libya in the west. The so-called Nubian goat probably does not in fact originate from Nubia (the area of southern Egypt and northern Sudan), and certainly not from Ethiopia, and the convex profile is a common characteristic of goats in the Middle East and India (General breed information from Mason, 1984).

Despite the social and economic values of goats as source of meat, milk and hides, with a great production potential, the research effected on goats in our country were neglected for long time. The goats revaluation depends on various factors, including the great prevalence of diseases, poor management practices and extensive production systems. The diseases action is the most aggressive on animals. From this point view, clinic and Para clinic exams are essential to sanitary strategies (control, prevention or treatment). The hematological tests served as information base for animal health assistance. It has been reported that regardless of age, sex and climate, goats reared under traditional husbandry system have low hematological values compared to those reared under modern husbandry (Coles, 1980; Schalm et al, 1975). Low nutritional grassland pasture, stress, parturition and climatic factors greatly alter the blood values of goats (Anosa and Isoun, 1978, Radostits et al 1994). Blood is an important and reliable medium for assessing the health status of individual animals (Oduye, 1976). Determination of the main haematological and biochemical parameters of animals helps veterinarians to confirm clinical

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diagnoses, estimate the severity of cases, administer appropriate treatment, and evaluate outcomes (Roubies et al., 2006). To interpret data correctly, the results obtained in the laboratory must be compared with values corresponding to the reference values of clinically healthy animals, which serve as a guide to the clinician in evaluating parameters (Yokus, et al., 2006). It is unequivocal that a large number of factors, such as species status, breed, sex, age, nutrition, illness, and seasonal variations, can affect the pattern of these values (Swanson, et al., 2004; Nazifi, et al., 2003). The significance of determining haematological and biochemical indices in animals is well documented (Oduye and Adadevoh, 1976; Obi and Anosa, 1980), and changes in these parameters have been studied in cattle (Ghergariu, et al., 1984), sheep (Kaushish, and Arora, 1977), and goats (Tschuor, 2008; Tibbo, 2008). There is great variation in the haematological and biochemical parameters observed between goat breeds (Azab and Abdel-maksoud, 1999; Tambuwal et al., 2002; Daramola, et al., 2005).

These differences have underscored the need to establish an appropriate physiological baseline values for various breeds of livestock including the desert goat which could be used in the realistic evaluation of the management practice, nutrition and diagnosis of health condition, furthermore, this paper focused on the hematological and some biochemical values of apparently healthy Desert goats as influenced by sex and attempt has been made to provides references ranges for these variables of Sudanese Desert goats.

MATERIALS AND METHODS

Survey background

This study was carried out in North Kordofan State, Sudan (Latitudes 13^0 and 29^0 North, Longitudes 21^0 and 33^0 East). It was conducted in July 2011 ranging under the same field conditions (at El Obied Animal market). Blood samples were collected from thirty Desert goats (15 male and female) apparently healthy goats of adult age. The goats herds were naturally ranging and had no feed supplementation, water was available ad labium.

Blood analysis

Samples of blood were collected from goats by jugular vein puncture. Five milliliter blood samples were collected from each goat using 5 mL plastic disposable syringes. Tow milliliter of the blood sample were immediately transferred to capped and heparinzed tubes (Medical Disposable Industrial Complex MDIC). These samples were used for the hematological analyses and the determination of plasma glucose concentration. The rest of the samples were allowed to clot for 2h at room temperature, the sera were then separated by centrifugation at 3000 rpm for 15 min and stored frozen at -20C for further analysis. Erythrocytic indices were determined according to the methods described in Schalm's Veterinary Hematology (Jain, 1986). The packed cell volume of erythrocytes was determined by the micro-haematocrit method using a special centrifuge. Haemoglobin concentration was determined by the cyano- methaemoglobin method as described by Van kampen and zijlstra (1961). Mean Corpuscular Hemoglobin (MCH), Mean Corpuscular Hemoglobin Concentration (MCHC) and Mean Corpuscular Volume (MCV) calculated from the following formula (Simon. et al, 2001):

MCV fl (femtoliter) = {PCV % × 10} / {RBCs count (in million /uL)}

MCH pg (picogram) = {Hemoglobin (in gm/dL) × 10} / {RBCs count (in million /uL)}

MCHC (g/dL) ={Hemoglobin (in gm/dL) × 100} / {PCV (in %)}

Differential leukocyte count (DLC) was determined microscopically from a count of 100 leukocytes in thin May-Giemsa stained blood smears (Kelly, 1984). Serum total protein was determined by the Biuret reagent method according to King and Wooton (1965), Plasma glucose level was determined by the enzymatic colorimetric method using a kit (Plasmatec Laboratory at Products Ltd Germany). The concentration of serum urea was determined by the colorimetric method according to Harold (1988).

Statistical analysis

The data obtained from the blood samples collected from the goats have been subjected to standard methods of statistical analysis was performed using windows based SPSS (Version 10.0, 1999). The analysis of student t-test was used to evaluate the effects of sex on haematological and biochemical parameters in Sudanese desert goats.

RESULTS AND DISCUSTION

The hematological and biochemical values obtained in this study in Tables 1-3 in both sexes in goats were in reference range and comparable to those previously reported concerning the influence of sex and values of Sudanese goats (Holman and Dew, 1965; Schalm et al, 1975; Oduye, 1976; Azab and Abdel-maksoud, 1999; Egbe-Nwiyi et al., 2000; Tibbo et al., 2004; Daramola, et al., 2005; Kamal, 2008; Tschuor, 2008; Waziri et al., 2010 Addass et al., 2010).

Erythrocyte indices of Sudanese desert goats

Mean Erythrocyte values (± Std) of adult male and female goats are presented in Table 1 and Figure 1 indicating the influence of Sex along with Mean values of all the 30 animals. In erythrocytes indices: Except R.B.Cs count and MCHC all Erythrocyte indices were slightly higher in males than females animals. The R.B.Cs mean on male and female was (12.10 ± 0.53) and (12.27 ± 0.74), respectively. The coefficients of variance permits the use

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of mean as statistic interpretation. This means are closed to the normal mean of R.B.Cs (8 – 18) (Table 1). In both, males and females the coefficient of variance is less than 30% which revealed that the mean of erytrocytes and erytrocitar constants are representative for this category of goats. The erythrocyte parameters HB, PCV, MCV, MCH and MCHC were analyzed in both sexes. HB mean was (8.47 ± 0.86) g/dl in females and (8.67 ± 0.85) g/dl in males. PCV had the following values: (25.60 ± 1.38)% in males and (23.80 ± 1.41)% in females. MCV, MCHC and MCHC were slightly higher in females compared with males animals. Coefficient of variance did not exceed the limit of 35%, which can be used in statistically interpretation. The RBC values in the ruminants in this study may, among other things, be due to excitement or strenuous exercise during handling (Gartner et al., 1969). This leads to the release of adrenaline and hence spleen contracts and this causes the release of more RBC into circulation. The mean of MCV was (21.52 ± 1.33)% in males and (19..96 ± 1.37)% in females, in MCHC the mean was (36.45 ± 2.49)% in females and (35.69 ± 2.94) in males animals. These values of MCV and MCHC in both sexes had been fluctuated and their values are dependent upon RBC, Hb and PCV values. The fluctuation of this values are represented in figure 1, where we observed the vaguely differences between females and males.

Table 1 - Erythrocyte indices (mean ± Std) of Sudanese desert goats

Parameter	Statistics									
	Sex	N	Mean	Std	SD	Min	Max	Median	CV	Reference values*
R.B.Cs ($\times 10^6$ /µL)	Male	15	12.10	0.53	2.07	10	18.7	11.8	17%	8 - 18
	Female	15	12.27	0.74	2.88	10.8	22.3	11.4	23%	
	Overall	30	12.18	0.45	2.47	10.0	22.3	11.55	20%	
HB (g/dL)	Male	15	8.67	0.85	3.31	3	13	10	38%	8 - 12
	Female	15	8.47	0.86	3.34	3	14	10	39%	
	Overall	30	8.57	0.60	3.27	3	14	10	38%	
PCV (%)	Male	15	25.60	1.38	5.34	13	34	24	21%	22 - 38
	Female	15	23.80	1.41	5.47	13	34	24	23%	
	Overall	30	24.70	0.98	5.39	13	35	24	22%	
MCV (fl)	Male	15	21.52	1.33	5.17	15.38	30.48	19.49	24%	16 - 25
	Female	15	19.96	1.37	5.30	10.31	30.09	20	27%	
	Overall	30	20.74	0.95	5.20	10.31	30.48	19.75	25%	
MCH (pg)	Male	15	7.28	0.76	2.92	2.38	11.54	8.20	40%	5.2 - 8
	Female	15	7.04	0.75	2.91	2.63	12.61	7.19	41%	
	Overall	30	7.16	0.52	2.87	2.38	12.61	7.34	40%	
MCHC (g/dl)	Male	15	35.69	2.94	17.09	11.43	75	34.38	48%	30 - 36
	Female	15	36.45	2.94	11.38	14.29	52.38	37.04	32%	
	Overall	30	35.57	2.60	14.27	11.43	75	35.91	40%	

N= Number of animals, Std= Standard error of mean, SD= Standard Deviation, Min= Minimum value, Max= Maximum value and CV= Coefficients of Variance. *Reference values Adapted from Merck Sharp & Dohme Corp., a subsidiary of Merck & Co., Inc. Whitehouse Station, NJ USA.; © 2011, from Duncan J.R. and Prasse K.W., Veterinary Laboratory Medicine, 2nd ed., Iowa State University Press, 1986.

Table 2 - leukocytes indices (mean ± Std) of Sudanese desert goats

Parameter	Statistics									
	Sex	N	Mean	Std	SD	Min	Max	Median	CV	Reference values*
Total W.B.Cs ($\times 10^3$/µL)	Male	15	3.50	0.60	2.31	0.8	8.9	2.8	66%	4 - 13
	Female	15	5.38	1.06	4.11	1.1	19.2	4.9	76%	
	Overall	30	4.44	0.62	3.41	0.8	19.2	3.65	77%	
Lymphocytes (%)	Male	15	61.33	2.16	8.36	47.0	80	60	14%	50 - 70
	Female	15	56.47	2.15	8.31	41	73	56	15%	
	Overall	30	58.90	1.56	8.56	41	80	58.5	15%	
Monocytes (%)	Male	15	7.20	0.94	3.63	1.0	13	6	50%	0 - 4
	Female	15	7.47	1.12	4.32	1.0	18	8	58%	
	Overall	30	7.33	0.72	3.92	1	18	8	53%	
Neutrophils (%)	Male	15	23.67	1.96	7.58	9.0	34	25	32%	30 - 48
	Female	15	27.40	2.27	8.80	9.0	40	30	32%	
	Overall	30	25.53	1.51	8.29	9	40	27.5	32%	
Eosinophils (%)	Male	15	7.93	1.29	4.99	2.0	21	7	63%	1 - 8
	Female	15	7.07	0.81	3.15	1.0	12	8	45%	
	Overall	30	7.50	0.75	4.13	1	21	7	55%	
Basophils (%)	Male	15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0 - 1
	Female	15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Overall	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

N= Number of animals, Std= Standard error of mean, SD= Standard Deviation, Min= Minimum value, Max= Maximum value and CV= Coefficients of Variance. *Reference values Adapted from Merck Sharp & Dohme Corp., a subsidiary of Merck & Co., Inc. Whitehouse Station, NJ USA.; © 2011, from Duncan J.R. and Prasse K.W., Veterinary Laboratory Medicine, 2nd ed., Iowa State University Press, 1986.

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In leucocytes indices

Total W.B.Cs, Monocytes (%) and Neutrophils (%) were faintly higher in females, while Lymphocytes (%) and Eosinophils (%) elevated in males are shown in Table (2) and Figure (2). The total W.B.Cs mean in males and females is between (3.50 ± 0.60) with a minimum of 0.8 and a maximum of 8.9 and (5.38 ± 1.06) with a minimum of 1.1 and a maximum of 19.2, respectively. The male category of goats had faintly lower values than normal (4 - 13) and can be attributed to immune response to different environmental factors and physiological status (Table 2). In leukocytary series: the mean of lymphocytes was (61.33 ± 2.16)% in male and (56.47 ± 2.15)% in females, respecting the normal rapport (50 – 70)%. The Eosinophils are in the same normal limit (1 - 8)% and their means are (7.07 ± 0.81)% for females and (7.93 ± 1.29)% in males. Neutrophils (%) average was smaller than normal (30 - 48)% as follows: (23.67 ± 1.96)% in males and (27.40 ± 2.27)% in females, can be attributed to occurrence of some viral infection or have been long term bone marrow damage as designated of the low neutrophils numbers (neutrophenia). The (7.20 ± 0.94)% value of Monocytes in males and (7.47 ± 1.12)% in females were higher than normal (0 - 4)% in both sexes, this could be due to chronic infections, carcinomas, leukemia (monocytic) or lymphomas. The white blood cells (WBCs) are the soldiers of the body and their high counts may also be due to the increase of the complement in the immune systems of the animals. It may also be attributed to physiological phenomena i.e. excitement or strenuous exercise during handling.

Biochemical parameters in Sudanese Desert goats

Glucose was diminutive higher in females goats, while total protein and urea higher in male animals, Table (3) and Figure (3). The overall value of glucose, total protein and urea were (65. 20 ± 3.24) mg/L, (6.90 ± 0.12) mg/dl and (15.60 ± 0.89) mg/dl, respectively. The coefficients of variance permits the use of mean as statistic interpretation, this means are closed to the normal mean of glucose (80 - 100) mg/L , total protein (6.4 – 7.8) mg/dl and urea(10 - 27) mg/dl.

Table 3 - Some biochemical indices (mean ± Std) of Sudanese desert goats

Parameter	Statistics									
	Sex	N	Mean	Std	SD	Min	Max	Median	CV	Reference values*
Glucose (mg/dl)	Male	15	65.20	3.24	12.54	48	81	63	19%	60 - 100
	Female	15	65.67	2.44	9.44	50	79	66	14%	
	Overall	30	65.43	1.99	10.91	48	81	65.5	17%	
Total protein (g/dl)	Male	15	6.95	0.20	0.76	5.9	8.0	7	11%	6.4 - 7.8
	Female	15	6.85	0.14	0.53	6.0	8.1	6.8	8%	
	Overall	30	6.90	0.12	0.65	5.9	8.1	6.85	9%	
Urea (mg/dl)	Male	15	15.73	1.19	4.60	10.0	26	14	29%	10 - 27
	Female	15	15.47	1.38	5.33	8.0	26	16	34%	
	Overall	30	15.60	0.89	4.9	8	26	14.5	31%	

N= Number of animals, Std= Standard error of mean, SD= Standard Deviation, Min= Minimum value, Max= Maximum value and CV= Coefficients of Variance. * Reference values Adapted from Veterinary Drug Handbook, D.C. Plumb, Iowa State University Press, 1999.

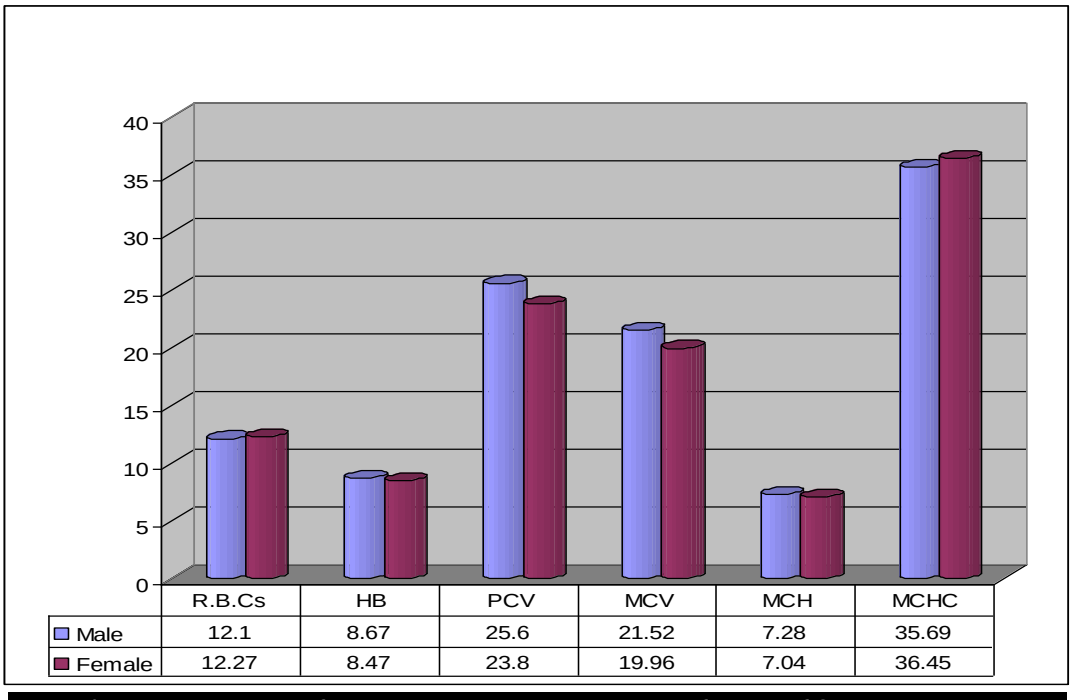

Figure 1 - Representation of erythrocytic indices in male and female of Sudanese desert goat

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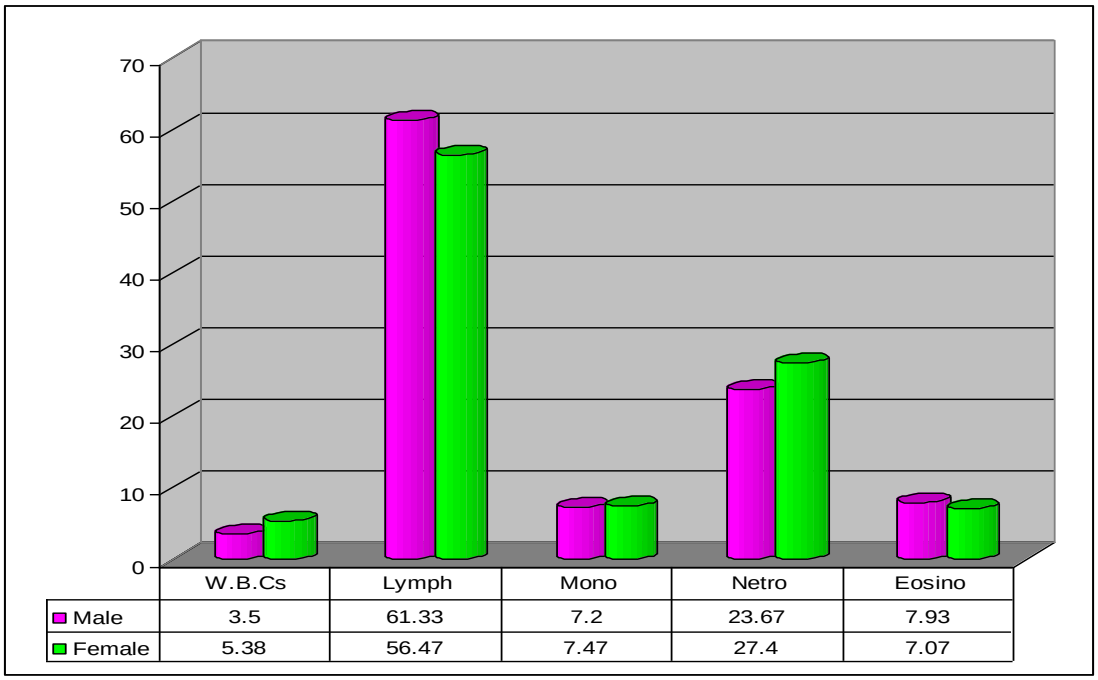
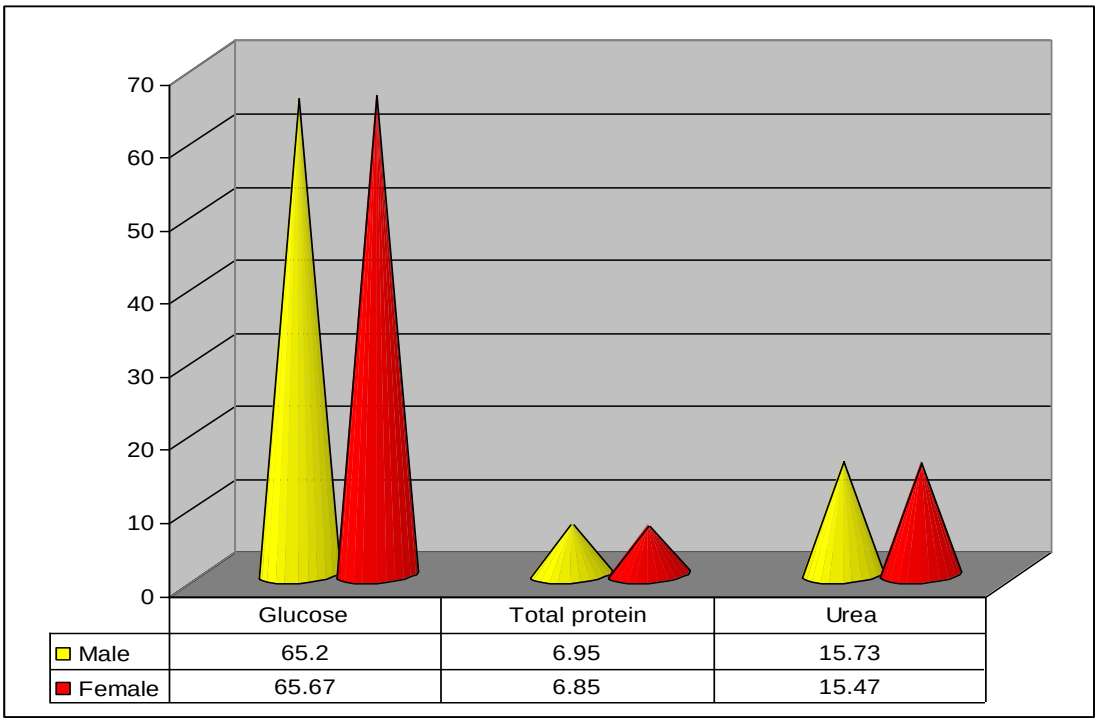


	W.B.Cs	Lymph	Mono	Netro	Eosino
Male	3.5	61.33	7.2	23.67	7.93
Female	5.38	56.47	7.47	27.4	7.07

Figure 2 - Representation of leukocytic indices in male and female of Sudanese desert goat



	Glucose	Total protein	Urea
Male	65.2	6.95	15.73
Female	65.67	6.85	15.47

Figure 3 - Representation of Some biochemical indices in male and female of Sudanese desert goat

CONCLUSIONS

Sex showed relatively influence on the haematological and biochemical values of the goat studied, existing fluctuations in all the hematological and biochemical parameters of both sexes. In this study the MCV and MCHC values in both sexes fluctuated and their values are dependent upon RBC, Hb and PCV values. The low neutrophils ratio in the animals in this study might be attributed to occurrence of some viral infection; the Monocytes values can translate to an infection or hermetic aggression. The fluctuation in various parameters may be undetected minor infections, weather extremities and poor management.

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		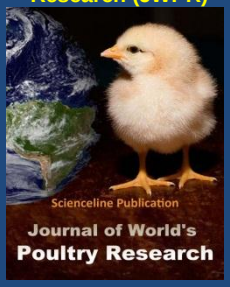	
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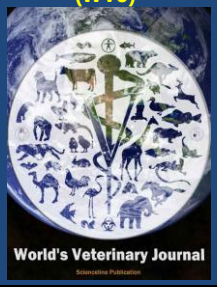		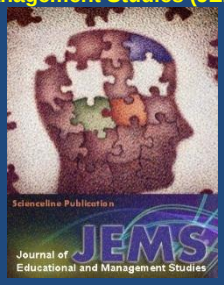	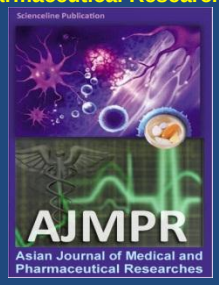
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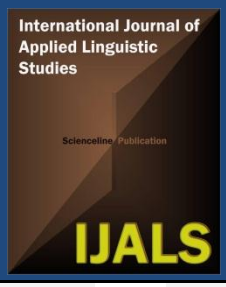	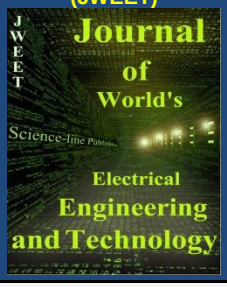		

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