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Fenugreek (*Trigonella foenum-graecum L.*) effect on muscle growth of broiler chicks

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Abstract

The purpose of this research work was to evaluate the aqueous seed extract of *Trigonella foenum-graecum* L. (Fenugreek) on the weight of breast, thigh and leg of broiler chicks. One hundred and sixty, day old male broiler chicks were randomly assigned to four treatments i.e., A, B, C and D. Each treatment was replicated four times with 10 chicks per replicate. Groups B, C and D received the aqueous extract of fenugreek @ 10, 20 and 30 ml/L, respectively while group A served as a control. Chicks were reared in cages in an open sided house. The data showed that weight of breast, thigh and leg were significantly ($P<0.05$) heavier in group C compared to control. It was concluded from this study that *Trigonella foenum-graecum* at the rate of 30 ml/L aqueous extract has a beneficial impact on the growth of these muscle tissues.

Keywords: Broilers, Fenugreek, Breast, Thigh, Leg

Introduction

Feed is a major component, affecting net return from the poultry business, because 80% of the total expenditure in terms of cash is spent on feed purchase (Khan et al., 2010). To ensure more net return and to minimize high expenditure on feed are the main challenges, for which many research strategies have been practiced such as introducing feed supplements and feed additives (Khan et al., 2009). In the past the major growth promoters were antibiotics. However the current research is looking for natural alternative to antibiotics because of their residue and subsequent resistance to bacteria. At present the scientists are working to improve feed efficiency and growth rate of livestock using useful herbs (Khan et al., 2010).

Fenugreek (*Trigonella foenum-graecum L.*) a well known medicinal plant grows in nature and is cultivated in India and Pakistan. It is having properties of lowering blood sugar level, anthelmentic, antibacterial, anti-inflammatory, antipyretic, and antimicrobial (Ahmadiani et al., 2001; Khan et al., 2009). It contains minerals, B.Complex, iron, Phosphates, PABA (Para-Amino Benzoic Acid), vitamins (A, D), lecithin and choline that help to dissolve cholesterol and fatty substances (Dixit et al., 2005). It also contains neurin, biotin, trimethylamine which tends to stimulate the appetite by their action on the nervous system (Michael and Kumawat, 2003). There is limited evidence about whether the inclusion of aqueous extract would have growth promoting effect on live birds. Therefore, in conducting the current experiment, an approach was taken so that the results could have practical application. If the experiment was successful, the use of aqueous extract would be helpful to reduce the feed costs involved in broiler production.

To the best of our knowledge the aqueous solution of fenugreek (*Trigonella foenum-graecum L.*) seeds on the carcass quality has not been reported. The present study was conducted to describe the effect of aqueous extract of fenugreek (*Trigonella foenum-graecum L.*) as a growth promoter supplementation on growth performance of breast, thigh and leg weights which are the major parts of muscles in broilers.

Materials and Methods

One hundred and sixty (160) a-day old male broiler chicks (Hubbard) were purchased from a local hatchery and divided into four treatment groups A, B, C and D, with four replicates of 10 chicks each per group in a completely randomized block design.

Feed and water were given *ad libitum*. Feed and water intake were calculated on daily basis. Control and treated groups received same diet (Table 1). Chicks were reared in cages in an open sided house, provided

Table 1: Ingredients and composition of basal diet (as fed bases)

Ingredients (g/kg of diet)	Starter	Grower	Finisher
Maize, yellow	354.0	329.0	250.0
Soybean meal (480 g CP/Kg)	275.0	205.0	170.0
Sunflower meal 350 g CP/Kg)	110.0	151.0	110.5
Wheat	99.0	130.5	331.0
Wheat bran	-	37.0	-
Meat-bone meal	65.0	55.5	49.5
Vegetable oil	73.9	85.5	73.5
Limestone	13.5	-	-
Mineral-vitamins premix[1]	3.5	3.1	3.5
Sodium chloride	3.1	2.5	2.5
L-lysine	0.4	-	0.1
DL-Methionine	1.6	0.1	1.7
Calculated chemical composition (per Kg of diet)			
ME (MJ)	13.2	13.4	13.4
Crude Protein (g)	231.2	212.0	189.8
Calcium (g)	15.0	9.0	8.0
Available phosphorus (g)	5.0	4.7	3.9
Lysine (g)	12.0	10.0	8.5
Methionine (g)	5.6	4.0	5.2
Methionine + cystine (g)	9.3	7.6	8.4
Sodium chloride (g)	3.4	2.9	2.9

[1]Provides per kg of diet: Mn 80 mg; Zn 60 mg; Fe 60 mg; Iron 5mg; Cu 5 mg; Co 0.2 mg; I 1 mg; Se 0.15 mg; choline chloride 200 mg; vitamin A 12 000 IU; vitamin D3 2 400 IU; vitamin E 50 mg; vitamin K3 4 mg; vitamin B1 3 mg; vitamin B2 6 mg; niacin 25 mg; calcium-d- pantothenate 10 mg; vitamin B6 5 mg; vitamin B12 0.03 mg; d-biotin 0.05 mg; folic acid 1 mg

with feeders, drinkers, electric bulbs and sand was used as bedding material. Strict sanitation practices were applied throughout the experiment. Average temperature at day time was 30±2 and 25±3°C at night.

Fenugreek seeds infusion was prepared according to the method described by Khan et al. (2009). Briefly, collected seeds were dried for 24 h at 37°C in oven. Dried seeds were ground. To prepare 6% aqueous extract, 60g of dried ground seeds were taken in a non-metallic jar and one liter of hot boiled distilled water were poured on it and was kept at room temperature for 5-8h.

Prepared seed extract was mixed with the drinking water of group B, C and D @ 10, 20 and 30 ml/L of drinking water. Group A served as control. The experiment lasted for 35 days. At the end of experiment, randomly selected 20 birds from each group were killed humanely. Internal organs were separated including abdominal fats and neck in such a way that only the solid muscular portion remained. Breast, right thigh and right leg of each bird were weighed on a wing balance on fresh basis. The Data obtained were subjected to statistical analysis using ANOVA. In case of significance difference Duncan Multiple Range Test was applied.

Results and Discussion

Data on feed intake, water intake and weight of breast, thigh and leg are shown in Table 2. Mean feed and water intake was non significant in control and treated groups. The weight of breast, thigh and leg were significantly heavier ($P<0.05$) in group D compared to control.

The results of this experiment show clearly a positive effect of Trigonella foenum-graecum on the weight of the breast, leg and thigh of broiler chicks. Mean feed intake and water consumption were non significant in control and treated groups. It is interesting to note that the beneficial effect of this plant is not due to better feed efficiency, since feed intake was non significant between control and experimental groups. Similarly, the non significant water intake between control and treated groups indicate that the higher weight of breast, leg and thigh are not due to better water consumption and consequently the water accumulation in the organs in question in the treated groups. In this experiment, we obtained better weight in terms of breast, leg and thigh in experimental group having treated with 30ml/L of aqueous extract of Fenugreek. Our findings are similar to Ibrahim et al. (1998) in broilers and Ghazalah and Ibrahim (1996) in ducks, who reported that adding

Table 2: Mean feed consumption, water intake, breast weight, thigh weight and leg weight of broilers.

Parameters	Groups			
	A	B	C	D
Feed intake (g)	3204±79	3211±80	3225±105	3178±125
Water intake (ml)	5895±300	5931±133	5829±189	5993±267
Breast weight (g)	259.77±13.44^{c}	265.45±21.33^{c}	289.98±19.72^{b}	315.2±12.65^{a}
Thigh weight (g)	60.76±3.4^{c}	63.11±3.3^{b}	65.12±2.9^{b}	69.55±3.00^{a}
Leg weight (g)	64.12±5.76^{b}	65.34±6.36^{b}	68.44±4.4^{ab}	73.55±3.77^{a}

Values (Mean± SE) with different superscripts in a row differ significantly (P<0.05); A=Control; B= 10ml Fenugreek; C=15 ml Fenugreek; D=20 ml Fenugreek solution

fenugreek to the control diet at a level of 1000g/ton improved live body weight.

The present increase in muscle weight may be due to the antioxidant property of this plant which increases digestive enzymes and decreasing bacterial activities and thus result in body weight gain in broiler chicks (Dixit et al., 2005; Khan et al., 2009). After many research studies on animal and human being, Dixit et al. (2005) reported that fenugreek seeds powder improved metabolism. Therefore, there is likelihood that improved metabolism has beneficial impact on weight gain of the studied muscles. Comparative higher weight of breast, leg and thigh in group C is attributed to the nutritive effect of fenugreek (*Trigonella foenum-graecum L.*). Gomez et al. (1998) concluded that the improvement in live body weight in broilers may be due to antibacterial related to flavonoids in fenugreek that led to maintaining normal intestine microflora by competitive exclusion and antagonism, altering metabolism and increased liver and muscle glycogen contents.

In conclusion it can be said that 6% aqueous extract of fenugreek (*Trigonella foenum-graecum L.*) at the rate of 30 ml/L of drinking water produced positive results in broiler chicks. It may also decrease the market age of broilers and reduce their rearing cost.

References

Ahmadiani, A., Javan, M., Semnanian, M.A., Barat, E and Kamalinejad, M. 2001. Anti-inflammatory and antipyretic effects of *Trigonella foenum-graecum* leave extracts in rats. *Journal of Ethnopharmacology*, 75: 283-286.

Dixit, P., Ghaskadbi, S., Mohan, H. and Devasagayam, T.P. 2005. Antioxidant properties of germinated fenugreek seeds. *Phytotherapy Research*, 19: 977-983.

Ghazalah, A.A. and Ibrahim, A.A. 1996. The possibility of using some edible and aromatic oils in the nutrition of Muscovi ducks. *Egyptian Poultry Science*, 16: 305-328.

Gomez, M.P., Geetha, B., and Aasker, G. 1998. Antidiabetic effects of fenugreek extract (*Trigonella foenum-graecum L.*) on domestic animals with special reference to carbohydrate metabolism. *Journal of Ecotoxicology and Environmental Monitoring*, 8: 103-108.

Ibrahim, M.R., Abd El-Latif, M.S., El-Yamany, A.T. 1998. Effect of adding some natural growth promoters to broiler chicks diets on growth performance, digestibility and some metabolic functions. *Journal of Agricultural Sciences*, 32: 1029-1037.

Khan, F.U., Durrani, F.R., Sultan, A., Khan, R.U. and Naz, S. 2009. Effect of fenugreek (*Trigonella foenum-graecum*) seed extract on visceral organs of broiler chicks. ARPN. *Journal of Agricultural and Biological Sciences*, 4: 58-61.

Khan, R.U., Durrani, F.R., Chand, N. and Anwar, H. 2010. Influence of feed supplementation with *Cannabis sativa* on quality of broilers carcass. *Pakistan Veterinary Journal*, 30: 34-38.

Michael, S. and Kumawat, D. 2003. Legend and archeology of fenugreek, constitutions and modern applications of fenugreek seeds. International-symp, USA. pp: 41–42.

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Epidemiology, electrolytes balance and treatment strategy of equine anhidrosis

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Abstract

This research work was designed to study the prevalence, electrolytes balance and treatment strategy of equine anhidrosis in Faisalabad, Pakistan. The study was conducted in the hottest month of summer (June-September). Anhidrosis was diagnosed by clinical signs and subsequent intra- dermal adrenaline and salbutamol injections. Overall prevalence of anhidrosis in horses was 13.2% of the total tested horses. Prevalence of anhidrosis was high during months of July and August. Further, it was observed that 6 12 years old horses are more susceptible to this syndrome. Serum analysis showed that sodium and chloride were significantly low and potassium concentration was significantly high in anhidrotic horses. Diseased horses showed positive response to the treatment of iodinated casein and germinated wheat and the clinical signs disappeared gradually. It was concluded from this study that horses are vulnerable to the attack of anhidrosis during warmer months of summer affecting serum electrolytes profile. Further, iodinated casein and germinated wheat have excellent therapeutic potential against this syndrome.

Keywords: Anhidrosis; Horses; Minerals; Treatment

Introduction

Horses that lack the ability to produce sweat in normal quantities have a condition known as anhidrosis. Such animals are sometimes called nonsweater or dry coat horses. Common clinical signs in equine anhidrosis include high respiratory rate, increased body temperature, decreased tolerance to exercise, dry and dull hair coat with alopecia especially around the face and shoulder (Mayhew et al., 1987; Warner and Mayhew, 1982; Bashir and Raesedee, 2009). High environmental ambient temperature and humidity limit heat loss through evaporation which results in thermal stress (Warner and Mayhew, 1982). As heat is accumulated due to inefficient loss of heat, it results in elevated body temperature, increased heart and respiratory rates (Bashir et al., 2009). In one study, Lindinger et al (2000) found that fluid and electrolytes balance is disturbed under hot and humid conditions in exercised induced anhidrotic horses. On the other hand Maqsood (1956) reported that iodinated casein affectively ameliorates the anhidrotic condition and the horses begin to sweat again.

In our country, equines are still on of the principal means of transporting goods and people. Tens of thousands of people in Pakistan earn their livelihoods by using equines for various purposes. The lives of these horses have often been plagued by miserable and poor conditions as equines in our country belong to poor families, which cannot afford their proper well being. In Pakistan, summer is extremely dangerous for horses. Further their owners lack awareness about the hazards of heat stress and anhidrosis. In such conditions, anhidrosis is a natural consequence as horses are unable to cope with sizzling heat and added burden of high work load. There is paucity of research on various aspects of anhidrosis in horses in Pakistan. Therefore, this research work was conducted to investigate on epidemiology, electrolytes balance and response to treatment regime in anhidrotic horses in Faisalabad, Pakistan.

Materials and Methods

The study was conducted at outdoor Clinic of Veterinary Medical Teaching Hospital, Department of

Clinical Medicine and Surgery, University of Agriculture, Faisalabad, Pakistan in the summer months (June September) of year, 2004. The study was conducted on clinico-epedemiology, electrolytes profile and physiological response to therapeutic agents by anhidrotic horses. Total 151 horses were tested for anhidrosis. Diagnosis of anhidrosis was determined by the methods described by Lovatt (1996) and Guthrie et al. (1992). Briefly, intradermal injection of 0.5 mL of 10-3 w/v adrenaline was injected to each horse received at the clinic. Then Salbutamol (0.1 mL of 10-7 concentration of Salbutamol Sulphate) was also injected intradermally at interval of one hour and responses to sweating in both the cases were recorded. The history of work load was obtained from the horse owners. Heart rate, rectal temperature, respiration rate coat texture were also recorded for each horse examined. Meteorological data including maximum and minimum temperature and relative humidity during the study was obtained from Department of Crop Physiology, University of Agriculture, Faisalabad, Pakistan.

For determination of serum electrolytes, 5 mL blood from each anhidrotic horse was obtained in a sterile needle by puncturing jugular vein. Blood samples from control horses were also obtained at the same clinic. Serum was separated from the blood by centrifugation at 2500 rpm for 15 minutes. Serum was kept at 20°C till further analysis. Sodium and potassium were determined with the help of flame photometer by the method described by Wolf (1982). Bicarbonate concentration was determined by commercially available (Randox Laboratories, Ireland) kit. The method provided with the kit was used for determination of bicarbonate. Chloride was determined with the kit method (Chloride determination kit, DMA Inc., Texas, USA), according to the manufacturer's instruction.

The anhidrotic horses were housed in cold airy rooms in the premises of the clinic. They were provided plenty fresh cold drinking water. For therapeutic evaluation, iodinated casein was administered to anhidrotic horses according to the method described by Maqsood (1956). For comparison of therapeutic efficacy of casein, germinated wheat was given orally to the affected horses according to the instructions described by Shamoon-ur-Rashid (1997).

Statistical analysis

Date obtained was spread on excel sheet of personal computer. Month-wise prevalence was analysed by using chi-square test. Student's t-test was applied on data to compare electrolytes between normal and anhidrotic horses. Physiological response to treatment regime was analysed using ANOVA (Steel et al., 1997).

Results

Twenty out of 151 horses were found suffered from anhidrosis. Thus the overall prevalence was 13.2%. High prevalence was found in the months of July and August (30%), followed by September (25%) and lowest in the month of June (15%) as shown in fig. 1.

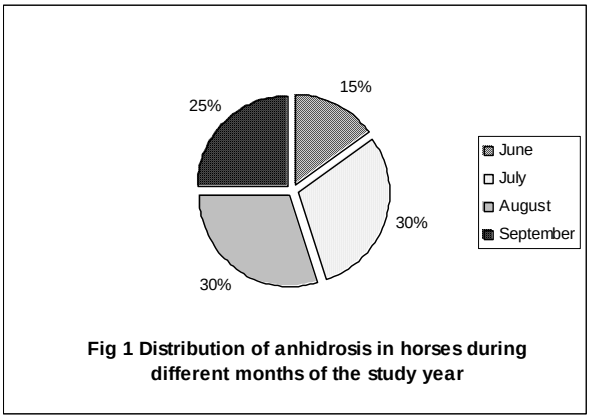

Fig 1 Distribution of anhidrosis in horses during different months of the study year

Prevalence of anhidrotic horses categorised by age group is given in table 1. No significant difference ($p > 0.05$) was found in different age groups.

Table 1: Distribution of anhidrosis in horses by their age groups

Age (years)	Total horses examined	Anhidrotic horses	Prevalence (%)	p-value
1 5	49	7	14.2	0.455
6 12	64	10	15.6	
13 18	38	3	7.8	
Total	151	20	13.24	

Prevalence of anhidrotic horses categorised by age group is given in table 1. No significant difference ($p > 0.05$) was found in different age groups.

Table 2: Mean ± SE of serum electrolytes between anhidrotic and normal horses

Variable (mEq/L)	Normal horses	Anhidrotic horses
Na^+	136 ± 0.267^a	117 ± 0.428^b
K^+	3.74 ± 0.01^b	3.94 ± 0.006^a
Cl^-	99.7 ± 0.534^a	83.3 ± 0.24^b
HCO_3^{-1}	26.5 ± 0.383	24.2 ± 0.32

Different superscripts in a row differ significantly ($p < 0.05$).

Sodium and chloride concentration were significantly low in anhidrotic horses. Significantly high concentration of potassium was found in anhidrotic horses. There was no significant difference of bicarbonate ion between normal and anhidrotic horses (table 2).

Table 3: Treatment effect of iodinated casein on different clinical signs of anhidrotic horses

Variable	Days		
	Day 1	Day 7	Day 14
Rectal temperature	105±0.86[a]	102±0.23[b]	102±0.7[b]
Pulse rate	81±2.32[a]	59.6±1.43[b]	53±1.12[b]
Respiration rate	95±3.55[a]	45.2±1.98[b]	47.3±1.91[b]
Adrenaline sweating time	12.9±0.56	10±0.43	11.1±1.01
Salbutamol sweating time	20±1.12[a]	15±0.98[b]	16.3±0.81[b]

Different superscripts in a row differ significantly ($p < 0.05$)

Table 4: Treatment effect of germinated wheat on different clinical signs of anhidrotic horses

Variable	Days		
	Day1	Day 7	Day 14
Rectal temperature	104.5±0.32	101.6±0.43	102±0.98
Pulse rate	78±1.49[a]	52±2.43[b]	48±2.87[b]
Respiration rate	95±2.33[a]	44±1.90[b]	42±1.65[b]
Adrenaline sweating time	12±0.76[a]	8.9±0.98[b]	8.7±1.00[b]
Salbutamol sweating time	19±0.98[a]	13.9±0.78[b]	13±0.45[b]

Different superscripts in a row differ significantly ($p < 0.05$)

Treatment effects of iodinated casein on different clinical signs of anhidrotic horses are given in table 3. It is evident that treatment of iodinated casein decreased rectal temperature, pulse rate and respiration rate significantly at day 7 and 14. Adrenaline and salbutamol sweating times also decreased in diseased horses gradually after treatment.

The treatment effect of germinated wheat on different clinical signs showed that pulse, respiration rate, adrenaline and salbutamol sweating time were significantly low at day 7 and 14 of germinated wheat treatment (table 4). Adrenaline and salbutamol sweating times also decreased significantly ($p < 0.05$) in diseased horses gradually after treatment.

Discussion

Local studies on the epidemiological aspect of different diseases which affect livestock especially equines are extremely sparse. Therefore, investigations are imperative for resource allocation as well as to minimize the economic effects of these diseases. In the realm of equine medicine, anhidrosis is a particular common disorder seen in hot, humid environment irrespective of the region. The pathogenesis of anhidrosis is not well understood, however, inability of the sweet gland to respond to adrenaline, breakdown of sweat gland, equaporin impairment, atrophy and hyperkeratinization of sweat gland ducts are some of the important causes of anhidrosis Bashir and Raesedee, 2009; Warmer and Mayhew, 1982; Bovell et al., 2006; Jenkinson et al., 2007).

In our study we observed that prevalence of anhidrosis increased from June to July. It was maintained in August and then decreased in September. The fluctuation of anhidrosis seems to be temperature dependant. In fact, in Faisalabad, the temperature increases from the month of June till August and then gradually decreases in September. Radostitis et al. (2000) reported that anhidrosis occurs most commonly in horses in countries with hot and humid climates including India, Indonesia, Srilanka, Malaysia, Australia and Gulf of Mexico Coast in the United States. Such results were also found by Warner and Mayhew (1982) who reported that anhidrosis is a common disease of horses found in hot and humid environment. In the current study, prevalence of anhidrosis was high in 6 12 years old horses. Our results are in agreement with that of Warner and Mayhew (1982) who concluded that age has significant effect on prevalence of this syndrome.

Horses can maintain homeothermy despite sever summer heat stress. In the current study, sodium and chloride concentration decreased significantly while potassium level significantly increased in anhidrotic horses. Our results are in agreement with those of Li et al. (2006) who found that sodium and chloride concentration decreased significantly and potassium increase in 6 12 years old training horses in endurance competition. The significant decrease in serum sodium and chloride has been attributed to their loss in sweat. On the other hand, the significant increase in serum potassium concentration in horses subjected to strenuous exercise in hot weather is probably due to release of potassium from the exercising muscles (Mckeever et al., 1993). We found no significant difference of bicarbonate concentration in normal and anhidrotic horses. Rose et al. (1980) found that bicarbonate level of plasma increases slightly at the midpoint of an endurance exercise but show no overall change.

Hyperthyroidism has been suggested as one of the causes of anhidrosis, because treatment with iodinated casein has been reported to ameliorate clinical signs. In this study, the anhidrotic horses were brought in cool, airy environment with plenty drinking water. Treatment of casein had desirable effects on different physiological parameters on day 7 and improved the condition on day 14. Maqsood reported that administration of daily dose of 10 15 gm of iodinated casein for a period of about 4 8 days cure the affected animals and again start to sweat.

It has been claimed that treatment with vitamin E improves condition and restore sweating (Mayhew et al., 1987. In this trial we treated anhidrotic horses with germinated wheat. Study on use of germinated wheat as a tool for treatment of anhidrosis is scarce. Young et al. (2001) found that dry wheat grains had no vitamin E. However, upon germination, the concentration of vitamin E steadily increased with increasing germination. Therefore, the germinated wheat may be used as a source of vitamin E to treat the anhidrotic horses. Recently, Shamoon-ur-Rashid (1997) reported 73% efficacy of vitamin E at the dose rate of 2000 I.U. in the equine anhidrosis treatment.

Therefore, it is concluded from this study that horses exposed to high temperature in hot and humid months in the summer are at the risk of anhidrosis altering electrolytes profile. However, the clinical signs disappeared when diseased horses were subjected to treatment of iodinated casein and vitamin E for a definite period of time.

References

Bashir, A. and Raesedee, A. 2009. Plasma catecholamines sweat electrolytes and physiological responses of exercised normal, partial anhidrotic and anhidrotic horses. *American Journal of Animal and Veterinary Scinces*, 4 : 26–31.

Bovell, D.L., Lindsay, S.L., Corbett, A.D., and Steel, C. 2006. Immunolocalisation of aquaporin-5 expression in sweat gland cells from normal and anhidrotic horses. *Veterinary Dermatology*, 17: 17–23.

Guthrie, A.J., Van, J.S., Killeen, V.M. and Nichas, E. 1992. Use of semi-quantitative sweat test in thoroughbred horses. *Journal of the South African Veterinary Association*, 63: 162–165.

Jenkinson, D.M., Elder, H.Y. and Bovell, D.L. 2007. Equine sweating and anhidrosis. Part 1: equine sweating. *Veterinary Dermatology*, 17: 362–392.

Li, A.I., Victoria, M.M., Gullmero, M.R., Manuel, Q.O., Ricacardo, K.L. and Mabel, F.X. 2006 Sodium, potassium, calcium and chloride determination in horses in training for endurance competition. *Avances en Ciencias Veterinarian*, 21:8–13.

Lindinger, M.L., McCutcheon, L.J., Ecker, G.L. and Geor, R.J. 2000 Heat acclimation improves regulation of plasma Na+ content during exercise in horses. *Journal of Applied Physiology*, 88: 1006-1013

Lovatt, E.C. 1996. Physiological mechanisms that underlie sweating in the horse. *British Veterinary Journal*, 122: 117–123.

Maqsood, M. 1956. Iodinated casein therapy for the 'non-sweating' syndrome in horses. *Veterinary Record*, 68: 475.

Mayhew, I.G. and H.O. Ferguson. 1987. Clinical, clinicopathologic and epidemiologic features of anhidrosis in Central Florida thoroughbred horses. *Journal of Veterinary International Medicine*, 1: 136–41.

McKeever, K.H., Hinchcliff, K.W. and Reed, S.M. 1993. Plasma constituents during incremental treadmill exercise in intact and splenectomised horses. *Equine Veterinary Journal*, 25: 233–236.

Radostitis, O.M., Blood, D.C., Gay, C.C. and Hinchiff, K.W. 2000. Veterinary medicine. 9th edition Saunders WB, Saunders Co. Philadelphia, USA. pp: 1812–1813.

Rose, R.J., Arnold, K.S. and Church, S. 1980. Plasma and sweat electrolyte concentrations in the horse during long distance exercise. *Equine Veterinary Journal*, 12: 19–22.

Shamoon-ur-Rashid. 1997. Prevalence of puff disease in horses with biochemical and chemotherapeutic studies. M.Sc (Hons) thesis, College of Veterinary sciences, Lahore, University of Agriculture, Faisalabad, Pakistan.

Steel, R.G.D., Torrie, J.H. and Dieky, D.A. 1997. Principles and Procedures of Statistics. 3rd Ed. McGraw Hill Book Co. Inc., New York.

Warner, A.E. and Mayhew, I.G. 1982. Equine anhidrosis – a survey of affected horses in Florida. *Journal of American Veterinary Medical Association*, 180: 627–629.

Wolf, B. 1982. A comprehensive system of leaf analyses and its use for diagnostic crop nutrient status. *Communication in Soil Science and Plant Analysis*,. 13:1035–1059.

Yang F, TK Basu, B Ooraikul, 2001. Studies on germination condition and antioxidant contents of wheat grain. *International Journal of Food Science and Nutrition*, 52: 319–330.

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Comparative efficacy of different schedules of administration of medicinal plants infusion on hematology and serum biochemistry of broiler chicks

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Abstract

The research study was undertaken to investigate the effect of different schedules of administration of medicinal plants infusion of aloe vera gel, barbery, garlic and ginger on hematology and serum biochemistry of broilers chicks. For this purpose 240, day old broilers chick (A) purchased were from a local dealer, divided in to four groups A, B, C and D and reared in separate pens for 35 days in an open sided house. These groups were divided into two vaccinated and non-vaccinated sub-groups for the different treatments. Each sub group was carrying three replicate (10 chicks/replicate). Group A was kept as control, while B, C and D were given infusion @ 10 ml/lit of water. The schedule was designated as the group B received infusion at alternate day, group C received infusion on alternate three days in a week and group D received infusion at alternate week. Relevant data was recorded throughout the experiment till the termination of experiment. Significant increase in hemoglobin concentration, PCV and total leukocyte count (TLC) was observed in group C. Significant reduction was recorded in ALT and ALP in group B, while AST and serum glucose in group C and increased in serum protein was found in group B. Decreased ($p<0.05$) total cholesterol, triglyceride, LDL, VLDL, and increased HDL ($p<0.05$) were experienced in group B. Comparing the values of risk ratio of, VLDL to HDL, Total cholesterol to HDL and LDL to HDL were found significantly lower in group B, while total cholesterol to VLDL was found significantly lower in group C. It is concluded that schedule on the basis receiving infusion three days in a week is more potent than other schedule of research study.

Keywords: Broiler, Schedule Based Administration, Hematology, Lipid Profile, Liver Function Test

Introduction

Poultry production has been improved significantly in the last three decades and plays a vital role in the economy of Pakistan. The provision of quality protein in the shortest period of time in the form of meat and eggs is the major contributing role of poultry birds in human nutrition. This is only possible when birds are provided quality feed and hygienic environment. Antibiotic and other feed additives are frequently given in feed as well as in drinking water to achieve the targeted nutritional and health status of the birds. The frequent use of drugs as feed additives in poultry ration resulted in resistant to pathogenic microorganism, affecting the feed efficiency and growth performance of poultry birds.
The consumption and demand for medicinal plants have been adopted in many countries because of low-cost, easy availability, affordability for a common farmer, good antimicrobial natured, reduced diseases associated risks, lowering blood cholesterol level and diversified functions in improving performance, growth rate, feed conversion rate and weight gain in birds (Lewis et al., 2003). Medicinal plants are used in pharmaceuticals, neutraceuticals, cosmetics, and food supplements and even as traditional source of medicines because of their antitumer, antiarthritic and antithrombotic functions (Thomson and Ali, 2003). Furthermore, scientists and researchers are trying to combat against fatal diseases in poultry through the use of medicinal plants, containing the most active ingredients to promote growth, weight gain, and immunostimulant.

Allium sativum (Garlic) is grown in many areas throughout the world and is considered by herbalists to be one of the most essential and useful herbs used for medicinal purposes. Various cultures have benefited from using garlic in medicines and foods for centuries. Garlic has been used for many years to prevent health problems

including colds, flu, menstrual pain, high blood pressure, coughs, gastrointestinal problems, atherosclerosis, and bronchitis. Garlic has been proven to kill various fungal infections, viruses, bacteria, and intestinal parasites (Elnima et al., 1983; Zenner et al., 2003).

Berberry (*Berberis lycium*) is a deciduous shrub growing up to 4 m high and belong to the family Berberidaceae. Its most potent agent is berberine, which is also known to have a number of therapeutical effects. Previous research has shown that berberry is helpful in increasing immune response (Abidi et al., 2006). Küpeli et al. (2002) has also reported that the extracts obtained from the roots and barks of various Berberis species are used as folk remedy worldwide for the treatment of various inflammatory ailments including lumbago, rheumatism and to reduce fever (antipyritic).

Aloe vera (*Alovera berbedinesis*) is a well documented medicinal plant in the literature, abundantly found in southern districts of NWFP. Aloe plants have pod like leaves, consist of two parts gel and latex. Most prominent monosaccharide in aloe vera gel is mannose-6-phosphate and most common polysaccharide, called gluco-mannans (beta 104 acetylated mannan). Active components of aloe vera plant are acids (glutaminic, aspartic, aloetic, formic, palmitic, estearic and ascorbic), essential oils (cineole, cariofilene and pinene), minerals (calcium, magnesium, potassium, zinc, phosphorus, manganese and aluminium), amino acids (aloin, aloesin, arginine, barbaloin, glycine, glutamine, histidine and serine. Aloe vera gel possesses anti-inflammatory activity (Udupa, 1994). Aloe gel heals lesions, created by coccidian parasites on the intestinal Wall and could effectively control Coccidiosis. Aloe vera gel also inhibits antiviral (Saoo, 1996), antiulcer and antidiabetic (Koo, 1994) and anticancer properties (Jeong, 1994).

Ginger (*Zingiber officinale*) is an herb indigenous to southeastern Asia. It is cultivated in U.S, India, china, West Indies and tropical regions of Pakistan. Ginger contain 44 constituents mostly Zingebirine, beta sisquiphellandrence and terinole, and contains various amount of nutrients such as protein, lipids and minerals. Ginger has been used as anti-microbial agent (Mascolo et al., 1989).

Keeping in view the effectiveness and significant importance of medicinal plants mixture of (aloe vera, ginger, garlic and barbery) with different administration schedule was used in broiler production to investigate the lipid profile of blood serum, hepatoprotective effect and hematological parameter.

Materials and Methods

Two hundred and forty day old Chicks were assigned to different treatment using complete randomized design. These chicks were alienated into four treatment groups A, B, C and D. Chicks were reared in an open sided house in pens. Feeder, drinker, bulb and other necessary materials were provided to chicks in each pen to maintain sound managemental and environmental conditions. Experiment was lasted for 35 days. The basal composition of feed is given in Table.1 The infusion was prepared from the different plants (garlic, barbary, aloe vera and ginger) with a known quantity already tested in a series of experiments conducted at poultry unit, NWFP Agricultural University Peshawar, Pakistan. To prepare the infusion from these plants the concentration of ginger and garlic contained 6 and 4 gm per liter respectively while barbery and aloe vera gel were present at the rate of 10 gm per liter of water infusion. Group A was kept as control while, B, C and D was given infusion @ 10 ml/lit of water. The schedule was fixed as group B received infusion at alternate day, group C received infusion three days in a week and group D received infusion at alternate week.

At the end of the experimental period, 20 birds per group were randomly selected. Blood samples from each bird were obtained by cervical dislocation. Two test tubes were prepared for each sample, one containing EDTA for hematological study and another for serum biochemistry. To get serum blood without EDTA was centrifuged at 1500 rpm for 20 minutes. Serum was aspirated by micropipette into sterile ependorphs and stored at -20°C until analysis.

Blood samples (3-5ml) with anticoagulant (EDTA) were collected from wing vein at the end of experiment. Blood samples were analyzed for hematological parameter including hemoglobin (Hb) concentration , packed cell volume (PCV), Total leukocytes count (TLC) and differential leukocyte counts by the method recorded by (Benjamin, 1978).

For the quantitative measurement of glucose in serum, commercially available kit BIORAY CAT # 1426-6 was used. For the quantitative determination of AST and ALT, ALP and serum protein in the serum commercially available kit by RANDOX were used. Lipid profile including total cholesterol to HDL ratio, LDL to HDL ratio, total cholesterol to VLDL ratio and VLDL to HDL ratio were determination using Elitech Kit technique as described by Werner et al. (1981).

Statistical Analysis

The data was statistically analyzed using standard procedure of analysis of variance as described by Steel

Table 1: Ingredients and composition of basal diet (as fed bases)

Ingredients (g/kg of diet)	Starter	Grower	Finisher
Maize, yellow	354.0	329.0	250.0
Soybean meal (480 g CP/Kg)	275.0	205.0	170.0
Sunflower meal 350 g CP/Kg)	110.0	151.0	110.5
Wheat	99.0	130.5	331.0
Wheat bran	-	37.0	-
Meat-bone meal	65.0	55.5	49.5
Vegetable oil	73.9	85.5	73.5
Limestone	13.5	-	-
Mineral-vitamins premix[1]	3.5	3.1	3.5
Sodium chloride	3.1	2.5	2.5
L-lysine	0.4	-	0.1
DL-Methionine	1.6	0.1	1.7
Calculated chemical composition (per Kg of diet)			
ME (MJ)	13.2	13.4	13.4
Crude Protein (g)	231.2	212.0	189.8
Calcium (g)	15.0	9.0	8.0
Available phosphorus (g)	5.0	4.7	3.9
Lysine (g)	12.0	10.0	8.5
Methionine (g)	5.6	4.0	5.2
Methionine + cysteine (g)	9.3	7.6	8.4
Sodium chloride (g)	3.4	2.9	2.9

[1]Provides per kg of diet: Mn 80 mg; Zn 60 mg; Fe 60 mg; Iron 5mg; Cu 5 mg; Co 0.2 mg; I 1 mg; Se 0.15 mg; choline chloride 200 mg; vitamin A 12 000 IU; vitamin D3 2 400 IU; vitamin E 50 mg; vitamin K3 4 mg; vitamin B1 3 mg; vitamin B2 6 mg; niacin 25 mg; calcium-d- pantothenate 10 mg; vitamin B6 5 mg; vitamin B12 0.03 mg; d-biotin 0.05 mg; folic acid 1 mg

and Torrie (1981). The statistical package (SAS 1988) was used to perform the data analysis.

Results and Discussion

The research study was conducted to investigate the effect of different schedule of administration of medicinal plants (aloe vera gel, garlic, barbery and ginger) infusion on, lipid profile, serum glucose, hematological and liver enzyme of broiler chicks. Means Hemoglobin estimation (Hb) level is presented in (Table 2). Group C receiving water based infusion three days a week, showed higher ($P<0.05$) Hb level (9.35 g/dl) as compared to other groups. The findings of the present research study are similar with the findings of Esonu et al. (2006), who observed significant increase in Hb level while feeding herbal plant (neem) to the laying hen. Results of our findings is in contrast with the findings of Gautam et al. (2004), who noticed that no significant effect on Hb was observed, fed *Withania somnifera* to the animals. Our result is in agreement with the result of Sham et al. (2003), who reported significant effect on hemoglobin and red cell count, while feeding *Withania somnifera* to animals. Means PCV level is presented in (Table 2). Group C receiving water based infusion three days a week showed higher PCV (39.50 %) level. This is parallel to the findings of Esonu et al. (2006), who reported significant increase in PCV level, in layers fed herbal plant neem. Means total leukocytes count (TLC) level is presented in table 2. Group C receiving infusion three days in a week showed higher TLC level. The findings of the present research study are parallel to the findings of Esonu *et al.* (2006), who observed significant increase in TLC level, while feeding herbal plant (neem) to the laying Hen. Finding of present study is in disagreement with the findings of Gautam et al. (2004), who noticed that no significant effect on lymphocyte and WBC counts was observed, while feeding *Withania somnifera* to the animals. Our result can also be comparable with the findings of Sham et al. (2003), who reported significant increase in white cell counts while feeding *Withania somnifera* to the mice. Means of Serum glucose level are presented in table 3. Significant ($P<0.05$) difference was observed in the mean serum glucose levels among the treated groups. Group C receiving infusion three days in a week was observed with the lowest significant value. The results of present study are in agreement with the results of Hemalatha (2004), who reported that administration of *Withania somnifera* significantly lowered the blood sugar. Findings of our study agree with the result of Sarika et al. (2006) who reported significant ($P<0.05$) decrease in blood glucose, while feeding of *Withania*

Table 2: Mean±SE hemoglobin (Hb), packed cell volume (PCV) total leucocytes count (TLC) in broiler chicks dosed with medicinal plants infusion (garlic, ginger, berberine, aloe vera) at different schedules

Parameters	A	B	C	D
Hb (mg/dL)	6.06±0.09[b]	6.38±0.08[b]	9.35±0.12[a]	5.08±0.09[b]
PCV (%)	24.00±4.23[b]	32.00±3.54[b]	39.50±3.42[a]	25.33±2.34[b]
TLC (10^3/mL)	20.16±1.23[b]	23.50±1.54[b]	28.83±3.21[a]	19.33±1.56[b]

Mean in the rows with different superscripts are significantly different at (P<0.05); Control: A, alternate day: B, alternate 3 days: C, alternate week: D

Table 3: Mean±SE glucose alanine transaminase (ALT), aspartate transaminase (AST), alkaline phosphatase (ALP) and serum protein (g/DL) in broiler chicks dosed with medicinal plants infusion (garlic, ginger, berberine, aloe vera) at different schedules

Parameters	A	B	C	D
Glucose (mg/dL)	100.32±2.35[a]	91.45±3.45[b]	80±4.54[c]	99.34±2.33[a]
ALT (U/L)	36.33±2.32[a]	16.16±2.31[c]	24.50±1.87[b]	39.33±1.34[a]
AST (U/L)	32.83±1.87[a]	16.33±1.09[b]	15.16±2.13[c]	31.50±2.76[a]
ALP (Unit/L)	2627.33±76.45[a]	1268.33±345.65[d]	1544.50±78.54[c]	2268.00±79.84[a]
Serum Protein (g/dL)	3.28±2.34[c]	7.86±1.34[a]	7.56±1.35[a]	3.88±1.25[b]

Mean in the rows with different superscripts are significantly different at (P<0.05); Control: A, alternate day: B, alternate 3 days: C, alternate week: D

somnifera extract to the albino rats. Result of our findings could be of relevance to the result of Andallu and Radhika (2000), who reported significant (P<0.05) lower serum glucose in the hyperglycemic rats, while feeding Withania somnifera extract to the mice. Findings of present study are related to the findings of Parihar et al. (2003), who reported that dietary supplementation of combination of *Withania somnifera* and aloe vera to diabetic mice produced a significant decline in plasma glucose concentration. The finding of present study is in contrast to the Mehrdad et al. (2006), who reported no significant hypoglycemic effect in treated, control and diabetic groups, while feeding of *Withania somnifera* extract to the animals.

Means Alanine Aminotransferase (ALT), aspartate transaminase (AST), alkaline phosphatase (ALP) and serum protein (g/DL) level for different groups A, B, C and D are presented in table 2. Significant (P<0.05) difference was fond in the mean ALT levels among the treatments. The group B receiving infusion on alternate day basis was observed the lowest numerical. The results of present study are in agreement with the results of Sudhir et al. (1986), who reported that alcoholic extract of leaves of *withania somnifera* has protective effect against the hepatotoxicity in rats. Mean serum ALP (alkaline phosphatase) value per chick at the end of experiment is presented in table 3. The ALP data was subjected to analysis of variance which revealed significant (P<0.05) difference among the groups. Significantly (P<0.05) reduced ALP was recorded in group B receiving infusion on alternate day as compared to the other groups. The results of present study are in agreement with the results of Choi (2005), who fed *Carum copticum* derived glabridin to mouse and found a significant elevation of alkaline phosphatase (ALP) activity. Thyagarajan et al. (2002), who reported that *Glycyrrhiza glabra* has been shown to be hepatoprotective and capable of inducing an indigenous interferon. Average serum AST (aspartate aminotransferase) value per chick at the end of experiment is presented in table 2. The AST data revealed significant (P<0.05) difference among the groups. AST was significantly (P<0.05) reduced in group C, receiving infusion three days a week as compared with other groups.

Significant (P<0.05) differences in the mean serum total cholesterol and triglyceride values were recorded among the treatments presented in (Table 4). Group C, receiving infusion three days a week was observed with the lowest numerical values of cholesterol, while group B receiving infusion at alternate day was observed with the lowest numerical value of triglyceride. Our findings are supported the observation of and Jayant and Dhuley (1997), who reported that ashwagandha (*Withania somnifera*) prevented the rise in LPO in rabbit and mice and Babu et al. (1997), who fed herbal plant to diabetic rats and found low value of serum cholesterol and serum triglyceride. Result of our findings are comparable with the findings of Nishant et al. (2006), who reported that Withania somnifera significantly (P<0.05) lowered the cholesterol in hypercholesteremic male albino rats. Result of our findings are relevant to the result of Andallu and Radhika (2000), who reported significant decrease in cholesterol and triglycerides in hyperlipidemic rats, while feeding *Withania somnifera* extract to the mice. Significantly higher (P<0.05) high density lipoprotein

Table 4: Mean (mg/dl#SE), total cholesterol, triglyceride, LDL (low density lipoprotein) , HDL (high density lipoprotein) , VLDL (very low density lipoprotein) ,total cholesterol to HDL ratio , LDL to HDL ratio ,Total cholesterol to VLDL ratio and VLDL to HDL ratio in broiler chicks through administration of medicinal plants infusion (garlic, ginger, berberine, aloe vera) at different schedules

Parameters (mg/dl)	A	B	C	D
Total cholesterol	250.00±5.43^{a}	150.50±2.34^{b}	143.83±4.35^{b}	236.16±4.32^{a}
Triglyceride	250.166±3.45^{a}	149.33±5.46^{b}	151.33±6.75^{b}	247.16±3.23^{a}
LDL	121.33±3.76^{a}	57.16±1.78^{c}	70.50±1.67^{b}	126.0±1.3^{a}
HDL	33.33±3.87^{c}	72.16±1.23^{a}	55.50±1.54^{b}	36.83±1.67^{c}
VLDL	95.3±2.54±1.53^{a}	33.16±1.25^{b}	27.50±1.54^{c}	73.33±2.46^{a}
Total cholesterol/ HDL	4.64±2.65±0.32^{a}	1.80±0.43^{c}	2.28±0.23^{b}	4.52±0.12^{a}
LDL/HDL	3.64±1.78±0.23^{a}	0.80±0.43^{c}	1.28±0.1.1^{b}	3.52±0.32^{a}
Total cholesterol/ VLDL	8.6316±2.65±0.08^{a}	2.7216±0.09^{c}	2.4100±0.11^{c}	4.8733±0.32^{b}
VLDL/ HDL	2.96±4.36±0.06^{a}	0.46±0.87^{c}	0.52±0.54^{b}	2.04±0.98^{a}

Mean in the rows with different superscripts are significantly different at (P<0.05).
Control: A, alternate day: B, alternate 3 days: C, alternate week: D

(HDL) values were observed in group B than control group (Table 4). Result of our findings are opposed by the findings of Nishant et al. (2006), who reported that Withania somnifera significantly (P<0.05) increased the HDL in hypercholesteremic male albino rats. Our findings agree with the result of Andallu and Radhika (2000), who reported that significant decrease in the HDL in hyperlipidemic rats fed Withania somnifera extract. Mean serum low-density lipoprotein (LDL) values were found significant (P<0.05) among the treatments presented in (Table 4). Significantly (P<0.05) lower serum low-density lipoprotein value was recorded in treatment B than control. The results of present study are in agreement with result of Babu et al. (2007), who fed herbal plant, cur cumin to diabetic rats and found low values of serum LDL. The results of present study are in agreement with result of Abidi et al. (2006)

Significantly lower (P<0.05) very low density lipoproteins (VLDL) values were observed in group C than control group (Table 4). The ratio was found lower in group C receiving infusion three days in a week, it seem to be lower chance of heart problem in group C following the group B receiving infusion on alternate day. Therefore, it's suggested that the infusion at the rate of 10 ml/liter should be used continuously without any more gap of days. Petit et al. 1993 conducted the research on Wister rats and observed that increase in plasma insulin and a decrease in total cholesterol and very low–density lipoprotein (VLDL) and low density lipoprotein (LDL).

Significantly lower (P<0.05) total cholesterol to HDL ratio and LDL to HDL ratio were observed in group B than control group (Table 4). The ratio was found lower in group B receiving infusion on alternate day, it seems to be lowered chance of heart problem in group B, and following group C received infusion after every three days in a week. It means that continuous use of the infusion of medicinal plants (aloe vera, garlic, ginger and barbery) had significantly reduced the chance of heart problems as compared to group D received infusion on alternate week. Result of our findings are comparable with the findings of Petit et al. (1993) conducted the research on Wister rats and observed that increase in plasma insulin and a decrease in total cholesterol and very low–density lipoprotein (VLDL) and low density lipoprotein (LDL). No other relevant literature is available on the ratio of total cholesterol to HDL and LDL to HDL ratio.

Significantly lower (P<0.05) Total cholesterol to VLDL ratio was observed in group C and VLDL to HDL ratio was significantly lower in group B. (Table 4). The ratio was found higher in group C receiving infusion three days in a week, it seems to be lowered chance of heart problem in group C following the group B receiving infusion on alternate day. It means that continues use of the infusion of medicinal plants (aloe vera, garlic, ginger and barbery) had significantly reduced the chance of heart problems as compared to the group D that receiving infusion on alternate week. Result of our findings are comparable with the finding of Petit et al. (1993) conducted the research on Wister rats and observed that increase in plasma insulin and a decrease in total cholesterol and very low–density lipoprotein (VLDL) and low density lipoprotein (LDL). No other relevant literature is available on the total cholesterol to VLDL ratio and VLDL to HDL ratio.

The present research study was undertaken to investigate the effect of different schedule of administration of medicinal plants of water based infusion of aloe vera gel, barbery, garlic and ginger on, hematological parameters, lipid profile, serum glucose level, total protein and liver function tests of broilers. Water based infusion of Aloe vera gel, Barbery, Garlic

and Ginger had significant effect on hemoglobin concentration, PCV and TLC of the broilers in group C. Similarly, a significant effect of water based infusion of Aloe vera gel, Barbery, Garlic and Ginger was established on AST, cholesterol, triglyceride, serum glucose, VLDL and cholesterol to VLDL ratio, in broiler's blood in group C. However, the water based infusion of aloe vera gel, barbery, garlic and ginger had significantly influenced the ALP, serum protein, VLDL to HDL ratio, LDL, HDL, cholesterol to HDL ratio, LDL to HDL ratio and number of oocysts of broiler in group B.

References

Abidi, P., Chen, W., Kraemer, F.B., Li, H. and Liu, J. 2006. The medicinal plant goldenseal is a natural LDL-lowering agent with multiple bioactive components and new action mechanisms. *Journal Lipid of Research*, 47: 2134-2147.

Andallu, B. and Radhika, B. 2000. Hypoglycemic, diuretic and hypocholesterolemic effect of winter cherry (Withania somnifera, Dunal) root. *Indian Journal of Experimental Biology*, 38:607-609.

Babu, P.S.and Sirivansan, K. 1997. Hypolipidimic action of curcumin, the active principle of turmeric (*Curcumia longa*) in straptozotocin induced diabetic rats. *Mollecular and Cellular Biochemistry*, 166: 169-175.

Benjamin, M. 1978. Outline of vet, clinical pathology 3rd Ed. The lowa state Uni. Press. Lowa., USA.

Chang, H.W. 1995. Antibacterial effect of spices and vegetables. *Journal of Food Industries*, 27:53-61

Choi, E.M. 2005. The liquorice root derived isoflavan glabridin increases the function of osteoblastic MC3T3-E1 cells. *Journal of Biochemistry*, 70:363-388.

Elnima, E.I., S, Ahmad, A., Mekkawi, A.G. and Mossa, L. 1983. The antimicrobial activity of garlic and onion extracts. *Journal of Phototherapy Research*, 20:352-358.

Esonu, B.O., Opara, M.N., Okoli, I.C., Obikaonu, H.O., Udedibie, C. and Iheshiulor, O.O.M. 2006. Physiological Response of Laying Birds to Neem (Azadirachta Indica) Leaf Meal-Based Diets: Body Weight Organ Characteristics And Haematology. *Journal of OJHAS*, 5: 972-997.

Gautam, M., Diwanay, S.S., Gairolac, S., Shinde, Y.S., Jadhav, S.S. and Patwardhan, B.K. 2004. Immune response modulation to DPT vaccine by aqueous extract of Withania somnifera in experimental system. *Journal of Ethnopharmalogy*, 4: 841-849.

Hemalatha, S., Wahi, A.K, Singh, P.N. and Chansouria, J.P. 2004. Hypoglycemic activity of Withania coagulans Dunal in streptozotocin induced diabetic rats. *Journal of Ethnopharmacology*. 93: 261-264.

Jayant, N., Dhuley, B. 1997. Effect of ashwagandha on lipid peroxidation in stress-induced animals. *Journal of Ethnopharmacology*, 60: 173-178.

Jeong, F. and Yang, D.P. 1994. The use of *Aloe vera* in the treatment of anticancer. *Phototherapy Research*, 10: 348-350.

Koo, M.W.L. 1994. *Aloe vera*: antiulcer and antidiabetic effects. *Journal of Phototherapy Research*, 8: 461-464.

Küpeli, E., Koşar, M., Yeşilada, E., Hüsnü, K. and Başer, C. 2002. A comparative study on the anti-inflammatory, antinociceptive and antipyretic effects of isoquinoline alkaloids from the roots of Turkish Berberis species. *Journal of Life Science*, 72: 645-657.

Lewis, M.R.., Rose, S.P., Mac kenzie, A.M. and Tucker, L.A. 2003. Effect of dietary inclusion of plant extract on the growth performance of male broiler chicken. *Journal of British Poultry Science*, 20: 78-82.

Mascolo, N., Jain, R., Jain, S.C. and Capasso, F. 1989. Ethnopharmacologic investigation of ginger (*Zingiber officinale*). *Journal of Ethnopharmacology*, 27: 129-140.

Mehrdad, R., Khalilia, M. and Mahdavia, F. 2006. The effect of chronic administration of Withania somnifera on learning and memory deficits of diabetic rats. *Journal of Alzheimer's and Dementia*, 2: 231.

Nishant, P., Visavadiyaa, K. and Narasimhacharya, A.V.R.L. 2006. Hypocholesteremic and antioxidant effects of Withania somnifera (Dunal) in hypercholesteremic rats. *Journal of Phytomedicine*, 2: 136-142.

Parihar, M.S., Chaudhary, M., Shetty, R. and Hemnani, T. 2003. Susceptibly of hippocampus and cerebral cortex to oxidative damage in streptozotocin treated mice: prevention by extracts of Withania somnifera and Aloe vera. *Journal of Clinical Neurological science*, 11: 397-402.

Petit, P., Sauvaire, Y., Ponsin, G., Manteghetti, M., Fave, A. and Ribes, G. 1993. Effect of a fenugreek seed extract on feeding behaviour in the ratmetabolic endocrincorrelates. *Pharmacology, Biochemistry and Behaviour*, 45: 369-374.

Saoo, K., Miki, H., Ohmori M. and Winters, W.D. 1996. Antiviral activity of aloe extracts against cytomegalo virus. *Journal of Phototherapy Research*, 10: 348-350.

Sarika, J., Pandhi, P., Singh, A.P. and Malhotra, S. 2006. Efficacy of standardised herbal extracts in type 1 diabetes - an experimental study. African Journal of Traditional *Complementary and Alternative Medicine*, 3: 23-33.

SAS Institute. 1988. SAS User's Guide: Statistics. SAS Institute, Inc., Cary, NC

Sham, D., Chitreb, D. and Patwardhan, B. 2003. Immunoprotection by botanical drugs in cancer chemotherapy. *Journal of Ethnopharmacology*, 90: 49-55.

Steel, R.G.D. and Torrie, J.H. 1981. principles and procedures of statistics: A biometrical approach. 2nd. Ed. McGraw-Hill, Singapore.

Sudhir, S., Budhiraja, R.D., Miglani, G.P., Arora, B., Gupta, L.C. and Garg, K.N. 1986. Pharmacological Studies on Leaves of *Withania somnifera. Plant Medicine*, 52: 61-63.

Thomson, M., Al-Qattan, K.K., Al-Sawan, S.S., Alnaqeeb, M.A., Khan, I. and Ali, M. 2002. The use of ginger (Zingiber officinale Rosc.) as a potential anti-inflammatory and antithrombotic agent. *Journal of Prostaglandins Leukotriens and Essential Fatty Acids*, 67: 475-478.

Thyagarajan S., Jayaram, S., Gopalakrishnan, V., Hari, R., Jeyakumar, P. and Sripathi, M. 2002. Herbal medicines for liver diseases in India. *Journal of Gastroentrology and Hepatitis,* 17: 370-376.

Udupa, S.L., Udupa, A.L. and Kulkarni, D.R. 1994. Anti-inflammatory and wound healing properties of *Aloe vera*. *Journal of Fitoterapia*, 65: 141-145.

Werner, M., Gabrielson, D.G. and Eastman, G. 1981. Ultramicrodeterminations of serum triglycerides by bioluminescent assay. *Clinical Chemistry*, 21:268-271.

Zenner, L., Callait, M.P., Granier, C. and Chauve, C. 2003. *In vitro* effect of essential oils from *Cinnamomum aromaticum*, Citrus limon and *Allium sativum* on two intestinal flagellates of poultry, *Tetratrichomonas gallinarum* and *Histomonas meleagridis*. *Journal of Parasitology*, 10:153-157.

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First field investigation report on the prevalence of trypanosomosis in camels in northern Tanzania

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Abstract

Parasitological evaluation of equine trypanosomosis in 193 camels (49 male and 144 female) from 8 geographical localities of northern, Tanzania were carried out during the period of June-August 2010. The evaluation was carried out using Giemsa stained microscopy examination of blood smear. The overall detected prevalence of camel trypanosomosis was 8.2% with highest prevalence in Kilindi district (100%) and with most of the positive slides showing 2+ and 3+. A higher infection was found in brought-in as compared to homebred camels (18.1% *vs.* 0.9%; P<0.05). When body score condition was considered, infection rate was 100, 6.8 and 3.5% in camels recorded to have poor, fair and good body score, respectively. It was concluded that camel trypanosomosis is prevalent in camel herds and administrative localities, source, and body condition score were identified as important risk factors for the distribution of camel trypanosomosis in the area under study. To our knowledge, this is the first report for the detection of trypanosome pathogen in camels in Tanzania.

Key words: Camels, prevalence, risk factors, Tanzania, trypanosomes

Introduction

Tsetse-transmitted animal and human trypanosomosis is considered to be one of the major constraints to improved livestock and agricultural production in sub-Saharan Africa (SSA) (Kristjanson et al., 1999). It is currently estimated that about 66 million people and 48 million cattle are at risk of contracting African trypanosomosis from the 23 species and 33 subspecies of tsetse flies infesting 10 million km^2 of Africa stretching across 40 countries (WHO, 1998; Kristjanson et al., 1999). Tsetse transmitted African trypanosomosis is responsible for 55,000 human and 3 million livestock deaths annually (Mulumba, 2003; Abenga et al., 2002).

In Tanzania, it is estimated that 11 million head of cattle, 7 million small ruminants, nearly 4 million people and 2 million wildlife animal species are at the risk of contracting trypanosomosis at any one time (MoAC, 1998), though these figures many vary over years. Consistently about 13,127,000 ha of agriculturally suitable land for livestock and wildlife grazing is tsetse infested (MoAC, 1998). The most important tsetse-borne diseases in Tanzania include bovine and human trypanosomosis caused by the four major species of salvarian trypanosomes namely, *T. congolense*, *T. vivax* and *T. brucei brucei* and *T. brucei rhodesiense*. One of the major factors influencing the transmission of animal and human trypanosomosis is the vector-tsetse fly distributions (Ford and Katondo, 1977). The main field vectors for transmission of trypanosomosis includes the seven species of Glossina, namely *G. morsitans*, *G. pallidipes*, *G. longipennis*, *G. brevipalpis*, *G. austeni*, *G. swynertonni* and *G. fuscipes* (Ford and Katondo, 1977).

While animal trypanosomosis mainly in cattle and small ruminants is well documented in Tanzania, on the contrary, information on camel trypanososmosis is not known and not available (Nonga and Kambarage, 2009). Camel trypanosomosis, also known as surra, is caused by *Trypanosoma evansi*. The disease is the most important single cause of economic losses in camel rearing areas, causing morbidity of up to 30.0% and mortality of around 3.0% (Njiru et al., 2001).

The present study was planned to investigate the prevalence of *T. evansi* infection in camels and to assess the relationship between trypanosomes prevalence and some risk factors responsible for maintenance and transmitting the disease in the northern geographical localities of Tanzania.

Materials and Methods

This cross-sectional study was conducted in randomly selected camels belonging to eight districts of the Tanga, Kilimanjaro, Arusha and Manyara regions, north Tanzania. The eight districts which covers an area

of 51,974 km^2, lies between Latitude 2^o 11' and 6^o 14' South of Equator, and Longitude 35^o 11' and 38^o 26' East of Greenwich. The climate is sub-humid with temperatures ranging from 14^{o}C to 23^{o}C on high elevation areas and 30^{o}C to 37^{o}C along north coastal Indian Ocean shore. The study areas experiences two main seasons, the dry season, from May to October and the wet season, from November to April with rainfall ranging from 635 mm to 3,050 mm, with low rainfall in the low laying areas and high rainfall on high altitude and plateau areas. The amount and duration of rainfall varies from year to year and from season to season.

The study subjects were all ages, sexes, indigenous breeds of camel, (one hump camel) reared under extensive husbandry which allows free grazing, usually mixed with livestock from other villages. The list of all camel owners in each district was obtained from District Livestock Office and further validated from the data we obtained from Heifer Project International country office, the main supplier of the camels in Tanzania. Data were collected using semi-structured questionnaire and information asked included herd size, source of animals classified as homebred or brought–in, sex, age retrieved from owner herd record. Body condition of camels was assessed visually and rated as poor, fair and good. Field survey was conducted during the period of June to August 2010.

Sampled camels were restrained in a kraal or boma using sisal ropes and nose rings. Thin blood was drawn from ear vein using a sharp hypodermic needle. A drop of blood was taken near one end of the clean glass slide and another slide used to prepare the blood smear**.** The dried blood smears were fixed in methyl alcohol (absolute) for 5 min and allowed to dry. The dry smears were placed in a glass staining jar containing working 10% Giemsa stain for 20 min. Subsequently the smears were taken out and washed with phosphate buffer solution (PBS) to remove excess stain. The slides were allowed to dry in air and then examined by microscope under oil immersion with a 100x objectives lens (Murray et al., 1979) for the detection of trypanosomes in the blood. Ten fields in each smear were examined in order to establish whether the smear was positive or negative. Quantification of the number of parasites (parasitemia level) was done by physical counting of the parasites (Murray et al., 1982). Species identification was confirmed by morphological examination of trypanosomes on Giemsa stained thin blood smear as described by (Murray et al., 1977).

Statistical analysis

Data collected from each study animal and laboratory analyses were coded into appropriate variables and entered in Epi-info (version 6.04d, CDC, Atlanta, USA). Biostatistical analysis was performed using Epi-info (version 6.04, CDC, Atlanta, USA). The point prevalence was calculated for all data as the number of infected individuals divided by the number of individuals sampled x 100. Categorical data were analyzed by using Chi-square (χ^2) test of independence. In all the analyses, a value of $p < 0.05$ was considered significant.

Results and Discussion

Over all, fourteen herds from 8 geographical localities of northern Tanzania were visited, owner or any other household member interviewed and 193 (49 male and 144 female) animals examined/sampled during the period of June-August 2010 (a 100% response rate). The interviewed households had about 338 camel with an average (mean ± SD) herd size of 24.1± 21.9, (range, 3-72).

The overall prevalence of trypanosomosis in camels was recorded as 8.3%. Affected camels showed increased body temperature, emaciation, dullness, impaired appetite and laboured breathing. The prevalence rates ranged from 0 % (Same, Mwanga, Monduli, Arumeru, Simanjiro) to100% (Kilindi) (Table 1), and in camels in Kilindi had the highest prevalence rate (100%), which is significantly different from that of the other administrative localities. These results are parallel with the investigations made by Tekle and Abebe (2001) and Pathak et al., (1993), who reported 10.9% and 7.5 % prevalence of *T. evansi* in camels, respectively. This overall rate of prevalence was slightly lower than that reported for camels in arid to semi arid regions of west and north Africa (Delafosse and Doutoum, 2004). But this prevalence rate is higher than that reported in Somalia and West Africa (Dirie et al., 1989; Baumann and Zessin, 1992; Dia et al., 1997; Joshua et al., 2008). One possible explanation for the lower prevalence rate detected in this study could be or related to distribution, challenge and density of parasite vector – the tsetse flies as well as vector control management practices (Ford and Katondo, 1977). A more plausible explanation for the differences in prevalence rate could be the different sensitivity of different test methods, because different microscopic methods could result in small difference in positive rates in the survey of camel infection with *T. evansi*. For example, Delafosse and Doutoum, (2004) compared the effectiveness of different methods including Buffy coat technique (BCT), haematocrit centrifugation technique (HCT) and card agglutination test (CAT) for detecting trypanosomes and the results showed that the positive rate obtained using CAT and HCT were higher than that obtained using BCT method (Ngaira et al., 2002). Microscopic examination of blood smears was used in the present study because of its simplicity and easy handling, even in a developing country, in addition to lacks of the equipments needed

for Enzyme-linked immunosorbent assay (ELISA) and Polymerase chain reaction (PCR) in its rural districts. Magona et al., (2003) reported 78% sensitivity and 27% specificity when compared to gold standard tests, i.e. ELISA and PCR.

Table 1: Administrative localities and sex-wise prevalence of trypanosomes in camels

District	Male	Positive (%)	Females	Positive (%)	Overall (%)
Same	3	0(0)	9	0(0)	0(0)
Mwanga	2	0(0)	6	0(0)	0(0)
Hai	4	0(0)	16	1(6.3)	1(5)
Meru	7	0(0)	13	0(0)	0(0)
Monduli	7	0(0)	0	0(0)	0(0)
Longido	17	0(0)	67	0(0)	0(0)
Simanjiro	7	0(0)	20	0(0)	0(0)
Kilindi	2	2(100)	13	13(100)	15(100)
Total	49	2(4.08)	144	14(9.7)	16(8.3)

No significant sex related differences (P>0.05) in prevalence were observed in camels. Other studies in Asia have also reported sex related differences in prevalence in camels (Shah et al., 2004) where females (15.68%) were observed to be more susceptible to disease than their male (11.76%) counterparts.

Infection rate according to body condition score was recorded and the results highlighted highest prevalence in animals rated to be at poor to fair compared to good body score counter part animals, respectively (Table 2). Higher infection recorded in poor to fair scored animals might be due to lowered body resistance due to nutritional stress or other concurrent infections and therefore rendering them more susceptible to *T. evansi* infection.

Prevalence varied with the mode of acquisition of the animals (Table 3). Brought-in animals were significantly more likely to be positive for *T. evansi* than were homebred animals. This finding may suggest that, most farmer dispose off their camel stock because of various reasons, which include diseases.

Age-wise analysis revealed that there was no significant difference in prevalence between age groups. However, the present finding is in agreement with reports of few workers (Pathak and Khanna, 1995) who reported that all camels were equally susceptible to trypanosome infection regardless of breed and age.

Table 2: Body condition score-wise prevalence of trypanosomes in camel

Score	Number sampled	Total number positive for trypanosomes	Prevalence (%)
Poor	6	6	100
Fair	102	7	6.8
Good	85	3	3.5

Table 3: Animal source-wise prevalence of trypanosomes in camel

Score	Number sampled	Total number positive for trypanosomes	Prevalence (%)
Brought-in	83	15	18.1
Home bred	110	1	0.9

In conclusion, results of the present investigation indicated for the first time that camel trypanosomosis is prevalent in northern Tanzania. Therefore enhanced integrated vector and parasite strategies and measure should be carried out to prevent and control *T. evansi* infection. In agreement with established evidences, this study also indicated administrative localities, source, and body condition score as important risk factors for the distribution of camel trypanosomosis in the area. Therefore further studies should be conducted to substantiate the above findings so that the actual prevalence of the disease and species involved is determined and a feasible method of prevention of infection with trypanosome parasites implemented.

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References

Abenga, J. N., Ewenzor, F.N.C., Lawani, F.A.G., Ezebuiro, C., Sule, J. and David, K.M. 2002**.** Prevalence of trypanosomiasis in trade cattle at slaughter in Kaduna State, Nigeria. *The Journal of Parasitology*, 23: 107-110.

Baumann, M. P. and Zessin, K.H. 1992**.** Productivity and health of camels (Camelus dromedarius) in Somalia: associations with Trypanosomosis and brucellosis. *Tropical Animal Health and Production,* 24(3):145-156

Delafosse, A. and Doutoum, A.A. 2004. Prevalence of Trypanosoma evansi infection and associated risk factors in camels in eastern Chad. *Veterinary Parasitology,* 119(2-3):155-164.

Dia, M.L., Diop, C., Aminetou, M., Jacquiet, P. and Thiam, A. 1997**.** Some factors affecting the prevalence of Trypanosoma evansi in camels in Mauritania. *Veterinary Parasitology,* 72(2):111-20.

Dirie, M.F., Wallbanks, K.R. and Aden, A.A. Bornstein, S. and Ibrahim, M.D. 1989. Camel Trypanosomiasis and its vectors in Somalia. *Veterinary Parasitology,* 32(4):285-91.

Ford, J. and Katondo, K.M. 1977**.** Maps of tsetse fly (Glossina) distribution in Africa 1973, according to sub-generic groups on scale of 1:5,000,000. *Bulletin of Animal Health and Production in Africa,* 15: 188-194.

Joshua, K., Turaki, A.U., Egwu, G. O., Mani, A.U., Saidu, M.K., Abdullahi, J.G. and Hussaini, H.A. 2008**.** Haemoparasites of camels (Camelus dromedarius) in Maiduguri, Nigeria. *Animal Research International,* 5: 2

Kristjanson, P.M., Swallow, B.M., Rowlands, G.J., Kruska, R.L. and Leeuw, P.N. 1999**.** Measuring the costs of African animal trypanosomosis: the potential benefits of control and returns to research. *Agricultural systems,* 59: 79-98.

Magona, J. W., Mayende, J. S., Olaho-Mukani, W., Coleman, P.G., Jonsson, N. N., Welburn, S.C. and Eisler, M.C. 2003. A comparative study on the clinical, parasitological and molecular diagnosis of bovine trypanosomosis in Uganda**.** *Onderstepoort Journal of Veterinary Research,* 70(3): 213-218.

Ministry of Agriculture and Cooperatives (MoAC)., 1998**.** 13th Coordination meeting on Framing in Tsetse Control Areas of East Africa, Kampala, Uganda, 7-8 May 1998. Prepared by Tsetse and Trypanosomiasis Control Section, Dar-es-Salaam

Mulumba, K. 2003**.** Socio economic and agricultural factors in the research and control of trypanosomiasis. PAAT technical and scientific series 4. FAO/ WHO/ IAEA/ OAU.

Murray, M. D., Murray, P.K. and McIntyre, W. I.M. 1977. An improved technique for the diagnosis pf African trypanosomes. *Transactions of the Royal Society of Tropical Medicine and Hygiene,* 71: 325-326.

Murray, M. D., Clifford, J. and McIntyre, W. I. M. 1979. Diagnosis of African Trypanosomiasis in bovine. Trans. *Transactions of the Royal Society of Tropical Medicine and Hygiene,* 73: 120-121.

Murray, M., Morrison, W.I. and Whitelaw, D.D. 1982**.** Host susceptibility to African trypanosomiasis: trypanotolerance. *Advances in Parasitology,* 21: 1-68

Ngaira, J. M., Bett, B. and Karanja, S.M. 2002. Animal-level risk factors for Trypanosoma evansi infection in camels in eastern and central parts of Kenya. *Onderstepoort Journal of Veterinary Research,* 69(4): 263-271.

Nonga, H. E. and Kambarage, D.M. 2009**.** Prevalence of bovine trypanososmis in Morogoro, Tanzania. *Pakistan Journal of Nutrition,* 8(3): 208-213.

Njiru, Z.K., Ole-Mepeny, I.M., Ouma, J.O., Ndungu, J.M. and Olaho-Mukani, W. 2001**.** Prevalence of trypanosomiasis in camel calves: a pilot study in Laikipia District of Kenya. *Revue d'elevage et de médecine vétérinaire des pays tropicaux*, 34: 183-186.

Pathak, K.M., Arora, J.K. and Kapoor, M. 1993**.** Camel trypanosomosis in Rajasthan, India. *Veterinary Parasitology,* 49(2-4):319-23.

Pathak, K.M.L. and Khanna, N.D. 1995. Trypanosomiasis in camel(*Camelus dromedarius*) with particular reference to Indian sub-continent: a review. *International Journal of Animal Science,* 10: 157-162.

Shah, S. R., Phulan, M.S., Memon, M.A., Rind, R. and Bhatti, W.M. 2004. Trypanosomes infection in camels. *Pakistan Veterinary Journal,* 24(4): 2009-210

Tekle, T. and Abebe, 2001. Trypanosomiasis and helminthoses: major health problems of camels(*Camelus dromedarius*) in the Southern rangelands of Borena, *Ethiopia. Journal of Camel Practice Research*, 8(1): 180-181

WHO 1998. Control and surveillance of African trypanosomiasis. A report of WHO expert committee. WHO technical report series no. 881 WHO Geneva.

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Effect of dietary calcium level on egg production and shell quality in broiler breeder hens at peak production

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Abstract

A study was conducted to evaluate the effects of dietary calcium levels on shell quality and egg production of Ross broiler breeder hens from 25 to 35 weeks of age of. One hundred and ninety eight Ross broiler breeder pullets were reared up to 22 weeks on restricted diets with 1.0, 1.5 and 2.0% Ca. The pullets in each experimental diet were further randomly divided into three treatments with 1.5, 2.5 and 3.5% dietary Ca (22 birds per treatment) in a 3 × 3 factorial arrangement. The feeds were isocaloric and isonitrogenous but differed only in the Ca and P contents. Feed intake was administered in accordance with Ross Breeders recommendations. Individual body weight measurements were taken on three weekly intervals for the duration of the experiment. Parameters evaluated included egg production, shell weight, shell percentage, SWUSA, egg contents, egg surface area and shell thickness. Dietary treatment had significant ($P<0.0001$) effect on Ca intake of broiler breeder hens. An average Ca intake (g/hen/day) of 2.14, 3.76 and 5.39 for the 1.5, 2.5 and 3.5% Ca levels, respectively occurred during the experimental period. Egg production, egg weight, egg mass, egg contents and eggshell quality (SWUSA, shell weight, shell percentage and shell thickness) increased ($P<0.0001$) when dietary Ca was increased from 1.5% to 2.5%. However, no significant ($P>0.05$) differences were observed in these variables between 2.5 and 3.5% Ca levels. The present results suggest that increasing Ca level from 1.5 to 2.5% can improve eggshell quality. All the eggshell quality variables increased over time while egg mass and egg production declined. These results support the current Ross Breeders recommended dietary Ca level of 2.8% (4-5 g) to ensure good eggshell quality. Dietary Ca level of 2.5% and Ca intakes (g/hen/day) of 3.9, 3.8 and 3.5 g at weeks 27, 30 and 33 resulted in a good eggshell quality.

Keywords: Calcium, Egg production, Egg weight, Phosphorus, Eggshell quality, phosphorus

Introduction

The ability of hens to produce quality shells depends largely on the availability of calcium (Ca) from ingested food and skeleton (Farmer et al. 1983). Boorman et al. (1985) stated that Ca could be derived directly from the diet in the light whereas it must be mobilised from the skeleton in the dark when the birds do not feed. The skeletal system is intimately involved in Ca storage for eggshell formation. According to Klasing (1998), the amount of dietary Ca required to maximize bone or eggshell mineralisation and strength is greater than that needed for other functions. Therefore, a proper build-up of Ca stores is essential for the maintenance of bone integrity and acceptable shell quality. Although the shell represents no more than 10% of the egg's weight, it is a vital component to protect and contain food contents of the egg until the consumer uses these (Hunton, 1982). According to Roland (1986), the average Ca requirement for eggshell formation within a population of hens is greatest at approximately peak production. The significance of Ca requirements in layers can be determined by the fact that eggshell contains about 94% calcium carbonate, which is equivalent to 2-2.2 grams (g) of Ca (Hopkins et al., 1987; Roland, 1988). Shell thickness and other physical characteristics of the shell such as shell weight per unit surface area (SWUSA) and percent shell (of total egg weight) have been used to describe shell quality (Hunton, 1982). According to Hamilton (1982), the term eggshell quality is often used as a synonym for "shell strength" and denotes the ability of eggshells to withstand applied forces without cracking or breaking. To ensure maximum shell quality, the hens should

consume a minimum of 3.75 g Ca/hen/day (Roland, 1986).

According to Ross Breeders (1998, 2001), broiler breeders require 4-5 g Ca per day from first egg throughout laying period. It is suggested (Ross Breeders, 2001) that this requirement could be satisfied by making the change from pre-breeder (1.5% Ca) to breeder (2.8% Ca) diets immediately prior to first egg. However, Summers *et al.* (1976) stated that although absolute intake of Ca and phosphorus will depend on strain of bird, energy level of the diet and environmental temperature, it is not uncommon to see intakes of Ca in excess of 4.5 g and available phosphorus of 0.6 g per day.

As feed intake is restricted in broiler breeder hens and most feed is consumed during the early hours of morning, these hens are likely to be more susceptible to periods of Ca deficiency during shell formation than *ad libitum* fed birds (Farmer et al., 1983). The present study was undertaken to gain additional information on the effects of dietary levels of Ca on shell quality and egg production up to 35 weeks of age of Ross broiler breeder hens selected for faster growth rate and heavier body weight.

Materials and Methods

One hundred and ninety eight Ross broiler breeder pullets were reared up to 22 weeks on restricted diets with 1.0, 1.5 and 2.0% Ca. The pullets in each experimental diet were further randomly divided into three treatments with 1.5, 2.5 and 3.5% dietary Ca (22 birds per treatment). The hens were placed in individual cages within a common room for all treatments. The cages were fitted with feed troughs, water nipples and perches. Following 3-week adjustment period the hens were fed test diets containing 1.5, 2.5 and 3.5% Ca, respectively.

Experimental diets are given in Tables 1 and 2. Pullets were fed pre-breeder diet containing 1.0, 1.5 and 2.0% Ca from 19 to 22 weeks of age. Two types of breeder diets containing 1.5, 2.5 and 3.5% Ca were fed from 23 to 35 weeks of age and these include breeder phase 1 (23 to 34 weeks) and breeder phase 2 which was fed at 35 weeks. The feeds were isocaloric and isonitrogenous but differed only in the Ca and P contents. The feed intake was administered in accordance with Ross Breeders recommendations. Individual body weight measurements were taken on three weekly intervals for the duration of the experiment. The hens were photostimulated at 22 weeks of age and received 16 hours of light by week 26. This photoschedule was continued to 60 weeks of age.

Egg numbers were recorded daily and summarised on a weekly basis throughout the experimental period (i.e., 25 to 35 weeks). Abnormal eggs having multiple yolks, shell-less and those with defective shells were recorded for production calculations. Cumulative egg production was calculated on a per bird basis throughout the experimental period. First egg laid was considered as age at point of lay while flock attaining maximum percent lay on any day and/or week was considered as peak percent lay and the day was regarded as age at peak of lay (Ali et al., 2003). Percent lay on daily basis was calculated using the formula given by North and Bell (1990).

Table 1: Physical composition of laying diets on air dry basis (%)

	Pre-breeder diet		Breeder Phase 1		Breeder Phase 2		Breeder Phase 3	
	1.5% Ca	3.5% Ca	1.5% Ca	3.5% Ca	1.5% Ca	3.5% Ca	1.5% Ca	3.5% Ca
Maize	63.54	63.51	61.92	59.66	63.11	60.81	56.43	62.23
Pollard Glutten	-	-	4.45	2.3	1.8	1.0	-	-
Wheat bran	12.65	6.65	5.15	-	6.55	-	14.90	1.00
Full fat soya	-	-	-	10.0	-	9.95	-	1.70
Soybean oil cake	7.75	11.4	8.6	10.3	8.4	7.55	8.75	9.50
Sunflower oil cake	12.45	11.1	15.0	7.75	15.0	10.00	15.00	15.0
Calcium carbonate (grit)	-	-	2.0	6.15	2.3	6.75	2.25	6.60
Calcium carbonate (fine)	1.15	2.2	0.5	1.5	0.6	1.65	0.6	1.65
Mono calcium phosphate	1.49	4.25	1.29	1.36	1.40	1.50	1.28	1.53
Salt	0.24	0.26	0.41	0.40	0.43	0.44	0.44	0.44
Bicarbonate	0.20	0.15	-	-	-	-	-	-
Choline liquid	0.04	0.04	0.03	0.03	-	0.03	-	-
Lysine	0.10	0.04	0.15	-	0.10		0.03	0.03
Methionine	0.05	0.05	0.005	0.06	0.01	0.05	0.01	0.02
Trace mineral/vitamin premix	0.35	0.35	0.50	0.50	0.30	0.30	0.30	0.30

Table 2: Nutrient composition of experimental diets on air dry basis (%)

	Pre-breeder diet		Breeder phase 1		Breeder phase 2		Breeder phase 3	
	1.0% Ca	2.0% Ca	1.5% Ca	3.5% Ca	1.5% Ca	3.5% Ca	1.5% Ca	3.5% Ca
Moisture	11.07	10.37	10.58	9.96	9.77	9.10	9.85	9.19
Metabolisable Energy (MJ/kg)	11.96	11.70	12.09	12.00.	11.94	11.87	11.46	11.43
Protein	15.22	15.50	18.33	17.72	17.03	16.77	16.68	16.06
Crude fat	3.30	3.06	3.00	4.20	2.97	4.07	3.09	2.98
Crude fibre	7.01	5.99	0.00	0.00	6.65	5.08	8.28	6.64
Ash			6.21	11.23	6.74	12.05	6.90	11.98
Calcium	1.00	2.01	1.51	3.50	1.52	3.50	1.59	3.46
Phosphorus	0.84	1.37	0.78	0.71	0.80	0.74	0.84	0.78
Available phosphorus	0.45	0.90	0.41	0.40	0.43	0.43	0.43	0.54
Arginine	0.98	1.01	1.11	1.12	1.08	1.09	1.10	1.07
Isoleucine	0.60	0.64	0.74	0.76	0.69	0.71	0.67	0.67
Lysine			0.81	0.83	0.76	0.78	0.73	0.72
Methionine	0.35	0.34	0.38	0.38	0.35	0.36	0.33	0.33
TSAA[1]	0.06	0.64	0.73	0.70	0.68	0.67	0.66	0.64
Threonine	0.55	0.57	0.66	0.66	0.62	0.63	0.61	0.60
Tryptophan	0.17	0.18	0.19	0.20	0.18	0.19	0.19	0.18
TA[2] Arginine	0.91	0.93	1.04	1.04	0.99	1.01	1.01	0.99
TA[2] Isoleucine	0.54	0.57	0.67	0.69	0.62	0.65	0.59	0.60
TA[2] Lysine	0.60	0.60	0.70	0.71	0.64	0.67	0.61	0.61
TA[2] Methionine	0.31	0.31	0.34	0.35	0.31	0.33	0.29	0.30
TA[2] TSAA	0.57	0.57	0.64	0.63	0.59	0.60	0.57	0.56
TA[2] Threonine	0.48	0.50	0.59	0.59	0.55	0.56	0.26	0.53
TA[2] Tryptophan	0.15	0.16	0.17	0.18	0.17	0.17	0.17	0.17
AC:Linoleic acid	1.83	1.68	1.65	2.32	1.65	2.26	1.71	1.64
Xanthophylls			23.51	17.68	17.12	14.66	11.29	12.45
Salt	0.24	0.27	0.42	0.41	0.44	0.44	0.45	0.45
Choline	1300.01	1309.56	1205.18	1204.08	1008.79	1003.18	1087.10	993.06
Sodium	0.16	0.16	0.18	0.18	0.19	0.20	0.20	0.20
Chlorine	0.22	0.57	0.33	0.29	0.33	0.31	0.32	0.32
Potassium	0.60	0.60	0.60	0.63	0.63	0.63	0.71	0.61
Magnesium			0.22	0.20	0.23	0.21	0.25	0.23
Manganese			46.82	63.94	50.82	68.71	61.84	71.60

[1]Total sulphur amino acids; [2]Chemically determined

Individual egg weights were recorded for all the eggs produced by each hen on daily basis. Eggs with multiple yolks and defective shells were also included in the weight data. Average egg weight per hen was recorded on a weekly basis. After the mean egg weight had been determined in grams each, daily egg mass was computed by multiplying percent hen day production by mean egg weight (North and Bell, 1990.). The surface area (cm^2) of each egg was calculated using the formula of Carter (1975a), $3.9782W^{.7056}$, where W is the egg weight in grams.

Three eggs from each hen were used to determine eggshell thickness at 3 weekly intervals (i.e., 27, 30 and 33 weeks of age). The eggs were weighed individually and stored in a cooled room at 5 ^oC. Following the measurement of egg weight, each egg was broken and shell thickness and shell weight including membranes determined. The shells were washed under slightly running water to remove adhering albumen (Strong, 1989; Kul and Seker, 2004) and wiped with a paper towel to remove excessive moisture. An eggshell thickness meter sensitive to 0.01 mm was used to measure the shell thickness. Two measurements were made on the broad end, the equator (waist region) and the sharp end of each egg and the average of each of the two measurements calculated (Ikeme et al., 1983; Ehtesham and Chowdhury, 2002). The shells from individual eggs were then placed in crucibles, dried at 60 ^oC overnight, and cooled in the dessicator for approximately 30 minutes, thereafter shell weight was recorded. Percentage shell was calculated by dividing dry shell weight by egg weight and multiplying by 100 (Chowdhury and Smith, 2001). The SWUSA (mg/cm^2) was calculated using the formula of Carter (1975b).

Statistical analyses

The effects of Ca level and age on the egg characteristics data during laying period (25 to 35 weeks) were analysed as a 3 x 3 factorial block design in which data from individual birds served as replicates. Data were subjected to ANOVA using the General Linear Models procedure (SAS Institute, 1996) to assess the effect of dietary Ca level and age on response variables relating to egg production and eggshell quality (shell thickness, SW, shell percentage, SWUSA, egg surface area and egg contents). The differences between treatment means were separated using Tukey's studentised range (HSD) test.

Results and Discussion

Dietary Ca level had a significant (P<0.0001) effect on hen's daily Ca intake (Table 3). The Ca intake of the hens significantly (P<0.0001) increased as dietary Ca concentration increased from 1.5 to 3.5%. These results are consistent with those of Clunies *et al.* (1992) who reported that Ca intake of Single Comb White Leghorn hens significantly (P<0.05) increased as dietary Ca concentration increased from 2.5 to 3.5%. Average Ca intakes (g/hen/day) of 2.2, 3.7 and 5.3 for the 1.5, 2.5 and 3.5% Ca levels, respectively were recorded during the experimental period. It is suggested that broiler breeders require 4-5 g Ca/hen/day throughout the laying period (Ross Breeders 1998, 2001). The inclusion of approximately 3.0% Ca in the diet of broiler breeders used in the current study would probably supply this requirement (i.e., 4-5 g Ca/hen/day).

Table 3: The effect of dietary calcium level and age on hen's daily calcium intake

Age (weeks)	Dietary level of calcium		
	1.5%	2.5%	3.5%
27	2.21±0.06[a]	3.91±0.06[b]	5.38±0.06[c]
30	2.29±0.06[a]	3.82±0.06[b]	5.45±0.06[c]
33	2.11±0.06[a]	3.47±0.06[b]	4.99±0.06[c]
CV%	12.8		
Significance level (P)			
Treatment	0.0001		
Age	0.0001		
Interaction	0.0178		

[a,b,c]Means within rows with no common superscripts differ significantly (P<0.05).

The hens Ca intake declined (P<0.0001) significantly with age. At 33 weeks of age the Ca intake was significantly (P<0.05) lower compared to 27 and 30 weeks. However, daily Ca intake was not significantly (P<0.05) different at 27 and 33 weeks.

The influence of Ca levels and age during early lay on egg production and egg mass is shown in Figures 1 and 2. Egg production and egg mass were not significantly (P<0.05) different among the experimental diets. There was a 1.6% average production difference (68.63 *vs.* 69.74%) between 1.5% and 3.5% dietary Ca levels. These results are consistent with published reports (Ousterhout, 1980; Keshavarz and Nakajima, 1993) but inconsistent with findings of Ahmad et al. (2003) and Roland et al. (1996). The type of bird (broiler *versus* commercial layers), as well as, bird strain differences (Ross *versus* Bovans) and Ca levels may have contributed to the various results reported in the literature.

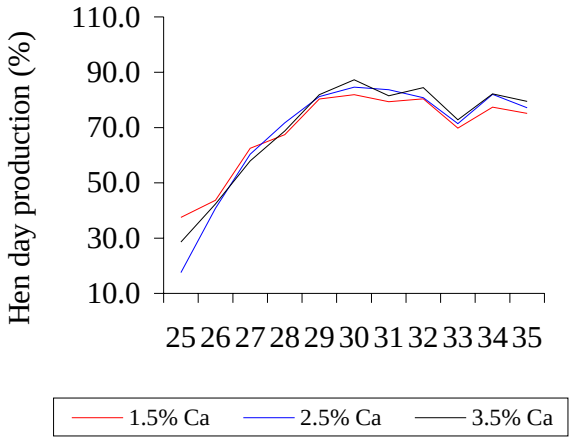

Fig. 1: The effect of dietary Ca levels and age on egg production

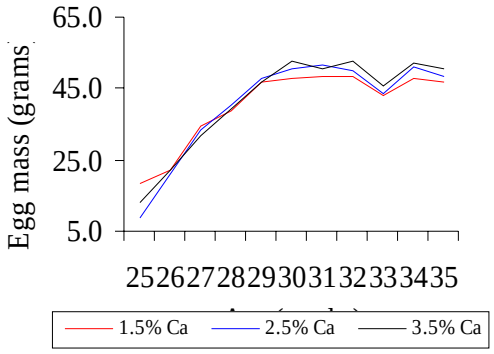

Fig. 2: The effect of dietary Ca levels and age on average egg mass

In the current study, age at point of lay (first time egg was laid) and age at peak of lay were 25 weeks (175 days) and 30 weeks (210 days), respectively. North and Bell (1990) stated that even though today's

breeder flocks are best brought into 5% hen-day production at 24 weeks of age, factors such as hatching date, season, strain, temperature, ration and feeding programme may lead to flocks varying 2 or 3 weeks from this age. Ali et al. (2003) reported average age at point of lay and age at peak of lay of broiler breeder hens to be about 24 weeks (164.67 days) and 33 weeks (232.83 days), respectively. In comparison with the results of Ali et al. (2003), the breeder hens in the present study came into lay 1-week late (25 weeks) but reached peak of lay earlier (30 weeks).

Egg production and egg mass significantly ($P<0.0001$) increased with age up to 30 weeks of age and thereafter declined non-significantly ($P>0.05$). A sharp decline in egg production and egg mass was noted at 33 weeks of age and this decline could probably be ascribed to among other factors a high ambient temperature (36.7^{o}C), which was 0.4^{o}C higher during this period compared to week 32. Although there is conflicting information in the literature regarding the thermoneutral zone, the accepted general rule of thumb is 20-30^{o}C for layers (Australian Poultry Convention Report, 1985). Additionally, North and Bell (1990) state that normally egg production does not decline until average house temperature reaches 27^{o}C. Barlett (1984) reported that for each 1 ^{o}C rise in temperature above the thermoneutral point of around 30 ^{o}C, there is a reduction of 1.5 g in feed intake. Reduced consumption renders nutrients such as protein and Ca deficient resulting in low production.

Mortality (includes also culls) rate during this period as calculated per dietary treatments were 4.5, 3.0 and 0% for birds on the 1.5, 2.5 and 3.5% Ca diets, respectively. The fact that mortality declined with increased dietary level suggests that Ca level had an effect on mortality. These results are in disagreement with those of Scott et al. (1999, 2000) who reported no differences in mortality in turkey hens after feeding diets containing Ca levels ranging from 1.24 to 4.5%. No other results on the influence of Ca intake on mortality of broiler breeders could be found in the available literature.

The growth of the broiler chick after hatching is directly related to egg weight. As a general rule, a 1 g change in egg weight results in a 7 to 10 g change in the weight of the 42-day-old finished broiler. In the current study, EW was not significantly ($P>.05$) different among dietary Ca levels (Table 4). These results are consistent with those of Atteh and Leeson (1983) and Zapata and Gernat (1995) and Ahmad et al. (2003). However, the current results are contradictory to the findings of Summers et al. (1976) who reported linear increase in EW with a higher level of Ca (2.96 *versus* 1.50%).

Age and body weight are the primary factors that influence egg weight. The present results confirm previous observations that egg weight is lowest at the beginning of the production cycle but increases as age and body weight increase throughout the laying period (Leeson and Summers, 1982; McDaniel, 1983). Regardless of Ca level in the diet, the egg weight significantly ($P<0.05$) increased from week 27 to 35 (Table 5.4). This result is consistent with Reddy et al. (1968) who fed laying hens Ca levels ranging from 2.25 to 5.05%. According to Figure 2, the greatest increases in egg weight were observed during the first 6 weeks of egg production (i.e., from 25 to 30 weeks). Similar results were observed by Yuan et al. (1994).

The mean egg weights for 1.5, 2.5 and 3.5% Ca diets in the current study were 57.76, 58.47 and 58.35 g, respectively. These average weights were slightly higher than the mean egg weight suggested by North and Bell (1990). According to these workers, the minimum egg weight for meat-type birds is between 49.6 and 52.0 g during the first 12 weeks of egg production and after 12 weeks of egg production, respectively. These workers reported that the minimum size is determined by the needs of the hatchery using the eggs and the size of the bird laying the eggs.

Table 4 presents data on egg surface area, SWUSA, egg contents, shell weight, shell percentage and eggshell thickness (sharp end, equator and broad end). Richards and Staley (1967) reported that shell thickness, SW, shell percentage and SWUSA were significantly ($P<0.01$) correlated with one another.

From the results in Table 4, it is clear that in accordance with egg weight, egg characteristics such as egg surface area and egg contents were not significantly ($P>0.05$) influenced by dietary Ca levels. However, SWUSA, shell weight, shell percentage and shell thickness improved significantly ($P<0.0001$) when dietary Ca increased from 1.5 to 2.5%. A further increase in dietary Ca resulted in no ($P>0.05$) further improvement in these characteristics. These results are inconsistent with those of Clunies et al. (1992) who reported that increasing dietary Ca level from 2.5 to 4.5% significantly ($P<0.05$) increased shell weight in Single Comb White Leghorn hens. The results on shell thickness are consistent with those of Damron and Flunker (1995) who reported significantly ($P<0.01$) higher specific gravity (indicating good shell thickness) when Ca level increased from 2.5 to 3.5% in diets of laying hens. A different response in egg quality on increasing Ca levels among breeds is to be expected as breeds differ in weight, frame size, egg production and composition.

In accordance with EW, egg contents and egg surface area significantly ($P<0.001$) increased with age

Table 4: Effect of calcium level and age on egg weight and egg characteristics

Variable	Treatment	Age (weeks) 27	30	33	Means	Significance of effect (P) Treatment	Age	Intera-ction	CV
Egg weight (g)	1.5% Ca	56.16 ± 0.74	60.07 ± 0.60	61.49 ± 0.61	59.24 ± 0.38[a]	0.5480	0.0001	0.2274	7.3
	2.5% Ca	56.35 ± 0.75	60.07 ± 0.57	62.97 ± 0.62	59.80 ± 0.38[a]				
	3.5% Ca	55.10 ± 0.73	60.51 ± 0.57	63.39 ± 0.60	59.67 ± 0.37[a]				
	Means	55.87 ± 0.43[a]	60.22 ± 0.33[b]	62.62 ± 0.35[c]					
Egg surface are (cm^2)	1.5% Ca	68.20 ± 0.62	71.54 ± 0.50	72.73 ± 0.51	70.83 ± 0.32[a]	0.5686	0.0001	0.2167	5.2
	2.5% Ca	68.38 ± 0.63	71.54 ± 0.48	73.95 ± 0.52	71.29 ± 0.32[a]				
	3.5% Ca	67.26 ± 0.62	71.88 ± 0.48	74.29 ± 0.50	71.14 ± 0.31[a]				
	Means	67.95 ± 0.36[a]	71.65 ± 0.28[b]	73.66 ± 0.29[c]					
SWUSA[1] (mg/cm^2)	1.5% Ca	73.56 ± 1.02	72.20 ± 0.82	69.48 ± 0.84	71.75 ± 0.52[a]	0.0001	0.0015	0.1731	8.0
	2.5% Ca	76.82 ± 1.03	78.13 ± 0.78	75.11 ± 0.84	76.69 ± 0.51[b]				
	3.5% Ca	75.99 ± 1.00	77.53 ± 0.78	76.27 ± 0.82	76.60 ± 0.50[b]				
	Means	75.46 ± 0.59[b]	75.95 ± 0.46[b]	73.62 ± 0.48[a]					
Egg contents (g)	1.5% Ca	51.14 ± 0.70	54.90 ± 0.56	56.44 ± 0.57	54.16 ± 0.35[a]	0.9399	0.0001	0.3113	7.5
	2.5% Ca	51.10 ± 0.71	54.48 ± 0.53	57.41 ± 0.58	54.33 ± 0.35[a]				
	3.5% Ca	49.98 ± 0.69	54.93 ± 0.54	57.72 ± 0.56	54.24 ± 0.35[a]				
	Means	50.74 ± 0.40[a]	54.77 ± 0.31[b]	57.19 ± 0.33[c]					
Shell weight (g)	1.5% Ca	5.02 ± 0.09[a]	5.16 ± 0.07[a]	5.05 ± 0.07[a]		0.0001	0.0001	0.0365	9.8
	2.5% Ca	5.26 ± 0.09[a]	5.59 ± 0.07[b]	5.55 ± 0.07[b]					
	3.5% Ca	5.12 ± 0.09[a]	5.57 ± 0.07[b]	5.67 ± 0.07[b]					
Shell percentage (%)	1.5% Ca	8.95 ± 0.12	8.61 ± 0.10	8.23 ± 0.10	8.59 ± 0.06[a]	0.0001	0.0001	0.3962	8.1
	2.5% Ca	9.33 ± 0.13	9.32 ± 0.09	8.83 ± 0.10	9.16 ± 0.06[b]				
	3.5% Ca	9.30 ± 0.12	9.23 ± 0.09	8.95 ± 0.10	9.16 ± 0.06[b]				
	Means	9.19 ± 0.07[bc]	9.05 ± 0.06[c]	8.67 ± 0.06[a]					
Sharp end (mm x 10^{-2})	1.5% Ca	39.32 ± 0.48[a]	38.60 ± 0.39[a]	37.00 ± 0.39[a]		0.0001	0.0007	0.01337	7.3
	2.5% Ca	40.59 ± 0.50[a]	41.32 ± 0.38[b]	39.86 ± 0.41[b]					
	3.5% Ca	39.66 ± 0.49[a]	41.09 ± 0.38[b]	40.46 ± 0.39[b]					
Equator (mm x 10^{-2})	1.5% Ca	38.63 ± 0.49	37.71 ± 0.40	36.46 ± 0.40	37.60 ± 0.25[a]	0.0001	0.0023	0.0707	7.5
	2.5% Ca	39.59 ± 0.50	40.58 ± 0.38	39.17 ± 0.41	39.78 ± 0.25[b]				
	3.5% Ca	39.43 ± 0.49	40.23 ± 0.38	39.56 ± 0.40	38.74 ± 0.25[b]				
	Means	39.22 ± 0.29[ab]	39.51 ± 0.0.22[b]	38.40 ± 0.23[a]					
Broad end (mm x 10^{-2})	1.5% Ca	38.71 ± 0.48	37.97 ± 0.39	36.10 ± 0.40	37.59 ± 0.25[a]	0.0001	0.0001	0.0842	7.4
	2.5% Ca	40.02 ± 0.50	40.83 ± 0.37	39.03 ± 0.40	39.96 ± 0.25[b]				
	3.5% Ca	39.70 ± 0.49	40.49 ± 0.38	39.46 ± 0.39	39.88 ± 0.25[b]				
	Means	39.47 ± 0.28[b]	39.76 ± 0.22[b]	38.20 ± 0.23[a]					

[1]SWUSA – shell weight per unit surface area; Means with the same letter within a column (treatment) or row (age) are not significantly different for the same variable, where no significant (P>0.05) interaction occurred; Means with the same letter within a row (age) are not significantly different for the same variable, where a significant (P<0.05) interaction occurred.

(Table 4). The increase in egg contents could be attributed mainly to the increase in egg yolk and to some extent increases in egg size. Egg surface area increased at a constant rate from 25 to 28 weeks of age and thereafter increased at a decreasing rate up to the end of the test period. Again, the greatest increase was

observed during the first 6 weeks of lay indicating that egg surface area is positively correlated to egg weight.

Eggshell thickness, shell percentage and SWUSA significantly ($P<0.0001$) declined with age. The SWUSA was significantly ($P<0.05$) lower at 33 weeks of age compared to 27 and 30 weeks (Table 4). The decline in SWUSA could be associated with an increased egg weight, which is negatively correlated with shell weight. These results confirmed previous reports that eggshell thickness declines with age. Roland (1980) contended that shell thickness decreases with hen age because total shell deposition after the first 3 months of lay remains fairly constant while eggs continue to increase in size. This causes the shell to be spread thinner, forcing shell quality to decline. A significant ($P<0.0001$) Ca level × age interaction for eggshell weight occurred. With the exception of 1.5% dietary Ca level, eggshell weight increased significantly ($P<0.0001$) from 27 to 30 weeks of age. A further increase in age (30 to 33 weeks) did not influence eggshell weight significantly ($P>0.05$).

As expected, eggshell weight was significantly ($P<0.05$) lower at 27 weeks of age compared to the advancing weeks (Table 4). The lower eggshell weight at 27 weeks of age could be attributable to the fact that smaller eggs are produced at the beginning of laying period'; hence lower eggshell weight during this period. Eggshell percentage declined non-significantly by 1.6% and 4.1% between 27 and 30 weeks, and significantly between 30 and 33 weeks, respectively. The 4.1% decline in eggshell percentage from 30 to 33 weeks could be associated with peak production and an increase in egg size. North and Bell (1990) contended that as eggs get larger during the laying period the shells become thinner to cover the larger egg contents. Another possible contributory factor to thinner shells is the decline of Ca from the medullary bone with age. The result on eggshell percentages is consistent with recent findings of Kul and Seker (2004) who reported that shell percentage decreases with increased egg weight. The results of the present study therefore confirmed the view that eggshell percentage is negatively correlated with EW.

The results of the present study suggest that increasing Ca level from 1.5 to 2.5% can improve eggshell quality as determined by eggshell weight, SWUSA, percentage shell and shell thickness. Ross Breeders (2001) recommended slightly higher level of 2.8% Ca in the diet. Shell weight, percentage shell, shell thickness and SWUSA declined with age while egg weight, egg surface area and egg contents increased with age. The decline in the first four factors is probably ascribable to a concomitant decline in the hens' Ca intake as they grow older. The results of the present study support the current recommended dietary level of 2.8% Ca (4-5 g) to ensure good eggshell quality. A Ca level of 2.5% and Ca intakes (g/hen/day) of 3.9, 3.8 and 3.5 g at weeks 27, 30 and 33 resulted in a good eggshell quality.

References

Ahmad, H.A., Yadalam, S.S. and Roland, Sr. D.A. 2003. Calcium requirements of Bovanes hens. *International Journal of Poultry Science*, 2: 417-420.

Ali, M., Farooq, M., Durrani, F.R., Chand, N., Sarbiland, K. and Riaz, A. 2003. Egg production performance and prediction of standard limits for traits of economic importance in broiler breeders. *International Journal of Poultry Science*, 2: 275-279.

Atteh, J.O. and Leeson, S. 1983. Influence of increasing dietary calcium and magnesium levels on performance, mineral metabolism, and egg mineral content of laying hens. *Poultry Science*, 62: 1261-1268.

Australia Poultry Convention Report. 1985. Energy conservation and the provision of optimum temperature conditions for intensive livestock. pp: 20-23.

Barlett, B.B. 1984. Feeding strategies for layers during hot weather, p.24-25. In: MacDonald, A. (ed) Managing poultry in hot weather. Proceedings of a seminar held 30th September. Victoria Department of Agriculture. Australia.

Boorman, K.N., Volynchook, J.G. and Belyavin, C.G. 1985. Eggshell formation and quality. In: Haresign, W. and Cole, D.J.A. (eds.). Recent Advances in Animal Nutrition – 1985. Butterworths. London. pp: 181-187.

Carter, T.C. 1975a. The hen's egg: A rapid method for routine estimation of flock mean shell thickness. *British Poultry Science*, 16: 131-143.

Carter, T.C. 1975b. The hen's egg: Estimation of shell superficial area and egg volume, using measurements of fresh egg weight and shell length and breadth alone or in combination. *British Poultry Science*, 16: 541-543.

Chowdhury, S.R. and Smith, T.K. 2001. Effects of dietary 1,4-Diaminobutane (Putrescine) on eggshell quality and laying performance on older hens. *Poultry Science*, 80: 1209.

Clunies, M., Parks, D. and Leeson, S. 1992. Calcium and phosphorus metabolism and eggshell formation of hens fed different amounts of calcium. *Poultry Science*, 71: 482-489.

Damron, B.L. and Flunker, L.K. 1995. Calcium supplementation of hen drinking water. *Poultry Science*, 74: 784-787.

Ehtesham, A. and Chowdhury, S.D. 2002. Responses of laying hens to diets formulated by using different

feeding standards. *Pakistan Journal of Nutrition,* 1: 127-131.

Farmer, M., Roland, Sr., D.A. and Eckman, M.K. 1983. Calcium metabolism in broiler breeder hens. 2. The influence of the time of feeding on calcium status of the digestive system and eggshell quality in broiler breeders. *Poultry Science,* 62: 465-471.

Hamilton, R.M.G. 1982. Methods and factors that affect the measurements of egg shell quality. *Poultry Science,* 61:2022.

Hopkins, J.R., Ballantyne, A.J. and Jones, J.L.O., 1987. Dietary phosphorus for laying hens. *Recent Advances in Animal Nutrition.* 231.

Hunton, P. 1982. Genetic factors affecting egg shell quality. *World's Poultry Science Journal*, 38*:* 75-82.

Ikeme, A.I., Roberts, C., Adams, R.L., Hester, P.Y. and Syadelman. 1983. Effects of supplementary water-administered vitamin D3 on egg shell thickness. *Poultry Science,* 62*:* 1121.

Keshavarz, K. and Nakajima, S. 1993. Re-evaluation of calcium and phosphorus requirements of laying hens for optimum performance and eggshell quality. *Poultry Science,* 72: 144-153.

Klasing, K.C. 1998. *Comparative Avian Nutrition.* CABI Publishing, Wallingford, UK. pp: 238-248.

Kul, S. and Seker, I. 2004. Phenotypic correlations between some external and internal quality traits in the Japanese quail (*Coturnix cortunix japonica*). *International Journal of Poultry Science,* 3: 400-405.

Leeson, S. and Summers, J.D. 1982. Consequence of increased feed allowance for growing broiler breeder pullets as a means of stimulating early maturity. *Poultry Science,* 62: 6-11.

McDaniel, G.R. 1983. Factors affecting broiler breeder performance. 5. Effects of preproduction feeding regimens on reproductive performance. *Poultry Science,* 62: 1949-1953.

North, M.O. and Bell, D.D. 1990. *Commercial chicken production manual (fourth edition).* Van Nostrand Reinhold, New York. 686.

Ousterhout, L.E. 1980. Effects of calcium and phosphorus levels on egg weight and eggshell quality in laying hens. *Poultry Science,* 59: 1480-1484.

Reddy, C.V., Sanford, P.E . and Clegg, R.E. 1968. Influence of calcium in laying rations on shell quality and interior quality of eggs. *Poultry Science,* 47: 1077-1082.

Richards, J.F. and Staley, L. 1967. The relationships between crushing strength, deformation and other physical characteristics. *Poultry Science,* 46: 430-437.

Robinson, F.E. 1999. Management for control of ovarian development in broiler breeders. http://www.mids.net/rossbreeders/usa/tech/99.01.html

Roland, Sr. D.A. 1980. Egg shell quality. II. Effect of dietary manipulations of protein, amino acids, energy, and calcium in young hens on egg weight, shell weight, shell quality, and egg production. *Poultry Science,* 59: 2047-2054.

Roland, Sr. D.A. 1986. Egg shell quality. II. Importance of time of calcium intake with emphasis on broiler breeders. *World's Poultry Science Journal,* 40: 255-259.

Roland, Sr. D.A. 1988. Eggshell problems: Estimates of incidence and economic impact. *Poultry Science,* 67: 1801-1803.

Roland, Sr. D.A., Bryant, M.M. and Rabon, H.W. 1996. Influence of calcium and environmental temperature on performance of first-cycle (Phase 1) commercial leghorns. *Poultry Science,* 75: 62-68.

Ross Breeders. 1998. Ross Broiler Parent Stock Management Guide, November, 1998. Newbridge, United Kingdom. pp: 40-46.

Ross Breeders. 2001. Parent Stock Management Manual: Ross 308. Newbridge, United Kingdom. 46.

SAS Institute, 1996. SAS® User's Guide. Version 6.12. SAS Institute., Inc., Raleigh, NC.

Scott, T.A., Kampen, R. and Silversides, F.G. 1999. The effect of phosphorus, phytase enzyme, and calcium on the performance of layers fed corn-based diets. *Poultry Science,* 78: 1743-1749.

Scott, T.A., Kampen, R. and Silversides, F.G. 2000. The effect of phosphorus, phytase enzyme, and calcium on the performance of layers fed wheat-based diets. *Canadian Journal of Animal Science,* 80: 183-190.

Strong, C.F. 1989. Research note: Relationship between several measures of shell quality and egg breakage in a commercial processing plant. *Poultry Science,* 68: 1730-1733.

Summers, J.D., Grandhi, R. and Leeson, S. 1976. Calcium phosphorus requirements of the laying hen. *Poultry Science,* 55: 402-413.

Waldroup, P.W., Maxey, J.F. and Luther, L.W. 1974. Studies on the calcium and phosphorus requirements of caged turkey breeder hens. *Poultry Science,* 53: 886-888.

Yuan, T., Lien, R.J. and McDaniel, G.R. 1994. Effects of increased rearing period body weight and early photostimulation on broiler breeder egg production. *Poultry Science,* 73: 792-800.

Zapata, L.F. and Gernat, A.G. 1995. The effect of four levels of ascorbic acid and two levels of calcium on eggshell quality of forced-molted while leghorn hens. *Poultry Science,* 74: 1049-1052.

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Toxicity of methanolic and chloroformic extract of Asistolochia brcteolata in rats

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Abstract

This study was designed to find the toxicological effect of methanolic and chlorformic extract of *Aristolochia bracteolata* in Swiss albino rats. Methanolic and chlorphormic extracts were given at doses of 250 and 500 mg/kg BW to Swiss albino rats. Oral administration of the extract caused symptoms such as depression, arching of the back and tremors. Serum analysis indicated increase in the activity of Aspartate aminotransferease (AST), Alanine amino transferase (ALT) and Alkaline phosphatase (ALP). The concentration of urea, creatinine, ammonia were also increased and the concentration of total protein decreased. The main lesions found were haemorrage in the kidney and congestion of the liver. We concluded that chloroformic extract at the rate of 500 mg/kg was more toxic than all the treatments.

Keywords: *Aristolochia bracteolata*, Toxicity, Rats

Introduction

Aristolochia bracteolata is a member of the family aristolochiaceae and is used in Kenya, Tanzania, Ethiopia and Sudan for the treatment of nematodes infections. The methanolic extract of *A. bracteolata* showed activity against some types of bacteria species (Farouk et al., 1983). There are also reports stated that *A. baracteolata* has hypotensive activity (Raq, 1980). The ethanolic extract of *Aristolochia* species roots decreased fertility in both rats and hamsters without interruption of pregnancy when administered on day six of pregnancy.

The extract of *Aristolochia bractelolata* exhibited activity against plasmodium falciparum strain. *Aristolochia bracteolata* was found to have a trypanocidal effect against *Trypanosoma evansi* (Samia et al., 2006). The quantitative analysis of aristolochiaceae determined that all the species contain aristolic acid (Hashimoto et al., 1999). It was reported that Aristolochia produce interstitial nephritis caused by aristolic acid during chronic use of treatment (Mengs and Stozen, 1993). The objective of this research was to find the effect of methanolic and chloroformic exatracts of *Aristolochia bractelolata* on serum biochemistry and histopathological alternations in albino rats.

Material and Methods

Forty Swiss albino rats (Albino Wister) weighed 150-200 gm were used in this experiment.They were housed in laboratory cages, fed with pellets and fresh vegetables and were watered *ad libitum* throughout the experimental period. The whole plant of *A. bracteolata* was collected and shade dried and then later ground to powder using a morter and pestle. The powder was extracted with chloroform and methonal successively by percolation. A ten fold quantity of solvent in relation to the plant material was mixed in 2-litre elenmeyer flask and kept over night at room temperature. It was evaporated at 40^{o}C low pressure using a rotatory evaporator completed to a themoregulatory device. The solid extract obtained was removed, weighed and was kept as the stock solution for use. The chloroformic extract was dissolved in propylene glycol while the methanolic extract was dissolved in distilled water.

The plant was extracted with chloroform and methanol, and given orally by nasogastric tube. The rats were divided into four groups. Group A was given 500 mg/kg BW Chloroformic extract, group B given 500 mg/kg BW methanolic extract, groups C given 250 mg/kg BW chloroformic extract and group D given 250 mg/kg BW methanolic extract. Group E was kept untreated control. Daily dosing was continued until the

rats died or were killed at the end of the experiments (4 weeks).

All rats were bled from oculars vein before dosing commenced and at week intervals thereafter for serum analysis and hitopathology of liver and kidneys. Blood samples were allowed to clot, serum was separated and stored at –20^{o}C until analyzed. Serum samples were examined for activities of AST and ALT by the method descrbed by Reitman (1969). The concentrations of total protein (Weichselbaum, 1946), ammonia and urea (Varley, 1967), magnesium (Gradwohp, 1956) and the activity of creatinine and alkaline phosphatase was determined by commercially available kit. For histopathological studies, tissues were fixed in 10% formal saline and 6-µm paraffin sections were stained with haemtoxylin and Eosin (HE).

Statisitcal analysis

The rsults were expressed as means and standard deviation. The significanse of differences between the means were analysed by Steel et al. (1997). Where there was significant difference, Duncan Multiple Range Test (DMRT) was used.

Results

The mortality rates for chlorofomic and methanolic extracts were shown in table 1. With 500mg/kg of the chloroformic extract, ten rats died during the observation period started from the third day of treatment till the end of experiment with percentage rate 100%. The 250 mg/kg BW of the chloroformic extract gave mortality percentage rate of 60% when 6 of the 10 rats died during the experimental period. The 500mg/kg BW methanolic extract gave percentage rate of 70% with 7 of 10 rats died, and the 250 mg/kg BW of the methanolic extract gave only 30% percentage rate of mortality. Mortality was only 10% in control rats.

The biochemical changes associated with the plant extracts was shown in table 2 and 3. The higher dose of both the chloroformic (500mg/kg) and methanolic extract (500mg/kg) gave significant increase in AST and ALT and ALP enzymes activity ($P<0.05$). There was also significant increase in the concentration of urea and creatinine ($P<0.05$). There was gradual decrease in the concentration of total protein which was found to be the significant with the chloroformic extract and non significant with the methanolic extract. The concentration of Ammonia in the group that given 500 mg/kg BW of the chloroformic extract increased from the second week of treatment and remained high till death or slaughter of the rats. With the 500mg/kg BW methanolic extract, the concentration of ammonia increased in the second week of treatment where it fluctuated after until the end of the experimental period.

The concentration of magnesium showed decrease with both plant extracts but the decrease was not found to be significant. It was found that the 250 mg/kg Bw of both the methanolic and chloroformic extract gave no significant changes in either liver enzymes or total Protein, or alkaline phosphatase, urea, creatinine, magnesium or ammonia table 4 and 5.

Table 1: Mortality rates in rats given *Aristolochia bracteolata* extracts for 4 weeks

Group No.	No. of rats used	Dose mg/kg BW	Mortality	Percentage
A	10	500 Chloroformic extract	10	100%
B	10	500 Methanolic extract	7	70%
C	10	250 Chloroformic extract	6	60%
D	10	250 Methanolic extract	3	30%
E	10	(Control)	1	1%

Table 2: Biochemical changes associated with the treatment of 500mg/kg BW of Chloroformic extract of *A. bracteola*

Parameters	Week 0	Week 1	Week 2	Week 3	Week 4
ALT (U/l)	18.76 ± 0.67^{d}	22.24 ± 0.83^{c}	29.36 ± 0.74^{b}	36.22 ± 0.64^{b}	43.21 ± 0.94^{a}
AST (U/l)	14.28 ± 2.14^{d}	18.21 ± 0.75^{c}	24.18 ± 0.82^{c}	29.12 ± 0.74^{b}	32.12 ± 0.52^{a}
Total protein (g/dl)	7.48 ± 0.19^{a}	5.65 ± 0.28^{b}	4.22 ± 0.08^{b}	3.53 ± 0.49^{c}	2.48 ± 0.21^{d}
ALP (U/l)	2056.64 ± 42.12^{d}	2216.21 ± 32.14^{d}	2500 ± 28.12^{c}	2982.47 ± 38.24^{b}	3313.38 ± 24.48^{a}
Urea (mmol/l)	4.52 ± 0.62^{b}	5.48 ± 0.54^{b}	6.88 ± 0.42^{b}	8.66 ± 0.52^{b}	11.84 ± 0.61^{a}
Creatinine (mmol/l)	0.68 ± 0.08^{c}	0.71 ± 0.07^{c}	0.82 ± 0.08^{b}	0.95 ± 0.08^{b}	1.68 ± 0.42^{a}
Magnesium (mmol/l	4.14±0.04	4.20±0.02	4.60±0.03	3.20±0.01	3.12±0.02
Ammonia	0.45±0.02	0.56±0.03	0.59±0.02	0.61±0.01	0.65±0.02

The different superscript letters a and b in columns are significantly different ($P\leq0.05$).

Table 3: Biochemical changes associated with the treatment of 500mg/kg BW of methanolic extract of *A. bracteolat*

Parameters	Week 0	Week 1	Week 2	Week 3	Week 4
ALT (U/l)	16.24±0.78^{c}	20.24±0.74^{b}	24.48±0.68^{ab}	29.00±0.62^{b}	35.21±0.64^{a}
AST (U/l)	12.32±0.82^{d}	15.82±0.25^{d}	18.25±0.83^{c}	25.25±0.83^{b}	31.50±0.68^{a}
Total protein (g/dl)	6.78±0.46	6.21±0.61	5.88±0.48	5.16±0.38	4.24±0.52
ALP (U/l)	1852.00±8.24^{c}	1984.01±11.23^{b}	2084.18±7.56^{b}	2121.32±9.24^{b}	2410.02±8.28^{a}
Urea (mmol/l)	4.23±0.52	5.56±0.45	6.84±0.48	8.21±0.26	9.86±0.36
Creatinine (mmol/l)	0.58±0.08^{d}	0.64±0.19^{d}	0.82±0.09^{c}	0.94±0.08^{b}	1.04±0.08^{a}
Magnesium (mmol/l	1.15±0.43	1.44±0.06	1.14±0.08	1.52±0.04	1.56±0.04
Ammonia	0.46±0.01	0.51±0.02	0.56±0.03	0.59±0.02	0.62±0.02

The different superscript letters a and b in columns are significantly different ($P \leq 0.05$).

Table 4: Biochemical changes associated with the treatment of 250 mg/kg BW of chloroformic extract of *A. bracteolata*

Parameter	Week 0	Week 1	Week 2	Week 3	Week 4
ALT (U/l)	15.84±0.44	16.55±0.24	18.42±0.62	19.22±0.72	21.62±0.44
AST (U/l)	14.42±0.23	15.62±0.25	16.27±0.24	18.88±0.54	19.88±0.24
Total protein (g/dl)	7.68±0.16	6.82±0.14	6.26±0.64	5.26±0.42	4.92±0.52
ALP (U/l)	1789±7.32	1886.08±6.2	1888.12±6.56	1911.92±4.42	1982.02±5.28
Urea (mmol/l)	4.85±0.12	5.68±0.52	6.94±0.42	7.86±0.25	8.84±0.18
Creatinine (mmol/l)	0.66±0.4	0.71±0.16	0.78±0.06	0.82±0.04	0.88±0.06
Magnesium (mmol/l	1.78±0.24	1.66±0.06	1.58±0.06	1.52±0.08	1.49±0.04
Ammonia	0.46±0.02	0.54±0.02	0.56±0.04	0.58±0.06	0.61±0.03

Table 5: Biochemical changes associated with the treatment of 250 mg/kg BW of methanolic extract of *A. bracteolata*

Parameter	Week 0	Week 1	Week 2	Week 3	Week 4
ALT (U/l)	15.23±0.88	16.14±0.54	17.48±0.60	18.21±0.52	20.12±0.64
AST (U/l)	13.22±0.73	14.62±0.25	15.25±0.75	16.28±0.66	18.52±0.22
Total protein (g/dl)	7.65±0.46	6.21±0.74	6.26±0.64	6.16±0.32	5.84±0.52
ALP (U/l)	1765.o±7.32	1876.01±9.22	1888.12±6.56	1898.72±7.45	1982.02±6.28
Urea (mmol/l)	4.56±0.52	5.24±0.32	6.84±0.48	7.22±0.26	7.86±0.24
Creatinine (mmol/l)	0.65±0.1	0.58±0.12	0.62±0.08	0.74±0.04	0.81±0.08
Magnesium (mmol/l	1.55±0.63	1.65±0.06	1.58±0.08	1.56±0.08	1.56±0.04
Ammonia	0.49±0.01	0.51±0.03	0.52±0.03	0.58±0.02	0.58±0.02

Rats given the high dose of chloroformic extract of the plant showed symptoms like depression, arching of the back and tremors. The histopathological changes associated with the chloroformic extract (500 mg/kg) were found to be degenerative changes in liver and kidney. The chloroformic extract resulted in vascular degenerative necrosis of the liver and focal segmental glomerulonephritis (Fig. 1 and 2).

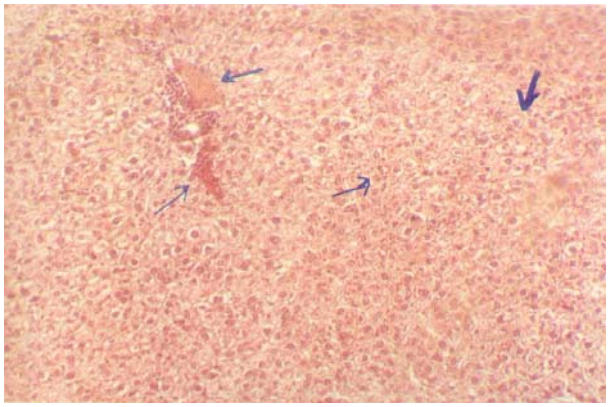

Fig 1: Haemorage in the liver and necrotic foci in response to methanolic extract (500mg/kg)

Discussion

Aristolochia bracteolata poisoning in rats caused lesions in the liver and kidney and the main signs were weakness, depression and loss of condition.

The increase in the activity of AST, ALT, ALP and the decrease in the concentration of total protein indicate liver damage. Cell damage increase the

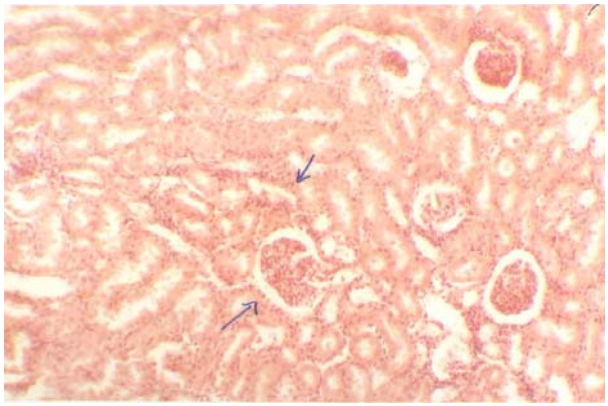

Fig 2: Degenerative changes in the kidney of rats dosed with 500mg/kg chloroformic extrac

membrane permeability, causing systolic enzymes to spill into the sinusoids and from there into peripheral blood (Carl and Edward, 2002). The increase in the concentration of urea and creatinine suggest renal disfunction. The renal tubular disorder have been known to cause hypomasgnesemia (Randel, 1969). This was probably the cause of hypomagnesemia in rats given the extract of *A. bracteolata*. Liver lesions even if relatively mild, can interfere with biluribin excretion. Similar findings have been described in goats fed with *Asristolochia bracteolata* (Barakat et al., 1983).

The mortality rates of the rats given *A. bracteolata* extracts indicate that the chloroformic extract is more toxic than the methanolic extract. This indicates that the chloroform may be capable to extract the toxic active material responsible for toxicity, this result agreed with that of Barakat et al. (1983) who found that the agous extract of *A. bracteolata* was toxic when given at high doses. The chloform extract the toxic materials found in the plant.

It was concluded that *Asristolochia bracteolate* was found to be toxic at higher doses and the chloformic extract was more toxic than the methanolic extract.

References

Barakat, S.E.M. Wasfi, A. and Adam, S.E.I. 1983**.** The toxicity of *Aristolochia bracteolata* in goats. *Veterinary Pathology*, 20**:** 611-616.

Carl, A.B and Edward, R.A. 2002. Analytes in Fundamentals of Clinical Chemistry. Fifth Edition. Pp: 494-516.

Farouk, A. Bashir, A.k. and Salih, A.K.M. 1983. Antimicrobial activity of certain Sudanese plants used in folkloric medicine for antibacterial activity. *Fitoterapia*, 54(1): 3-7.

Gradwohp, R.B. 1956. Clinical laboratory method and diagnosis. 4th (ed.) C.V. Mosby company, St. Lowis. MO. P. 455.

Hashimoto, K. Higuchi, M. Makino, B. Sakakibo, I. Kubo, M. Komatsu, Y. Maruno, M. and Okada, M. 1999. Quantitative analysis of aristolochic acids, toxic compounds, contained in some medicinal plants. *Ethnopharmacology*, 64(2): 185-9.

Mengs, U. and Stotzen, C.D. 1993. Renal toxicity of aristolochic acid in rats as an example of nephrotoxicity testing in routine toxicology. *Archive Toxicalogy* 67(5): 307-11.

Samia, H.A.R, Elmalik, K.H. and Khalid, H.S. 2006. Therapeutic effect of Aristolochia bracteolate extract againstexperimental *Trpanosoma evansi* infection. *International Journal of Tropical Medicine* 1(4): 170-172.

Randel, R.E. 1969. Magnesium metabolism in chronic renal disease. *Annals of the New York Academy of Science*, 162:831-846, 1969

Raq, V.S. 1980. Pharmacological screening and comparative efficacy of some indigenous anthelmintics. Abstr 4th Asian Symp Med Plants Species Bankok Thailand. September 15-19.

Reitman, S. and Frankel, S. 1969. Colorimetric method for the determination of serum glutamic oxalo-acetate and glutamic pyruvic transaminases. *American Journal of Clinical Pathology*, 28: 56-63.

Snedicor, G.W. And Cochron, W.G. 1967. Statistical methods. Six edition. The lowa State University. Press USA. Pp: 128-135.

Steel, R.G.D., Torrie, J.H. and Dieky, D.A. 1997. Principles and Procedures of Statistics. 3rd Ed. McGraw Hill Book Co. Inc., New York.

Varley, H. 1967. Practical clinical biochemistry 4th ed. William Heinemann Medical books Ltd. Unc. New York. P: 407.

Weichselbaum, T.E. 1946. An accurate and rapid method for the determination of proteins in small amounts of blood serum and plasma. *American Journal of Clinical Pathology*, 16:40-43.

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Modification of productive performance and physiological aspects of broilers on the addition of a mixture of cumin and turmeric to the diet

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Abstract

A study was conducted to determine the performance of broilers fed diets supplemented with a mixture of cumin (*Cuminum cyminum*) and turmeric (*Curcuma longa*). A total of 300 (Arbor-Acres) day old chicks were used in this study. Five levels of a mixture cumin and turmeric at the rate of 0.00%, 0.25%, 0.50%, 0.75% and 1% were incorporated into the basal diet for six weeks. Feeding period for all groups was lasted for 42 days. Results revealed that the inclusion of cumin and turmeric mixture at levels of 0.75% and 1% in the diets improved body weight gain, feed intake and feed conversion ratio. At the same time the cumin and turmeric mixture of 0.75% and 1% depressed the cholesterol, Hb, RBC, WBC, and H/L ratio concentration. It was concluded that the use of mixture containing cumin (*Cuminum cyminum*) and turmeric (*Curcuma longa*) as feed additive at levels 0.75% and 1% enhanced the overall performance of broiler chicks.

Key words: Performance, Physiological, Broiler, Cumin, Turmeric

Introduction

Antibiotic growth promoter (AGP) in poultry industry has been seriously criticized by governmental policy makers and consumers, since the development of microbial resistance to these products and the potential harm on human health (Williams and Losa, 2001; Bostoglou et al., 2004). The phasing out AGP will affect the poultry and animal industry widely, to minimize the loss in growth. There is a need to find out the alternative to AGP, such as enzymes inorganic acids, probiotics, prebiotics, herbs, immunostimulant and some other management practices (Banerjee, 1998). Since ancient times, herbs and their essential oils have been known for their varying degrees of antimicrobial (Juven et al., 1994; Change, 1995).

The medicinal plant turmeric is commonly used as spices in cuisine dishes. Turmeric is a perennial herb and a member of *Zingiberacae* family. Turmeric grows to a highest of 3 to 5 feet and has oblong pointed leaves, which bears funnel shaped yellow flowers. The rhizome is partly used as spices and medicine. It is usually boiled, cleaned and dried, yielding a yellow powder (Durrani et al., 2006). Turmeric is a medicinal plant widely used and cultivated in tropical regions. Plant extracts obtained from turmeric were found to have antifungal and antioxidative properties. The active compounds found in turmeric are curcumin, demethoxcurcumin, bisdemethoxycurcumin and tetrahydrocurcuminoids (Osawa et al., 1995). Moreover, Soni et al. (1997) proved that the protective effect of turmeric feed additives on aflatoxin–induced mutagenicity and hepatocarcinogennicity.

On the other hand cumin as medical plant could be introduced in poultry among their diets as nutritional and medical sources for different purpose. Cumin contains most dietary nutrients such as carbohydrates, fats of both saturated and unsaturated fatty acids and proteins, in addition to minerals and vitamins. Cumin is the dried seed of the herbs *Cuminum cyminum*. Cumin grows to 30-50 cm (0.98-1.6 ft) tall. The flowers are small, white or pink and borne in umbels. Cumin seeds resemble *caraway* seed. Cumin seeds are used as a spice. Jazani et al. (2008) indicated the potential use of cumin essential oil for the control of some diseases caused by *Pseudomonas aeruginosa* infections. Chemically cumin contained carbohydrates 44.24g, sugar 2.25g, fiber 10.5g, fat 22.27 g, protein 17.81g and water 8.06g (Jonas et al., 2007). Nutritionally, inclusion of cumin seeds meal in broiler diets induces an increase in the weight gain of the birds. Also an improvement in the absorption process as a result of increasing diet fibers was also noticed (Mansoori et al., 2006). Other researchers proved that there is an increase in body weight, feed conversion ratio, with decreasing hematological values of some important blood

parameters using 2% of cumin in broiler diets (Ibrahim et al., 2007).

The literature is very rare related to the cumin and turmeric activities in poultry nutrition. The present experimental work was planned to investigate the effect of cumin and turmeric on the overall performance of broilers.

Materials and Methods

The experiment involved three hundred day-old mixed sexed chicks (Arbor-Acres). They were obtained from local hatchery and placed in closed house at the poultry farm of the Collage of Veterinary Medicine, University of Baghdad, Iraq. Chicks were fed with the starter diet (3000 Kcal ME/Kg, 21.3% CP as fresh matter basis) for the first three weeks of the experiment. Consequently they were fed on finisher diet (3086 Kcal ME/Kg, 19.5% CP as fresh matter basis) during 3-6 weeks of the experiment.

Chicks were weighted and the average weight and were assigned into 5 treatment groups of 3 equal replicates (20 chicks each). Chicks were reared in floor pens (1.25 ×1.25 m). Artificial lighting was provided throughout the experiment. Temperature of the house was maintained and vaccination program was applied based on broiler raisers recommendation.

Chemical composition of the basal diet is presented in Table 1. It is formulated to meet nutrient requirement of broiler chickens (NRC, 1994). The cumin and turmeric were purchased commercially as dried herbs supplements. Birds in group 1 were fed a basal diet and assigned as untreated control. Whereas groups 2, 3, 4, and 5 were fed a mixture of cumin and turmeric at 0.25%, 0.50%, 0.75% and 1% respectively in addition to group 1 diet. Chicks of each treatment were fed the respective diets. Water was provided *ad libitum* throughout the experimental period.

The average live body weight, body weight gain, feed intake, mortality percent and feed conversion ratio were measured on weekly basis. At the end of the experiment, birds were slaughtered and spotted for throat and jugular vein using a sharp knife near the first vertebra. From each replicate 10 birds were picked for eviscerating to calculate the dressing percent without the edible giblets.

Meanwhile blood samples (5ml) were collected from the bronchial vein with an anticoagulant (Sodium Ethylene Ditetra amino) to determine the number of red blood cells (RBC), white blood cells (WBC), packed cell volume (PCV) and hemoglobin (Hb) percentage. 5 ml of the blood sample was collected from each bird and serum was separated to determine the concentration of cholesterol and uric acid measured according to the method described by Ellefson and Ganaway (1967).

Table 1: Chemical composition of the basal diet in different periods of the experiment

Ingredients%	Starter	Finisher
	1-21	22-42
Yellow corn	51.0	53.3
Soybean meal (45% soybean protein)	30.0	25.0
Wheat	13.8	15.0
Soybean oil	1.0	2.5
Premix*	2.5	2.5
Salt	0.3	0.3
Methionine	0.1	0.1
Lysine	0.1	0.1
Di-calcium phosphate	1.2	1.2
Total	100	100
Calculated chemical analysis		
ME(Kcal/kg)	3000	3086
Crude protein %	21.30	19.50
Calcium %	0.69	0.52
Available phosphate	0.74	0.69
Methionine	0.33	0.31
Lysine	1.19	1.08

∗Premix (2.5%) Provided the following (Per Kg of complete diets). Vit A. 367500 IU,133500 IU Vit. D_3, 1920 mg Vit.E, 84.42 Vit. K_3, 50 mg Vit. B_1, 150 mg Vit. B_2, 500 mg Vit. B_3, 177.5 mg Vit. B_6, 0.8 mg Vit. B_{12}, 600 mg Vit. PP, 24.5 mg folic acid, 27 mg biotin, 5767.5 mg choline, 2667 mg Fe, 333.75 mg Cu, 3334.06 mg Mn , 203 mg Co , 2334.38 mg Zn , 100.75 mg Ca , 10 mg Se, 65446.46 mg Ph, 36667.5 mg DL-Mithionine, 200.02mg, Ethoxyquin,50mg Flavophospholipol, 30g Fish meal, 1800g wheat bran

Data were analyzed by using the General Linear Model Procedure of SAS (2001). Means were compared by the Duncan's Multiple Range test at 5% probability (Steel and Torrie, 1980).

Results and Discussion

The effect of a mixture cumin and turmeric on the growth performance (body weight gain, feed intake and feed conversion ratio) of broiler was presented in table 2. Results showed significant effects ($P<0.05$) for chicks fed a mixture of cumin and turmeric for all treatments as compared with control group. These results showed that the inclusion of cumin and turmeric mixture in the diets improved body weight gain, feed intake and feed conversion ratio. This improvement may be due to the biological functions of cumin improve growth (Cowieson et al., 2003; Ghazalah et al., 2005; Al-Kassie, 2010), or that may be due to its role as stimulant, carminative, enhanced digestibility, anti-microbial properties and the prevention of gastric toxicity (Jones et al., 1997; El-Husseiny et al., 2002)

Table 2: Effect of adding a mixture of cumin (*Cuminum cyminum*) and turmeric (*Curcuma longa*) to the diet on performance of broiler

Treatments	3 weeks			6 weeks		
	Body wt. Gain (gm)	Feed consumption (gm)	FCR	Body wt. gain (gm)	Feed consumption (gm)	FCR
Control T1	698±13.3^{c}	1200±22.3^{c}	1.72±2.7^{b}	2290±41.3^{b}	4603±58.4^{a}	2.01±2.11^{c}
0.25% T2	863±16.2^{b}	1476±19.4^{b}	1.71±1.3^{b}	2379±38.9^{b}	4496±61.2^{b}	1.89±1.99^{b}
0.50 % T3	938±15.3^{a}	1566±23.4^{b}	1.67±2.7^{a}	2538±36.4^{a}	4543±64.3^{b}	1.79±1.92^{a}
0.75 % T4	998±16.7^{a}	1616±20.8^{a}	1.62±2.8^{a}	2608±35.4^{a}	4538±58.4^{b}	1.74±1.71^{a}
1.00% T5	988±14.1^{a}	1610±24.7^{a}	1.63±1.9^{a}	2568±42.1^{a}	4525±62.3^{b}	1.76±1.68^{a}

^{abc} means in the same column with no common superscript differ significantly (P≤0.05).

Table 3: Effect of adding a mixture of cumin and turmeric to the diet on mortality %, dressing and edible giblets %

Treatments	Mortality %	Dressing %	Edible giblets %		
			Liver	Gizzard	Heart
Control T1	5.8±4.7^{a}	73.4±1.7	4.1±0.3	3.8±0.06	0.74±0.04
0.25% T2	4.7±3.3^{b}	72.6±1.9	3.8±0.7	4.3±0.08	0.85±0.03
0.50 % T3	2.9±3.9^{c}	71.4±1.6	3.7±0.1	4.2±0.07	0.79±0.02
0.75 % T4	3.4±4.2^{c}	73.6±1.8	3.5±0.6	3.2±0.04	0.09±0.04
1.00% T5	3.9±3.8^{bc}	72.9±1.8	3.9±0.5	3.4±0.01	0.82±0.04

^{abc} means in the same column with no common superscript differ significantly (P<0.05)

Table 4: Effect of adding a mixture of cumin *(Cuminum cyminum*) and turmeric (*Curcuma longa*) to the diet on hematological and serum parameters

Treatment	Hb (g/dl)	RBC (10^6/mm^3	PCV (%)	WBC (cells/L)	H/L ratio	Cholesterol (mg/dl)	Uric acid (mg/dl)
Control T1	10.3±2.7^{a}	3.7±1.3^{a}	36.3±2.7^{a}	24.1±2.8^{a}	0.30±0.2^{a}	149.2±4.3^{a}	4.6±0.4^{a}
0.25% T2	9.9±2.3^{b}	3.6±1.1^{a}	36.1±2.8^{a}	24.0±2.6^{a}	0.28±0.1^{b}	148.3±3.8^{b}	4.7±0.3^{a}
0.50% T3	9.3±3.2^{c}	3.6±1.2^{a}	35.4±3.2^{b}	23.7±2.9^{a}	0.28±0.2^{b}	148.4±3.7^{b}	4.4±0.2^{a}
0.75% T4	8.9±3.2^{d}	2.8±1.9^{b}	33.1±3.0^{c}	21.7±2.8^{b}	0.26±0.3^{c}	145.6±2.9^{c}	3.8±0.2^{a}
1.00% T5	9.1±2.7^{cd}	2.9±1.4^{b}	32.2±3.3^{a}	21.5±2.4^{b}	0.26±0.2^{c}	145.4±2.8^{c}	3.6±0.1^{a}

^{abc} means in the same row with no common superscript differ significantly (P<0.05)

and to the activity of turmeric as a antioxidant that stimulate protein synthesis (Osawa et al., 1995).

Table (3) shows the effect of cumin and turmeric mixture on mortality, dressing and edible giblets percents. It showed that there was significant difference (P<0.05) on mortality percentages between treatments as compared with the control group. This may be due to the role of herbal plants (cumin and turmeric) on the immune stimulating factor (Al-Kassie, 2010). The same table showed that there was no significant difference (P<0.05) between treatments and control group in dressing % and edible giblets %.

Table 4, showed a depression in cholesterol level in groups 4 and 5 as compared with other groups as expected and this may be due to the inhibition of the active enzyme hepatic 3-hydroxyl-3 methyglutaryl coenzyme A(HMG-CoA) which is responsible for cholesterol synthesis in the liver (Crowell, 1999). Furthermore the reduction in blood cholesterol could be attributed in some cases to the reduction in the levels of some hormones secreted by the cortex of the adrenal glands, which decreases the secretion of fatty acids from the adipose tissue or as a result of fat oxidation process, leading to depression of levels of fatty acids including blood cholesterol (Ganong, 2005).

It was concluded that the use of mixture cumin (*Cuminum cyminum*) and turmeric (*Curcuma longa*) as fed additive at levels of 0.75% and 1% enhance the overall performance of broiler chicks.

References

Al-Kassie, G.A.M. 2010. Effect of feed cumin (*Cumin cyminum*) on the performance and some blood traits of broiler chicks. *Pakistan Journal of Nutrition*, 1:72-75.

Bangerjee, G.C. 1998. A Text Book of Animal Husbandry.2nd Ed. Indic Puplicalication, Delhi, India.

Botsoglou, N.A.E. Christaki, P., Florou-Paneri, I., Giannenas, G., Papageorgious and Spais, A.B. 2004. The effect of a mixture of herbal essential oils or tocopheryl acetate on performance parameters and oxidation of body lipid in broiler.

South African Journal of Animal Science, 34:52-61.

Chang, H.W. 1995. Antibacterial effect of spices and vegetables. *Food Industries*, 27:53-61.

Cowieson, A.J., Acamovic, T. and Berford, M.R. 2003. Supplementation of diets containing pea meal with exogenous enzymes: Effect on weight gain, feed conversion, nutrient digestibility and gross morphology of the gastrointestinal tract of growing broiler chicks. *British Poultry Science*, 44:427-437.

Crowell, P.L. 1999. Prevention and therapy of cancer by dietary monoterpenes. *Journal of Nutrition*, 129:775 -778.

Durrani, F.R., Mohammad, I., Asad, A., Suhail, S.M., Naila, C. and Durrani, Z. 2006. Effect of different levels of feed added Turmeric (*Curcuma longa*) on the performance of broiler chicks. *Journal of Agricultural and Biological Science,* 1:11-16.

El-Husseiny, O., Shalash, S.M. and Azouz, H.M. 2002. Response of broiler performance to diets containing hot pepper and /or fenugreek at different metabolizable energy levels. *Egyptian poultry Science*, 22:387-406.

Ellefson, R.D. and Garaway, W.T. 1967. Lipids and lipoprotines. In: Fundamentals of clinical chemistry, Tietz, N.W. (Ed) Saunders, W.B. Company. Philadelphia, pp: 512-514.

Ganong, W.F. 2005. Review of medicate physiology. 16th Ed. Alange Medical Book. PP:336-338 .

Ghazalah, A.A, Abd El-Gawad, A.H., Soliman, M.S. and Amany Youssef, W.A. 2005. Effect of enzyme preparation on performance of broilers fed corn-soybean meal based diets. *Egyptian Poultry Science*, 25:295-316.

Ibrahim, I.A., Elbadwi, S.M.A., Bakhiet, A.O., Abdel Gadir, W.S. and Adam, S.E.I. 2007. A 9-week feeding study of *Cuminum cyminum.* and *Hibiscus sabdariffa. Journal of Pharmacology and Toxicology*, 2: 666-671.

Jazani, N.H., Zartoshti, M. and Shanhabi, S. 2008. Antibacterial effect of Iranian *Cumin cyminum* essential oil on Burn of *Pseudomonas aeruginosa*. *International Journal of Pharmacology*. 34:23-34.

Jonas, D. Skemaite, M. Kirkilaite, G. Vinauskiene, R. and Venskutonis, P.R. 2007. Antioxidant and antimicrobial properties of caraway (*Carum carvi L.*) and cumin (*Cuminum cyminum)* extracts. *Veterinarja IR Zootechnika T*., 40: 12-20.

Jones, N.L., Shabib, S. and Sherman, P.H. 1997.Capsaicin as an inhibitor of the growth of the gastric pathogen, *Helicobacter pylori*. *FEMS Microbiology Letter*, 146:223-227.

Juven, B.J., Kanner, J. Schved, F. and Weisslowicz, H. 1994. Factors that interact with antibacterial action of thyme essential oils and its active constituents. *Journal of Applied Bacteriology*, 76:626-631.

Mansoori, B. Mehrdad, M. and Mohammad-Mehdi, K.S. 2006.Cumin seed meal with enzyme and polyethelen glycol as an alternative to wheat bran in broiler diets. *Journal of Food Science and Agriculture*, 86:2621-2627.

National Research Council, (NRC). 1994. Nutrient Requirements of Poultry 9th Ed. National Academy Press. Washington, DC. of Alletchs 10th Annual Symposium .Nottingham University Press. Nottingham, UK.

Oswa, T. Sugiyama, Y. Lnayoshi, M. and Kawakisi, S. 1995. Anti-oxidative of tetrahydrocurcuminoids. *Biotechnology and Biochemistry*, 59:1609-1610.

SAS Institute, 2001. SAS/STAT User's Guide for Personal Computer .Relesse 6.12 SAS Institute, Inc., Cary, N.C., USA.

Soni, K.B., Lahiri M., Chackrader, P., Bhide, S.Y. and Kuttan, R. 1997. Protective effect of food additives on aflatoxin–induced mutagenicity and hepatocarcinogenicity. *Cancer Letter*, 34:115-129.

Steel, R.G.D. and Torrie, J.H. 1980. Principle and Procedures of Statistics .2nd Edn.McGrow-Hill Book Co., Inc, New York.

Williams, P. and Lossa, R. 2001. The use of essential oils and their compounds in poultry nutrition. *World's Poultry Science*, 17:14-15.

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Odds ratio of dystocia in Holstein cows in Iraq

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Abstract

The objective of this research was to determine the effect of some factors on dystocia in Holstein cows. The analysis consist of 19090 records of parturitions belonged to 3181 cows from 1990 to 2004 in the Nasr Dairy Cattle Station in Iraq. A logistic regression model was used to predict dystocia. The model included effects of year of birth, season (winter or other seasons), parity (first or later), birth weight (kg), and sex of calf. Results revealed that odds of dystocia decreased by 5% per year. Calves born in the winter have higher risk of dystocia by 27% than calves born in the other seasons. Male calves associated with dystocia were greater than female calves by 39%. First parity cows had a 2.04 times higher risk of dystocia than cows in later parities. Odds of dystocia increased with increasing birth weight by 16%/kg. It was concluded that dystocia was affected by all the factors under consideration.

Keywords: Odds Ratio, Dystocia, Heritability, Holstein Cattle

Introduction

The main objective in animal breeding is to obtain the desired products more efficiently in relation to the present generation by changing the genetic merit of animals in coming generations (Groen et al., 1997). In dairy cattle, the traditional breeding goal has been to obtain high-yielding cows to increase milk, fat, and protein yields. Presently, however, as a consequence of the milk quota system and decreased milk prices, economic efficiency can be further improved by adequate emphasis on other characteristics, called functional or secondary traits (Essl, 1998; Pryce et al., 2004). The term "functional trait" is used to summarize those characteristics of an animal that increase economic profit, not by higher output of products but by reduced costs of input (Groen et al., 1997). Examples of these traits are fertility, calving ease, or milking speed. Calving ease is one of the most economically significant secondary traits (Dekkers, 1994; Dematawewa and Berger, 1997), especially for first-calf heifers since it measures the presence or absence of dystocia.

There are different definitions of dystocia, and methods of data collection are not uniform (Berger et al., 1992). Dystocia, defined as a prolonged or difficult parturition, affects the profitability of herds (Pollak and freeman, 1976; Carnier et al., 2000). In general most researches scored dystocia on a scale of 1 to 5 (Berger et al., 1992; Adamec et al., 2006). Dystocia is an undesirable phenomenon that may arise from several environmental and genetic causes (Burfening et al., 1981). Age, parity of dam and sex of the calf are genetic factors that affect dystocia. Season and year of calving and nutritional level of the cows during gestation are also associated with dystocia (Meijering, 1984). Many studies have found the effect of sire of calf to be larger than that of the sire of the cow (Thompson et al., 1981; Meijering, 1984; Ron et al., 1986; Weller et al., 1986).

Difficult births increase direct costs of the herd (veterinary fees, calf or cow death or both and extra farmer labor), as well as indirect costs, such as an increase in the risk of subsequent unfavorable health events, an increase in culling rate and a reduction in yield (Philipsson, 1976; Dekkers, 1994; Dematawewa and Berger, 1997). Moreover, dystocia can negatively affect reproductive traits such as days open or number of services per pregnancy (Dematawewa and Berger, 1997). Thompson et al. (1982) reported that increased calving difficulty resulted in more days open, longer interval to first breeding, more breeding per conception and lower milk yield in first 30 days but no depression in production after 30 day. Martinez et al. (1983) found that across all parities, in the most difficult births (score 5) 57% of all calves died, and for the next most difficult calving ease category (score 4), 27% of all calves died. Differences in production and reproduction associated with difficult births represent substantial economic losses, and more emphasis should be put on reporting of dystocia by dairy personnel (Djemali et al., 1987).

Dystocia may also contribute to additional management costs for continuous surveillance of parturient cows. Dematawewa and Berger (1997) estimated costs associated with dystocia to be \$0.00, 50.45, 96.48, 159.82, and 397.61 for no assistance, slight assistance, needed assistance, considerable force needed, and extreme difficulty respectively. Also, Dematawewa and Berger (1997) estimated total average cost of dystocia for primiparous cows was \$28.01 compared with \$11.10 for multiparous cows. In a different analysis, Dekkers (1994) calculated dystocia costs to be \$43.11 and \$20.25 for first and later parities respectively.

The objectives of this study were 1) to determine the frequency of dystocia in field data for Holstein cows 2) to determine the factors affecting dystocia and 3) to estimate heritability of dystocia by using the sire of calf as a source of variation in estimation of variance component.

Materials and Methods

Records on Holstein parturitions were analyzed from 1990 to 2004 in the Nasr Dairy Cattle station in Iraq. Twin calves were ignored from the analysis, because we were primarily interested in what causes correctly single-born calves to be difficult to deliver. However, twins are noted to have higher dystocia rates than singletons (Johanson et al., 2001). The data of the present study were divided into two categories (assisted and unassisted). Johanson and Berger, (2003) point out that the best way to align the recording system was to condense the five dystocia categories down to only two, assisted and unassisted. Season was classified as winter and other seasons, because of the weather in Iraq was hot in most months and nearly cold in a few months. Winter included December, January, February and March while other seasons included the residual months.

Because dystocia is binary trait, a traditional regression model for a continuous trait cannot be used. We chose to use logistic regression to model dystocia. Logistic regression handles binary variables well and gives results that are easy to interpret. The logistic regression analysis was done using PROC LOGISTIC in SAS (2001). Odds ratios (OR) are another useful way to interpret results from a logistic regression analysis (Kleinbaum, 1994; Hosmer and Lemeshow, 2000). An OR compares two opposing probabilities to determine which is more problematic. For example, we may want to compare dystocia in male calves versus dystocia in female calves. If the OR is exactly equal to 1, then there is no difference between the sexes for the odds of dystocia. In that case, sex of the calf would not be a good predictor of dystocia. If the OR is 1.5, we interpret this value as meaning male calves have a 50% greater chance of dystocia than female calves given that all other variables are the same. An OR of 2 is double the risk. The OR above was for a discrete variable such as sex of calf. An OR can also be calculated for a continuous variable. This type of OR can be interpreted as a linear trend over the range of the variable. For example, an OR of 1.05 for year is interpreted as a 5% increase in the OR for dystocia for the next year while the other variables are held constant. Suppose all calves born in 1990 have a 10% chance of incidence of dystocia, then all calves born in 1991 have a 10.5% (10% × 1.05) chance of incidence of dystocia.

Statistical analysis

Odds ratio for dystocia was estimated by using the following model:

$Log\ (\Pi DYS/\ (1 - \Pi DYS)) = \beta 0 + \beta 1Y + \beta 2\ S + \beta 3\ G + \beta 4P + \beta 5BW,$

Where ΠDYS is the probability of dystocia.

Y is year of calving (Linear trend), S is season of calving, G is sex of calf, p is parity, and BW is birth weight of calf (Linear trend).

Variance components were obtained by MIVQUE (Rao, 1971) using the following model:

$Yijklmno = \mu + Ai + Yj + Gk + Pl + Wm + Sn + eijklmno$

$Yijklmno$ denotes a 0 or 1 for normal vs. dystocia,

μ = the overall mean,

Ai = fixed effect of the ith season of calving,

Yj = fixed effect of jth year of calving,

Gk = fixed effect of kth sex of calf,

Pl = fixed effect of lth parity,

Wm = fixed effect of weight of calf,

Sn = random effect of calf's sire

$eijklmno$ = residual effect.

Results and Discussion

The overall means of dystocia was 15.24% (Table 1), the present estimation is within estimates obtained by several researchers 5.08 – 16.3% (Weller et al., 1988; Manffredi et al., 1991; Heins et al., 2001; Cassell, 2005). Table 2 gives parameters along with their estimates for factors affecting dystocia. The first thing that one may notice is the significant effect of all factors on dystocia. Also note that the quadratic term for birth weight is not necessary to predict dystocia. This is due to the fact that smaller than average birth weights do not need assistance as often as larger than average birth weights. Hence the linear trend of birth weight is sufficient to model the increase in dystocia (Johanson and Berger, 2003).

Table 3 presents estimates of the OR for the factors affecting dystocia. Results revealed that birth season has significant effect ($P<0.01$) on dystocia. Calves born

Table 1: Least square means of factors affecting dystocia

Effect	No. of Observation	Least squares means ± SE %
Overall means	19090	15.24 ± 0.07
Calving season		
Winter	5256	15.26 ± 0.14
Other seasons	13834	15.89 ± 0.09
Parity		
1	5079	16.65 ± 0.14
2 +	14011	14.51 ± 0.09
Sex		
Male	9808	16.44 ± 0.11
Female	9282	14.72 ± 0.11

Table 2: Parameter estimates for dystocia

Parameter	Pro>	Estimate ± SE
Intercept	0.0001	84.2193 ± 14
Season	0.0001	0.2398 ± 0.06
Year	0.0001	- 0.0476 ± 0.007
Sex	0.0001	0.3300 ± 0.02
Parity	0.0001	0.7141 ± 0.05
BW	0.0001	0.1519 ± 0.007

BW = Birth weight

in the winter have a 27% higher risk of dystocia than calves born in the other seasons. These results were higher than 15% which was reported by Johanson and Berger (2003). Pollak and Freeman (1976) found that more dystocia was in winter (October through March) due to male calves were significantly larger than female and experienced more dystocia. Also McClintock et al. (2005) reported that incidence of dystocia in Holsteins was influenced by the season due to gestation lengths were longer in winter, resulting in larger calves and more dystocia. Two hypotheses explaining this, first, cows calving in summer may be in better physical condition to calve. Second, herdsmen may have more time in winter to witness and aid in delivery of calves (Pollak and Freeman, 1976).

The estimate of the OR for year indicated that there is a 5% decrease in dystocia per year. For example, if the incidence of dystocia is 16.3% in a given year, then it will decrease to 15.4% (0.163 × 0.95) the next year. The differences in dystocia due to years of calving were significant (P<0.01). These results were closed with results obtained by Johanson and Berger, (2003). Odds of dystocia was 39% higher in males than females which means that cows calving males are at more risk to face difficult of calving compared with calving female. This finding may be reflecting of differences in birth weight of males and females which was reported by AL-Samarai et al. (2006) who found that the differences between weight of male (41.56kg) and female (38.36kg) were significant (P<0.01) in the same herd. Similar results were documented by several reports (Manffredi et al., 1991; Heins et al., 2001; Cassell, 2005; Lombard et al., 2007).

The OR estimate for parity indicated that first-parity cow has 2.04 times higher risk of dystocia than later-parity cows. This finding was supported by Johanson and Berger (2003) who found that the odds was 4.7 times higher risk of dystocia in heifers compared with cows. The results of present study revealed that a 1-kg increase in birth weight corresponds to a 16% increase in dystocia, which was imitated to 13% obtained by Johanson and Berger (2003). The heritability of dystocia in the present study (0.12) was within range (0.03–0.20) obtained by several researchers (Phillipsson, 1979; Meijering, 1984; Djemali et al., 1987; Manfredi et al., 1991). The low heritability in this study supports previous result obtained by Weller et al. (1988) who revealed that dystocia has low heritability even in the threshold model analysis.

Although this study answered some questions, there is another questions, for example, several researchers (Philipsson, 1976; Cady, 1980) have suggested that dystocia in first and later parities should be considered separate traits, however, others assumed that dystocia in first and later parities represents the same trait and uses progeny from all parities of dam to rank sires for dystocia. This assumption was made because the larger volume of data from older dams should improve accuracy of sire evaluation for use on virgin heifers if the traits are similar. We need to know the correlation of sire rankings from first with sire rankings from later parity data. A large genetic correlation between dystocia in first with later parities indicates major influence of the same genes affecting

Table 3: Odds ratio (OR) estimates and interpretations for dystocia

Effect	Comparison	OR	95% CI	Interpretation
Season	Winter vs Other seasons	1.27**	1.13-1.43	27% higher odds for dystocia in winter than other seasons
Year	Linear trend	0.95**	0.94-0.96	5% decreased in odds for dystocia per year
Sex	Male vs Female	1.39**	1.31-1.47	39% higher odds for dystocia in males than female
Parity	1 vs 2+	2.04**	1.83-2.27	2.04 times higher odds for dystocia in first than later parities
BWT	Linear trend	1.16**	1.14-1.18	16% increase in odds for dystocia per kg increase in BWT

BW = Birth weight; **(P < 0.01)

Table 4: Variance component and heritability estimates obtained with the linear model analyses

Parameter	Variance components
Sire variance	5.78
Residual variance	186.09
Heritability (h^2)	0.12

dystocia in all parities and would allow inclusion of data from later parity animals for improved accuracy in evaluating sires for use on virgin heifers. Discussion also exists as to whether dystocia should be considered a trait of the calf or a trait of the dam and what about the correlations of sire rankings as a trait of the calf with sire rankings as a trait of the dam? Finally a multitrait analysis has been suggested (Van Vleck and Edlin, 1984), but little would be gained if later parity heritability and the genetic correlation between first and later parities are low. However, a multi trait threshold analysis is considerably more complex than a single trait analysis (Foulley et al., 1987).

Results clearly demonstrate that dystocia was affected by all factors in the employed model and parity has the highest effect on dystocia. The low estimate of heritability for dystocia indicates the importance of environmental factors in the variation of the trait.

References

Adamec, V., Cassell, B.G., Smith, E.P. and Pearson, R.E. 2006. Effects of inbreeding in the dam on dystocia and stillbirths in US Holsteins. *Journal of Dairy Science,* 89: 307–314.

Al-Samarai, F.R., Al-Anbari, N.N. and Al-Doori, Z.T. 2006. Estimation of genetic merit of sires in a herd of Holstein for many generations depending on their calves birth weight. *Journal of Tikrit University for Agriculture Science.* 3: 11- 18.

Berger, P.J., Cubas, A.C.,Koehler, K.J. and Healey, M.H.1992. Factors affecting dystocia and early calf mortality in Angus cows and heifers. *Journal of Animal Science*, 70: 1775 – 1786.

Burfening, P.J., Kress, D.D. and Friedrich, R.L. 1981. Calving ease and growth rate of Simmental-sired calves. 111. Direct and maternal effects. *Journal of Animal Science*, 53: 1210 – 1212.

Cady, R.A. 1980. Evaluation of Holstein bulls for dystocia. Ph.D. dissertation. Comell University, Ithaca, NY.

Carnier, P., Albera, A., Dal Zotto, R., Groen, A.F., Bona, M. and Bittante, G. 2000. Genetic parameters for direct and maternal calving ability over parities in Piedmontese cattle. *Journal of Animal Science*, 78: 2532–2539.

Cassell B., McAllister, A., Nebel, R., Franklin, S., Getzewich, K., Ware, J., Cornwell, J. and Pearson R. 2005.Birth weights, mortality, and dystocia in Holsteins, Jerseys, and their reciprocal crosses in the Virginia Tech and Kentucky crossbreed project. *Journal of Dairy Science,* 88: (Suppl.1), 94.(Abstr.).

Dekkers, J.C.M. 1994. Optimal breeding strategies for calving ease. *Journal of Dairy Science,* 77: 3441–3453.

Dematawewa, C.M.B. and Berger. P.J. 1997. Effect of dystocia on yield, fertility, and cow losses and an economic evaluation of dystocia scores for Holsteins. *Journal of Dairy Science,* 80: 754 – 761.

Djemali, M., Freeman, A.E. and Berger, P.J. 1987. Reporting of dystocia scores and effects of dystocia on production, days open, and days dry from Dairy Herd Improvement data. *Journal of Dairy Science,* 70: 2127 – 2135.

Essl, A. 1998. Longevity in dairy cattle breeding: A review. *Livestock Production Science,* 57: 79–89.

Foulley, J. L., Gianola, D. and Hoschele, I. 1987. Empirical Bayes estimation of parameters for polygenic binary traits. *Genetics Selection Evolution,* 19: 197 – 206.

Groen, A. F., Steine, T., Colleau, J.J., Pedersen, J., Pribyl, J. and Reinsch, N. 1997. Economic values in dairy cattle breeding, with special reference to functional traits. Report of an EAAP-working group. *Livestock Production Science*, 49: 1–21.

Heins, B.J., Hansen, L.B., Seykora, A.J. and Marx, G.D. 2001.Calving disorders of Holstein cows selected for large versus small body. *Journal of Dairy Science,* 84: (Suppl. 1),1018 (Abstr.).

Hosmer, D.W. and Lemeshow, S. 2000. Applied Logistic Regression. 2nd Ed. John Wiley & Sons, Inc., New York, NY.

Johanson, J.M. and Berger, P.J. 2003. Birth weight as a predictor of calving ease and perinatal mortality in Holstein cattle. *Journal of Dairy Science,* 86: 3745–3755.

Johanson, J.M., Berger, P.J., Kirkpatrick, B.W. and Dentine, M.R. 2001. Twinning rates of North American Holstein sires. *Journal of Dairy Science,* 84: 2081–2088.

Kleinbaum, D.G., 1994. Logistic Regression: A self-learning text. Springer-Verlag New York, Inc., New York, NY.

Lombard, J.E., Garry, F.B., Tomlinson, S.M. and Garber, L.P. 2007. Impacts of dystocia on health and survival of dairy calves. *Journal of Dairy Science,* 90: 1751 – 1760.

Manfredi, M., Ducrocq, V. and Foully, L. 1991. Genetic analysis of dystocia in dairy cattle. *Journal of Dairy Science,* 74: 1715 – 1723.

Mangurkar, B. R., Hayes, J.F. and Moxley, J.E. 1984. Effects of calving ease-calf survival on production and reproduction in Holsteins. *Journal of Dairy Science,* 67: 1496 – 1509.

Martinez, M. L., Freeman, A.E. and Berger, P.J. 1983. Factors affecting calf livability for Holsteins. *Journal of Dairy Science,* 66:2400 - 2407.

McClintock, S., Kevin, B., Wells, M. and Michael, G. 2005. Calving difficulty in Holsteins and Jerseys and their crossbreeds. *Journal of Dairy Science,* 87:(Suppl. 1), 533.(Abstr.).

Meijering, A. 1984. Dystocia and stillbirth in cattle. a review of causes, relations and implications. *Livestock Production Science*.11:143 – 149.

Philipsson, J. 1976. Studies on calving difficulty, stillbirth, and associated factors in Swedish cattle breeds. V. Effects of calving performance and still birth in Swedish Friesian heifers on productivity in the subsequent lactation. *Acta Agriculturae Scandinavica,* 26: 230 – 238.

Philipsson, J., Foulley, J.L., Lederer, J., Liboriussen, T. and Osinga, A. 1979. Sire evaluation standards and breeding strategies for limiting dystocia and stillbirth. *Livestock Production Science*, 6: 111- 127.

Pollak, E. J. and Freeman, A.E. 1976. Parameter estimation and sire evaluation for dystocia and calf size in Holsteins. *Journal of Dairy Science,* 59: 1817- 1824.

Pryce, J. E., Royal, M.D., Garnsworthy, P.C. and Mao, I.L. 2004. Fertility in the high-producing dairy cow. *Livestock Production Science*, 86: 125–135.

Rao, C.R. 1971. Minimum variance quadratic unbiased estimation of variance component. *Journal of Multivariate Analysis,* 1: 445-456.

Ron, M., Bar-Anan, R. and Welter, J.I. 1986. Sire and maternal grandsire effects on calving difficulty and calf mortality in Israeli Holsteins. *Journal of Dairy Science,* 69: 243 – 247.

SAS, 2001. SAS/STAT Users Guide for Personal Computer. Release 6.12.SAS Institute, Inc., Cary, N.C., USA.

Thompson, J.R., Freeman, A.E. and Berger, P.J. 1981. Age of dam and maternal effects for dystocia in Holsteins. *Journal of Dairy Science,* 64: 1603 – 1612.

Thompson, J. R., Pollak, E.J. and Pelissier, C.L. 1982. Effects of calving difficulty on production and reproduction in the subsequent lactation in large California dairy herds. *Journal of Dairy Science,* 65:(Suppl. 1), 87.(Abstr.)

Van Vleck, L. D. and Edlin, K.M. 1984. Multiple trait evaluation of bulls for calving ease. *Journal of Dairy Science,* 67: 3025 – 3032.

Weller, J. I., Ezra, E. and Bar-Anan, R. 1986. Studies on the model of choice for genetic analysis of calving traits. *Journal of Dairy Science,* 69: (Suppl. 1), 124.(Abstr.)

Weller, J. I., Miszaal, I. and Gianola, D. 1988. Genetic analysis of dystocia and calf mortality in Israeli-Holsteins by threshold and linear models. *Journal of Dairy Science,* 71: 2491-2501.

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Studies on the prevalence of caprine and ovine hydatidosis at slaughter houses of Larkana, Pakistan

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Abstract

A total of 1000 carcasses of sheep (500) and goats (500) of different ages were examined from January 2005 to December 2005 at the slaughter houses of Larkana, Sindh (Pakistan). 53 (10.6%) sheep and 51 (10.2%) goats were found infected with hydatidosis. Liver was the most infected organ (8.8%), whereas spleen and heart were the least infected (0.2%) in goat. In sheep highest percentage (8.8%) of infection was recorded in the lungs and lowest (0.2%) in the heart. In sheep, the length of cyst ranged between 1 to 12, 1 to 10 or 0.5 cm in liver, lungs and heart respectively. In goats, the length of hydatid cysts was recorded as 1 to 9, 1 to 7, 1 and 0.75 cm in liver, lungs spleen and heart respectively. In sheep, the average numbers of hydatid cysts were found as 5.5, 4 and 1 liver, lungs and heart respectively, whereas in case of goats the average numbers of cysts were 5.5, 5 and 1.5 in liver, lungs and spleen respectively. Moreover, only 1 cyst was found in heart. Sheep fell in age category of 25 months and above were more infected (16%) compared to 13 to 24 (7.24%) and 6 to 12 months (2.05%) old. Likewise, the prevalence in goats was 13.88, 8.59 and 3.26% respectively in the same age groups. The highest rate of infection was recorded in the month of January (23.80%) and May (19.51%) in sheep and goat respectively. This data will help in controlling strategies of hydatidosis in small ruminants.

Key word: *Echinococcus granulosus*, Hydatidosis, Hydatid Cyst, Sheep, Goats

Introduction

Hydatidosis is a major parasitic disease of veterinary and public health importance throughout the world. The disease has great economic and zoonotic importance because it affects almost all the domestic animals and human. The disease is caused by *Echinococcus granulosus* and is characterized by the formation of single or multiple cysts (hydatidosis) varying in size from that of a pea to medium sized foot-ball.

Sheep, goats, cattle, Buffaloes, horses, pigs and men act as intermediate hosts. Hydatid disease, not only results in loss of millions of rupees each year, but also it worsens the protein deficiency for human consumption in terms of condemned organs and lowered productivity of infected animals (Iqbal et al., 1989).

Echinococcus granulosus has a broad geographical and cosmopolitan distribution. The cysts are mainly found in the liver, lung, spleen, kidneys, and other organs of the intermediate hosts, develop slowly over several months. *Echinococcus granulosus* is the main species, the adult worm grows only in carnivores and is extremely small in size with three to four segments (Soulsby, 1982).

The eggs of the parasite may develop particularly in any mammal to form cysts, within the cysts which are filled with fluid and grow many secondary cysts, very small in diameter and within each of these cysts dozen of scolices are produced. The secondary cysts are known as brood capsules, the scolices may sometimes grow independently of these capsules but within the cysts. Animals especially dogs may harbour hundreds and thousands of adult worms of this specie.

Even in the clinical stage, the major symptoms in animals are weakness and emaciation (Sheikh and Hussain, 1967). In the absence of prominent symptoms, the diagnosis of disease is usually difficult and it depends upon the demonstration of scolices, brood capsules of daughter cysts in hydatid fluid either on laparotomy or necropsy (Crosby et al., 1968). The human-beings are infected during the close contact with the dogs or by direct consumption of infected organs, drinking water or green vegetables polluted by faeces of infected dogs (Schantz et al., 1995).

A more effective approach to control this disease would be one which eliminates the source of infection in dogs i.e. the larval stages in sheep and other ruminants, besides regular deworming of pets and elimination of

stray dogs (Eckert et al., 2001). The disease controlled programme is limited due to lack of sensitive and specific methods of diagnosing hydatidosis in livestock prior to slaughter (Schant, 1983).

Therefore, the present study was carried out to record the prevalence of hydatidosis in sheep and goats in slaughter houses of Larkana, Pakistan.

Materials and Methods

A total of 1000 carcasses of sheep (500) and goats (500) of different age groups were examined from January 2005 to December 2005 at the slaughter houses of Larkana, Pakistan. The viscera such as liver, lungs, spleen, heart and kidneys of the slaughtered animals were collected and examined for the presence of cysts. The number of cysts in each organ was recorded. The infected organs were collected in plastic bottles containing 10% formalin as preservative and then samples were brought to the Department of Veterinary Parasitology, University of Agriculture, Tandojam, Pakistan.

The infection was described as slight if a quarter of the organ was affected, moderate if half of the organ was affected and severe if almost the entire organ was infected. The infected organs as well as the size (in cm) and consistency of the cysts were recorded. In order to explore the relation between age and prevalence of disease, all the animals under study were segregated in three age groups viz., 6-12, 13-24 and 25 months and above.

Results

The results recorded revealed that 53 sheep (10.6%) and 51 goats (10.2%) were infected with hydatidosis, and overall percentage of infection was recorded as 10.4%. During post-mortem examination the major organs like lungs, liver, spleen, heart and kidneys were examined. In goats the highest rate of infection (8.8%) was recorded in liver and the lowest (0.2%) in spleen and heart. No cyst was found in Kidneys. In sheep the highest percentage (8.8%) of infection was recorded in lungs (Table 1).

Table 1: Organ-wise distribution of Hydatid cysts in sheep and goats

Organs	No. of carcasses examined		Infected (%)	
	Sheep	Goats	Sheep	Goats
Liver	500	500	36 (7.2)	44 (8.8)
Lungs	500	500	44 (8.8)	37 (7.4)
Spleen	500	500	00	01(0.2)
Heart	500	500	01 (0.2)	01 (0.2)
Kidneys	500	500	00	00

In sheep minimum 1, maximum 10 and at average 5.5 number of hydatid cysts were found in liver, whereas maximum 7, minimum 1 and average 4 cysts were found in lungs. Only 1 number of hydatid cyst was recorded in heart, whereas no cyst in spleen and kidneys was found. In case of goats maximum 10, minimum 1 and average 5.5 cysts were observed in liver, whereas 09, 1 and 5 numbers of hydatid cysts were found in lungs as maximum, minimum and average, respectively. In spleen 2, 1 and 1.5 cysts were recorded as maximum, minimum and average respectively. Only 1 cyst was found in heart and no cyst was found in kidneys (Table 2).

The size of the hydatid cyst found varied among the organs investigated. In the sheep, the size of the cyst varied from 1 to 12 cm in liver, 1 to 10 cm in lungs and 0.5 cm in the heart. In goats, the size of the hydatid cyst of liver was recorded as 1 to 9 cm, 1 to 7 cm in lungs, 0.75 cm in spleen and 1 cm in heart (Table 3).

The highest rate of infection (16%) was recorded in sheep older than 2 years, followed by age group of 13 to 24 months (7.24%) and 6 to 12 months (2.05%). Likewise, the prevalence of disease in goats was 13.88, 8.59 and 3.26% in the above mentioned groups, respectively (Table 4).

In sheep the highest (19.51%) incidence of hydatid cyst was recorded in the month of May and the lowest (5.88%) in the month of February. In Goats, the highest incidence (23.80%) was found in the month of January and lowest infection (5.24%) in the month of September (Table 5).

Table 2: Minimum and maximum number of hydatid in infected organs of sheep and goats

Organs	Min. Number		Max. Number		Average	
	Sheep	Goats	Sheep	Goats	Sheep	Goats
Liver	01	01	10	10	5.5	5.5
Lungs	01	01	07	09	4.0	5.0
Spleen	00	01	00	02	00	1.5
Heart	01	01	00	00	00	00
Kidneys	00	00	00	00	00	00

Table 3: Size of hydatid cysts in infected organs of sheep and goats

Organs	Sheep		Goats	
	Min. (cm)	Max. (cm)	Min. cm)	Max. (cm)
Liver	01	12	01	12
Liver	01	10	01	10
Lungs	00	00	0.75	00
Heart	0.5	00	01	00
Spleen	00	00	00	00
Kidneys	00	00	00	00

Table 4: Age-wise rate of infection of hydatidosis in sheep and goats

Age group (months)	No. of Carcases examined		No. of infected (%)	
	Sheep	Goats	Sheep	Goats
6 – 12	98	92	2 (2.05)	3 (3.26)
13 – 24	152	163	11 (7.24)	14 (8.59)
25 – above	250	245	40 (16.00)	34 (13.88)
Total	500	500	53 (10.60)	51 (10.2)

Table 5: Month-wise incidence of hydatidosis in sheep and goats

Month	Sheep		Goats	
	No. of examined	No. of infected (%)	No. of examined	No. of infected (%)
January	52	6 (11.53)	42	10 (23.80)
February	34	2 (5.88)	28	2 (7.14)
March	33	3 (9.09)	28	3 (10.71)
April	57	7 (12.28)	46	5 (10.86)
May	27	5 (19.51)	47	5 (10.63)
June	60	7 (11.66)	50	6 (12.00)
July	45	7 (15.55)	79	5 (6.32)
August	72	7 (9.72)	82	5 (6.09)
September	24	3 (12.4)	19	1 (5.24)
October	34	3 (8.82)	30	3 (10.00)
November	22	0	19	2 (10.52)
December	40	0	30	4 (13.33)
Total	500	53 (10.6)	500	51 (1.2)

Discussion

Haridy et al. (2000) and Njoroge et al. (2002) observed hydatid cyst infection in sheep as 0.33 and 3.6 respectively. In case of goats, Haridy et al. (2000), Njoroge et al. (2002) and Azlaf and Dakkak (2006) observed prevalence as 4.5, 3.4 and 1.88%, respectively. The results of the above workers highlighted prevalence rate of hydatid cysts in sheep and goats lower than current study. Deviation may be attributed to the climatic condition or good veterinary practices in the areas of study.

Dueger and Gilman (2001), Tashani et al. (2002), Sortiraki and Korkoliakou (2003), Umur (2003) and Akhlaghi and Housaini (2005) detected the prevalence as 43.4, 77.4, 20, 80 and 26.6% respectively in sheep. However, in goat prevalence of infection was observed by Dorchies et al. (2000), Sotiraki and Korkoliakou (2003) and Umur (2003) as 28.4, 24 and 22.1 respectively. The present findings are not in agreement with the above mentioned workers, The possible reason may be climatic condition and the husbandry status of the livestock which may vary in different areas.

Saeed et al. (2000), Dalimi et al. (2002), Elmahdi et al. (2004), Afzal and Dakkak (2006) observed the prevalence as 14.1, 6.0, 10.58 and 10.3%, respectively in sheep. In case of goats, Saeed et al. (2000) and Dalimi et al. (2002) observed the prevalence as 6.2 and 6.3%, respectively. The findings of the above workers are in partial agreement with the findings of present study.

Murat et al. 2009 reported that 114 (8.0%) out of 1421 younger sheep and 47 (13.3%) out of 351 older sheep were infected with hydatid cyst, these results do not coincide with the present study results. Ibrahim 2010 highlighted that the incidence in age group 1-2years of sheep (8.8%) and goat (4.27) were high than under one year of age. These findings are coinciding with our results. The prevalence trend of the hydatid cystic infection clearly indicates that the aged animals were under the higher risk of occurrence of disease in comparison of young ones.

Bilquess (1984) recorded infection rate of hydatidosis as 23% in the month of December while bhutto (1994) reported an incidence rate as 25% in the month of June. In our study, the disease prevails round the year and appears to have no strong relation with the season. The results of the present study provide a base line data on hydatidosis in small ruminants which will help in controlling of this disease.

References

Afzal, R. and Dakkak, A. 2006. Epidemiological study of the cystic echinococcosis in Morocco. *Veterinary Parasitology*, 15:83-93.

Akhlaghi, L., Massoud,J. and Housaini, A. 2005. Observation on Hydatid cyst infection in Kordestan province (West of Iran) using epidemiological and sero-epidemiological criteria. *Iranian Journal of Public Health*, 34 (4): 73-75.

Bilquees, M. 1984. Incidence of hydatid cyst disease in livestock in Karachi. 5th pakistan Congress of Zoology, Part-13.

Bhutto, H. 1994. Incidence of hydatid cyst in cattle and and buffaloes slaughtered at slaughterhouses of Hyderabad district. M.Sc. thesis, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University, Tandojam.

Crosby, W.M; Tvey, M.H. and Holmes, D.D. 1968. Echincoccus cysts in the savannah baboon. *Laboratory Animals*, 18: 395-397.

Dalimi, A.G., Motamedi, M., Hosseini, B., Mohammadian, H., Malaki, Z., Ghamari and Ghaffari, F. 2002. Echinococcosis/ Hydatidosis in western Iran. *Veterinary Parasitology*, 105 (2):161-71.

Dorchies P., Bergeaud, J.P., Tabouret, G., Duranton, C., Prevot, F. and Jacquiet, P. 2000. Prevalence and larval burden of oestrus ovis (Linne 1761) in sheep and goats in northern mediterranean region of France. *Veterinary Parasitology*, 88 (3-4): 269-73.

Dueger, E.L. and Gilman, R.H. 2001. Prevalence, intensity, and fertility of ovine cystic echinococcosis in the central Peruvian Andes. *Transaction of the Royal Society of Tropical Medicine and Hygiene*, 95 (4): 379-83.

Eckert, J., Gemmell, M.A., Meslin, F.X and Pawlowski, Z.S. 2001. WHO/OIE Manual on Echinococcosis in Humans and Animals: a Public Health Problem of Global Concern. World Organisation for Animal Health (Office International des Epizooties) and World Health Organization, Pp: 94.

Elmahdi, I.E., Ali, Q.M., Magzoub, M.M., Ibrahim, A.M., Saad, M.B and Romig, T. 2004. Cystic echinococcosis of livestock and humans in central Sudan. *Annals of Tropical Medicine and Parasitology*, 98(5): 473-9.

Haridy, F.M., Ibrahim, B.B and Morsy, T.A. 2000. Sheep-dog-man. The risk zoonotic cycle in Hydatidosis. *Journal of Egyptian Society of Parasitology*, 30 (2): 423-429.

Ibrahim, M.M. 2010. Study of cystic echinococcosis in slaughtered animals in Al Baha region, Saudi Arabia: Interaction between some biotic and abiotic factors. *Acta Tropica*, 113: 26–33.

Iqbal, Z.C.S., Hayat, B. and Khan, M.N. 1989. Prevalence, organ distribution and economics of Hydatidosis in meat animals at Faisalabad abattoir. *Pakistan Veterinary Journal*, 9: 70-74.

Murat, K., Yunus, G., Baris, S., Hanef, B. and Arslan, M.O. 2009. A slaughterhouse study on prevalence of some helminthes of cattle and sheep in Malatya Province, Turkey. *Journal of Animal and Veterinary Advances*, 8(11):2200-2205.

Njoroge E.M., Mbithi, P.M., Gathuma, J.M., Wachira, T.M., Gathura, P.B., Magambo, J.K. and Zeyhle, E. 2002. A study of cystic echinococcosis in slaughter animals in three selected areas of northern Turkana, Kenya. *Veterinary Parasitology*, 104 (1): 85-91.

Saeed, I., Kapel, C., Saida, L.A., Willingham, L and Nansen, P. 2000. Epidemiology of *Echinococcus granulosus* in Arbil province, northern Iraq. *Journal of Helminthology*, 74 (1): 83-88.

Schant, E. M. 1983. Incidence of Hydatid cyst in victorian cattle. Aust. *Veterinary Journal*, 34: 193-220.

Schantz, P.M., Chai, J., Craig, P.S., Eckert, J., Jenkins, D.J., Macpherson, C.N.L. and Thakur, A. 1995. Epidemiology and control of hydatid disease. In: *Echinococcus* and Hydatid Disease. Thompson, R.C.A. and Lymbery, A.J. (Eds.). CAB International, Wallingford, Oxon, Pp: 233-331.

Sheikh, S.A. and Hussain, M.Z. 1967. Incidence of Hydatidosis in livestock in Lahore. *Pakistan Journal of Science*, 19: 56.

Sotiraki, S., Himonas, C and Korkoliakou, P. 2003. Hydatidosis-echinococcosis in Greece. *Acta Tropica*, 85 (2): 197-201.

Soulsby, E.J.L. 1982**.** Helminths, arthropods and protozoa of domesticated animals 7th Ed. Lea and Feberiger Philadelphia.

Tashani, O.A., Zhang, L.H., Boufana, B., Jegi, A. and McManus, D.P. 2002. Epidemiology and strain characteristics of *Echinococcus granulosus* in the Benghazi area of Eastern Libya. *Annals of Tropical Medicine and Parasitology*, 96 (4): 369-81.

Umur, S. 2003. Prevalence and economic importance of cystic echinococcosis in slaughtered ruminants in Burdur, Turkey. *Journal of Veterinary Medicine B*, 50 (5): 247-52.

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Haematological and serum biochemical indices of growing rabbits fed camel blood-rumen content mixture

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Abstract

Forty-five crossbred rabbits (Dutch × New Zealand White) of mixed sexes with age between 5 and 7 weeks were divided into 5 groups of 9 rabbits and fed camel blood–rumen content mixture (CBRCM) for 10 weeks. The CBRCM which contained 36.40% crude protein and 22.36% crude fibre was included at 0, 10, 20, 30 and 40% levels in diets of group 1, 2, 3, 4 and 5 respectively. The packed cell volume (PCV), red blood cells (RBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were not significantly different ($P>0.05$) among the treatments groups, although the haemoglobin (Hb) and white blood cells (WBC) were significantly ($P<0.05$) influenced by the treatments. The number of basophils, neutrophils, eosinophils and lymphocytes were not affected by the levels of inclusion, however, only the monocytes differed significantly ($P<0.05$) among the treatments. All values for blood parameters were within the normal range for growing rabbit. Thus, the study indicated that up to 40% CBRCM could be incorporated into the diets of growing rabbits without compromising the health status of the rabbits.

Key words: Camel Blood-Rumen Content Mixture, Rabbits, Blood Parameters

Introduction

Blood-rumen content meal is an abattoir waste that is often environmentally unfriendly. It has been reported to have potentials as source of protein and fibre in rabbit's diet (Dairo et al., 2005; Mohammed et al., 2005, Adeniji, 2008).

The protein content has been reported to vary based on the nutrition and species of the ruminant from which the rumen content are obtained. It is also known that various species of ruminants harbour different types of micro-organisms that will obviously influence the quality of protein of the rumen content (Mann, 1984; Whyte and Wadak, 2002; Mohammed et al., 2008).

Haematological and biochemical blood components are influenced by the quantity and quality of feed (Akinmutimi, 2004). Biochemical and haematological components of blood are sensitive to elements of toxicity in feed, especially with feed constituents that affect the formation of blood (Oyawoye and Ogunkunle, 1998). This study was therefore undertaken to assess the effect of feeding the camel blood-rumen content mixture on haematological and biochemical parameters of growing rabbits.

Materials and Methods

This study was carried out at the Rabbit Unit of the Teaching and Research Farm, University of Maiduguri. Forty-five (45) crossbred rabbits (Dutch × New Zealand White) of mixed sexes with age ranging from 5 to 7 weeks were randomly allocated to five treatments in groups of 9 rabbits each. Each rabbit was housed individually in a cage cell and supplied daily with the experimental diets in mash form. Clean drinking water was also provided *ad libitum* throughout the experimental period.

The composition of the experimental diets is shown in Table 1. The diets contained 0, 10, 20, 30 and 40% CBRCM in diets 1 (control), 2, 3, 4 and 5 respectively.

At week 10 of the experiment, blood samples were collected randomly from three (3) rabbits per treatment for the determination of the haematological and serum biochemical indices. Samples were collected from the ear vein of the rabbits by venipunture using disposable needle (21–gauge needle) and syringes. The rabbits were fasted overnight (12hrs) and normally bled in the morning (7.00–8.00am) to avoid excessive bleeding. The collection site was cleaned with alcohol and xylene to dilate the veins. Sterile cotton was used to cover the

Table 1: Composition of the experimental diets

	Diets / Treatments				
Ingredient (%)	1	2	3	4	5
Maize	40.98	39.12	37.41	35.24	24.35
Wheat offal	17.00	17.00	17.00	17.00	17.00
CBRCM	0.00	10.00	20.00	30.00	40.00
Groundnut cake	23.37	15.23	6.94	2.11	0.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Groundnut haulms	13.00	13.00	13.00	13.00	13.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Common salt (NaCl)	0.50	0.50	0.50	0.50	0.50
Premix*	0.15	0.15	0.15	0.15	0.15
Total	100.00	100.00	100.00	100.00	100.00
Determine Analysis (%)					
Crude protein (CP)	19.20	19.01	18.94	18.63	18.24
Crude fibre (CF)	18.34	19.34	20.12	20.37	22.36
Ether extract (EE)	4.50	3.50	3.40	3.82	3.66
Total Ash	2.00	3.01	3.08	3.07	3.50
Nitrogen-free extract (NFE)	55.96	55.14	54.46	54.17	54.13
ME (Kcal/kg)	3061.48	2953.10	2909.51	2861.02	2892.96

CBRCM = Camel blood-rumen content mixture

* Premix (grow fast) manufacture by Animal care service consult (Nig) Ltd. Lagos, Supplying the following per kg of premix: Vitamin A, 5000,00 IU; Vitamin D_3 800,000IU; Vitamin E, 12,000mg; Vitamin K, 1,5000mg; Vitamin B_1, 1,000mg; Vitamin B_2, 2,000mg, Vitamin B_6, 1,500mg; Niacin, 12,000mg; pantothenic acid, 20.00mg; Biotin, 10.00mg; Vitamin B_{12}, 300.00mg; folic acid, 150,000mg; choline, 60,000mg; manganese, 10,000mg; iron, 15,000mg, zinc 800.00mg; Copper 400.00mg; Iodine 80.00mg; cobalt 40mg; selenium 8,00mg.

punctured vein after collection. The blood samples were collected in sample bottles containing dipotassium salt of ethylene diamine–tetra acetic acid (EDTA–K^{2+}) which served as a anticoagulant for haematology while the bottles for serum biochemical indices were free of EDTA–K^{2+}.

The haematological analysis of blood samples were carried out at the Department of Veterinary Public Health, Faculty of Veterinary Medicine, University of Maiduguri, Nigeria, using the routinely available clinical methods (Bush, 1975). The haematological indices determined were packed cell volume (PCV), haemoglobin (Hb), red blood cell (RBC) count and white blood cell (WBC) count and differential count. Mean corpuscular haemoglobin (MCH), mean corpuscular volume (MCV) and mean corpuscular haemoglobin concentration (MCHC) were obtained from calculation according to standard formulae (Schalm et al., 1975; Jain, 1986).

The other blood samples collected without coagulant were used to determine the biochemical components such as albumin, total protein, cholesterol, globulin, glucose, calcium and phosphorus using the methods described by other workers (Spencer and Price, 1997; Ajagbonna et al., 1999; Uko et al., 2000).

Statistical Analysis

All the data collected were subjected to analysis of variance (ANOVA) using a randomized complete block design (Steel and Torrie, 1980). Means were compared, where applicable, using the Duncan's multiple range test (Duncan, 1955).

Results and Discussion

The result for the haematological and serum biochemical indices is shown in Table 2. The inclusion levels of CBRCM did not affect PCV, RBC, MCV, MCH and MCHC values. The values obtained in this study were similar to those reported by other workers (Dairo, 2005; Mohammed et al., 2005) who fed similar diets to growing rabbits. The values for HB and WBC differed significantly ($P<0.05$) among the treatment groups. However, the values were comparable to the values reported by Anon (1980) for normal healthy growing rabbits. The normal range of values observed for all the treatments suggest adequate protein in the experimental diets for normal metabolic and physiological activities. The basophils, neutrophils, eosinophils and lymphocytes were not significantly ($P< 0.05$) affected by treatments, only monocytes were significantly influenced ($P<0.05$) by the diets. Rabbits on treatment 2 (10%) had higher concentration of monocytes than other treatments, the values obtained for all the groups were within normal range as reported by Anon (1980). In differential count, an abnormally higher monocytes level is synonymous with bacterial infection (Akinmutimi, 2004).

Table 2: Haematological indices in rabbits fed diets containing various levels of camel blood-rumen content mixture

Parameter	T1 (0%)	T2 (10%)	T3 (20%)	T4 (30%)	T5 (40%)	SEM
PCV (%)	42.67	43.00	47.00	44.00	45.0	1.41^{NS}
Hb (g/100ml)	10.33^{b}	11.00^{ab}	12.33^{a}	11.33^{ab}	11.33^{ab}	0.51^{*}
RBC ($x10^6/mm^3$)	4.58	4.08	4.03	3.34	4.36	0.58^{NS}
WBC ($x10^3/mm^3$)	3.28^{a}	3.62^{a}	1.83^{b}	3.30^{a}	2.85^{a}	0.26^{*}
MCV (Fl)	103.03	105.49	119.57	116.60	104.23	13.85^{NS}
MCH (Pg)	24.53	27.74	31.08	30.08	26.10	2.9^{NS}
MCHC (%)	24.17	25.64	26.28	25.76	25.18	0.80^{NS}
Differential count						
Monocytes %	2.00^{a}	4.33^{a}	2.67^{ab}	2.67^{ab}	2.67^{ab}	0.67^{*}
Basophils %	1.00	1.33	0.67	0.67	1.00	0.54^{NS}
Neutrophis %	40.67	38.33	41.00	31.33	42.33	4.96^{NS}
Eosinophils %	8.33	11.00	8.00	6.00	9.67	1.14^{NS}
Lymphocytes %	45.00	44.00	47.08	58.00	44.33	5.81^{NS}

[a,b]Means in the same row bearing different superscripts differ significantly (P<0.005)
NS =Not significant (P>0.05); RBC = Red blood cell counts; *= Significant (P<0.05); WBC = White blood cell counts; CBRCM = Camel blood-rumen content mixture; MCV = Mean corpuscular volume; PCV = Packed cell volume; MCH = Mean corpuscular haemoglobin concentration; Hb = Haemoglobin; MCH = Mean corpuscular haemoglobin

Table 3: Serum biochemical indices in rabbits fed diets containing various levels of camel blood-rumen content mixture

Parameter	T1 (0%)	T2 (10%)	T3 (20%)	T4 (30%)	T5 (40%)	SEM
Albumin (g/dl)	4.23^{a}	4.14^{ab}	3.38^{b}	4.10^{ab}	3.97^{ab}	0.25*
Total protein (g/dl)	5.64	6.01	5.77	5.82	6.30	0.21^{NS}
Cholesterol (mg/dl)	39.11^{a}	38.04^{ab}	41.02^{a}	35.61^{b}	40.04^{a}	1.00^{*}
Globulin (g/dl)	2.66	2.73	2.95	2.77	2.70	0.36^{NS}
Glucose (mg/dl)	81.87^{ab}	82.03^{ab}	80.34^{b}	87.44^{a}	72.04^{c}	2.09^{*}
Calcium (mg/dl)	6.73	6.90	6.20	6.50	6.17	0.71^{NS}
Phosphorus (mg/dl)	2.61	2.54	2.07	2.57	2.06	0.18^{NS}

[a,b]Means in the same row bearing different superscripts differ significantly (P< 0.005)
NS =Not significant (P>0.05); *****= Significant (P<0.05); SEM = Standard error of means

to the values reported by Anon (1980) for normal healthy growing rabbits. The normal range of values observed for all the treatments suggest adequate protein in the experimental diets for normal metabolic and physiological activities. The basophils, neutrophils, eosinophils and lymphocytes were not significantly (P< 0.05) affected by treatments, only monocytes were significantly influenced (P<0.05) by the diets. Rabbits on treatment 2 (10%) had higher concentration of monocytes than other treatments, the values obtained for all the groups were within normal range as reported by Anon (1980). In differential count, an abnormally higher monocytes level is synonymous with bacterial infection (Akinmutimi, 2004).

Serum biochemical values such as total protein, globulin, calcium and phosphorus were not significantly different (P>0.05) among rabbits on different dietary treatments. The study indicates that there was no wasting or catabolism of muscle tissues and that rabbits were not surviving at the expense of body reserve. This was a good sign that dietary protein was well utilized by the rabbits. The albumin differed significantly (P<0.05) among groups. Rabbits on control diets had higher albumin value than other treatments. Cholesterol and glucose values were also significant different (P<0.05) among the treatments. However, the values were within the normal range as reported elsewhere (Anonymous, 2006).

The haematological and biochemical values obtained for rabbits fed camel blood-rumen content meal fell within normal stipulated ranges. This is a good indication that camel blood-rumen content can be fed to growing rabbits without any health hazard. However, there is still the need for further studies on histopthatology which was not covered in this study.

References

Adeniji, A.A. 2008. Replacement value of maize with enzyme supplemented decomposed bovine rumen content in the diet of weaner rabbits. *Journal of Animal and Veterinary Advances*, 3:104-108.

Ajagbonna, O.P., Onifade, K.I. and Suleman, U. 1999. Haematological and biochemical changes in rats given extracts of *Calotropis procera*. Sokoto *Journal of Veterinary Sciences*, 1: 36 – 42.

Akinmutimi, A. H. 2004. Evaluation of sword bean (*Canavalia gladiate*) as an alternative feed resource for broiler chickens. Ph.D Thesis, Michael Okpara University of Agriculture, Umudike, Nigeria.

Anon, 1980. Guide to the Care and Use of Experimental Animal Vol. 1. Canadian Council on Animal Care, Ottawa, Ontario, Canada. Pp: 85–90.

Bush, B.M. 1975. Veterinary Laboratory Manual. William Heinemann Medical Books Ltd London. P: 447.

Dairo, F.A.S. 2005. Assessment of rumen content on the haematological parameters of growing rabbits: Proc. of 10th Annual Conference of Animal Science Association of Nigeria (ASAN), Sept. 12-15. University of Ado Ekiti, Nigeria. Pp. 301–302.

Dairo, F. A. S., Aina, O. O. and Asafa, A. R. 2005. Performance evaluation of growing rabbits fed varying levels of rumen content and blood rumen content mixture. *Nigerian Journal of Animal Production*, 32 (1): 67–72.

Duncan, D.B. 1955. Multiple Range Test and Multiple F-test. *Biometrics*, 11: 1–2.

Jain, N.C. 1986. Veterinary haematology. 4th ed. Lea–Febiger Publishers, Philadelphia, USA Pp: 153–159.

Mann, I. 1984. High protein from blood and ruminal content using solar drier. *World Animal Rev*iew, 50: 24–28.

Anonymous (2006). Biochemical Reference Values. *http://www.medirabbit.com/EN/Hematology_chemistry.htm*

Mohammed, G., Igwelbuke, J.U. and Kwari, I.D. 2005. Performance of growing rabbits fed graded levels of goat rumen content. *Global Journal of Pure and Applied Sciences*, 11 (1):39– 43.

Mohammed, G. Igwebuike, J. U., Ubosi, C.O. and Alade, N.K. 2008. Comparative study of the nutrient composition, Amino acid profile and microbial assay of fresh and dried cattle, camel, sheep and goat rumen content. Proceeding of the 13th Annual Conference of Animal Science Association of Nigeria. *(ASAN)*, ABU, Zaria, Sept. 15th -19thPp: 518–520.

Oyawoye, E.O. and Ogunkunle, M. 1998. Physiological and biochemical effects of raw jack beans on broiler. *Proceeding of Nigerian Society of Animal Production*, 23:141–142.

Schalm, O.W., Jain, N.C. and Carrol, E. 1975. Veterinary haematology. 3rd Edition Lea and Febiger, Philadelphia, USA. Pp. 160 – 210.

Spencer, K. and Price, C.P. 1997. Chemical analysis of bilirubin in biological fluid. *Annals of Clinical Biochemistry*, 14: 105 – 115.

Steel, R. G.D. and Torrie, J.H. 1980. Principles and Procedures of Statistics. A Biometrical Approach. 2nd ed. McGraw – Hill Book, Co; New York, USA. P: 633.

Uko, O.J., Ataja, A.M. and Tanko, H.B. 2000. Weight gain, haematology and blood chemistry of rabbit fed cereal offal. *Sokoto Journal of Veterinary Science*, 2: 18–26.

Whyte, E.P. and Wadak, I. 2002. Evaluation of rumen content on the growth performance of weaner rabbits. Proceeding 7th Annual Conference of Animal Science of Nigeria (ASAN) September, 16 –19. University of Abeokuta, Nigeria Pp: 143–146.

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Effect of the nature of energy and nitrogen sources on the population of ciliates in the rumen of sheep

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Abstract

The effect of the nature of raw materials in concentrate on the population of ciliated protozoa was evaluated in the rumen of Sicilo-Sarde sheep. Four rams with permanent rumen canulas, 4.8 ± 0.5 years with an average live weight of 45.25 ± 3.5 kg were used. Rams were fed a common base ration of hay oats (1.5 kg DM/ head/day). Animals were supplemented with 500g/head/day of one of four iso-energetic and iso-proteic concentrates. The four concentrates were: A concentrate (10% barley, 43.3% corn, 25% wheat bran, 17.7% soybean meal and 4% CMV), B concentrate (71.5% barley, 17.5% horse bean, soybean meal, 7% and 4% CMV), C concentrate (66% white sorghum, 30% fava, 4% CMV) and D concentrate (71% triticale, 18% horse bean, soybean meal, 7%, 4% CMV). The determination of ciliates was performed on unfiltered rumen fluid, collected two hours after the morning meal. The enumeration of protozoa and determination of various genuses were carried out with a HAWSKLEY counting room after several dilutions, using a microscope. The population of ciliates for, the concentrate B was significantly higher ($P<0.05$) than those for A, C and D concentrates while different genus of these protozoa were comparable among diets. It can be concluded from this study that the use of local resources in the diet of sheep increased micro organisms in the rumen.

Keywords: Ciliates, Local resources, Raw materials imported, Rumen, Sheep

Introduction

Digestive function in ruminants is characterized by the existence of a micro population residing in the pre stomach, especially in the rumen (Krause and Russel, 1996) which can be regarded as a vast ecosystem, within which changes in environmental conditions depending on diet and its ingredients (Krause and Oetzel, 2006; Selmi et al., 2009). Protozoa are most important by their numbers and their influence on digestion. Indeed, the amount of protozoa and specifically Entodiniomorphes varies rapidly with the meal (Jouany and Ushida, 1999; Ben Salah et al., 2004). These Entodiniomorphes are very sensitive to nutrition and do not disappear in 2 to 3 days diet. Moreover, the number and different genus present in the rumen of sheep is related to several factors such as geographic region, the nutritional quality of food resources and adaptation of the animal. For example, in Australia Holotriches are not often found in the rumen of sheep (Calabro et al., 2005). However, the main factor is the diet, because the protozoa population is higher with high-energy diets (Rouissi and Guesmi, 2004; Dayani et al., 2007). Whereas a diet rich in starch such as concentrated promotes gender Entodinium (Jouany, 1996; Jouany and Ushida, 1999).

The objective of this work was to test the effect of nitrogen source (soybean or scotch bean) and the energy source (corn, sorghum white, triticale and barley) in the feed concentrate on the population of ciliates in the rumen of Sicilo-Sarde sheep.

Materials and Methods

Four Sicilian-Sarde rams with an average live weight of 45.25 ± 3.5 kg and age of 4.8 ± 0.5 years, fitted with permanent canulas in the rumen were used in this experiment. They were housed in individual boxes (1.6 m length by 1 m width) in a building belonging to the farm of the School of Higher Education in Agriculture in Mateur, Tunisie. Animals had a common basal diet of 1.5kg DM/head/day of oat hay supplemented by 500g/head/ day of one of four concentrates (A, B, C and D). Concentrates differ by the nature of protein and energy ingredients they contained. The ration was distributed twice a day at fixed times throughout the trial (at 9.00 and 17.00 hours). The physio-chemical composition of different

concentrates is given in table 1. They were formulated to have comparable protein and energy contents to meet design requirements (AOAC, 1990).

Table 1: Chemical composition of aliments (% DM)

	Concentrate				
	A	C	D	B	Oat hay
DM (%)	94.7	94.7	95.2	95	92
CP (%)	16.3	14.65	15.2	15.26	4.9
CF (%)	12.7	3.7	4.7	9.1	35.6
OM (%)	91.0	88.3	83.8	90.8	92.1

DM: Dry matter, CP: Crude protein, CF: Crude fiber, OM: Organic matter

Different protozoa genus counting was performed on unfiltered content of rumen, collected two hours after the morning meal. A volume of 5 ml of unfiltered juice using a pipette previously sawed and 5 ml of fixative (for 1 liter: 500 ml glycerol + 20 ml + 480 ml formaldehyde distilled water) was sampled. The enumeration of protozoa and determination of various kinds were carried out with a HAWSKLEY counting room after several dilutions, using a microscope with a lens 100X. At the time of counting, protozoa were diluted several times until they were easily distinguishable in the field of the microscope and the counting became easier. Protozoa were identified from photographs and descriptions given by (Ogimoto and Imai, 1981).

Statistical analysis

The number of ciliated protozoa and different geniuses were subjected to analysis of variance by the GLM procedure in SAS (1989) using the following model:

$Yij = \mu + Ri + Eij$, where Yij: is total protozoa or the count of a protozoa genus.

μ: average,

Ri: effect of the i^{th} diet (1, 2, 3, 4),

Eij: random residuals

Means of different diets were compared by the test Duncan.

Results and Discussion

The majority of protozoa found in the rumen of sheep belong to the phylum of ciliates. Their numbers varied rapidly with the meal. Furthermore, protozoa species vary with the geographic area, nutritional quality of food resources and adaptation of the animal (Yanagita et al., 2000). In our study we were interested in counting Entodiniomorphes (Entodinium, and Ophryoscolex Polyplastron) and the main kind of Holotriches (Isotricha). From table 2, the total number of protozoa in the rumen regardless of the nature of the raw material making the food concentrate was similar to that advocated by Williams and Withers (1993), Jouany and Ushida (1999) and Selmi et al. (2009). The B concentrate that was made of barley and fava was associated with the highest numbers of protozoa (6.40 ± 0.15 105/ml) compared to other diets ($P<0.05$), while the D concentrate resulted in the lowest number of protozoa. Moreover, results revealed that there were no significant differences ($P>0.05$) between A and C diets. Regarding the types of ciliates, they were dominated by the Entodinium genus regardless of the regimen. This result is in agreement with findings of Jouany and Ushida (1999). Entodinium genus is then followed in numbers by Isotricha, Ophryoscolex and Poly plastrongenuses. The Entodinium protozoa were 55.64 ± 6.21, 54.86 ± 15, 50.97 ± 3.10 and 56 ± 4.09% for the A, C, D and B diets, respectively, without statistical differences ($P>0.05$), which is consistent with the results found by Selmi et al. (2009) who showed that the nitrogen source affect the total number of Entodinium and the proportion of *Isotricha polyplastron.*

Total number of ciliates in the rumen is more significant ($P<0.05$) for the B diet. This can be explained by the nature of starch granules in barley that are rapidly fermentable in the rumen, which will result in a higher concentration of protozoa and more intense production of butyrate, end product of the metabolism of protozoa (Jouany, 1994; Demeyer and Fievez, 2000), and protein quality in terms of fava beans from those of

Table 2: Effect of the nature of energy and nitrogen sources on the population of ciliates in the rumen of sheep (10^5/ml) and genus (%) of protozoa

	population (10^5/ml)	Genres of ciliates (%)			
		Entodinium	Isotricha	Ophryoscolex	Polyplastron
A	6.08 ± 0.23^b	55.64 ± 6.21^a	27.31 ± 6.46^a	10.95 ± 1.32^a	7.82 ± 2.82^a
B	6.40 ± 0.15^a	56 ± 4.09^a	30.37 ± 3.92^a	8.32 ± 1.83^b	5.29 ± 1.83^a
C	6.06 ± 0.22^b	54.86 ± 15^a	29.7 ± 15.29^a	8.06 ± 2.62^b	5.73 ± 3.93^a
D	5.66 ± 0.09^c	50.97 ± 3.10^a	30.48 ± 1.5^a	11.24 ± 2.35^a	6.55 ± 1.35^a

Means in the same row with different superscripts are significantly different at p=0.05; Concentrate A: 10% barley, 43.3% corn, 25% wheat bran, 17.7% soybean meal and 4% CMV; Concentrate B: 71.5% barley, 17.5% horse bean, soybean meal, 7% and 4% CMV; Concentrate C: 66% white sorghum, 30% fava, 4% CMV; Concentrate D: 71% triticale, 18% horse bean, soybean meal, 7%, 4% CMV

soybean meal (Selmi et al., 2009). This result further explains what is found by Jouany (1991) and Eugene et al. (2004) who reported that in the rumen of conventional animals, deamination is intense and the ammonia concentration is always higher than that measured in the defaunated animals. While the low concentration of the population of ciliates for the regimen D can be explained by the anti-nutritional factors and triticale seed coat that prevents the degradation of proteins and starch grains even if they are readily biodegradable. The A and C diets occupy an intermediate position relative to other regimens in terms of protozoa counts. This is explained by the nature of the starch of corn and sorghum white and the speed of digestion of nutrients in addition to the close relationship between the concentration of ammonia nitrogen in the rumen (N-NH3) and the number of protozoa (Jouany, 1994; Jouany and Senaud, 1982; Sauvant, 2004).

References

AOAC. 1990. Official methods of analysis. Association of official analytical chemists, Washington, DC.

Ben Salah, M., Prensier, G., Senaud, J., Jouany J.P and Bohatier, J. 2004. Development of two microscopic techniques to enumerate rumen bacteria: Staining With acridine orange and indirect immunofluorescence. *Revue Médecine Vétérinaire*, 155: 205-211

Calabro, S., López, S., Pícalo, V., Dijkstra, J., Dhanoa, M.S and France, J. 2005. Comparative analysis of gas production profiles obtained with buffalo and sheep ruminal fluid as the source of inoculum. *Animal Feed Science and Technology*, 123-124: 51-65.

Dayani, O., Ghorbani, G.R., Alikhani, M., Rahmani, H.R and Mir, P.S. 2007. Effects of dietary whole cottonseed and crude protein level on rumen protozoal population and fermentation parameters. *Small Ruminant Research*, 69: 36–45.

Demeyer, D and Fievez, V. 2000. Ruminants et environnement: la méthanogenèse. Annales de Zootechnie, 49: 95- 112

Eugene, M., Archimède, H., Weisbecker, J.L., Periacarpin, F., Saminadin, G and Sauvant, D. 2004. Effects of defaunation on digestion and growth, in sheep receiving a mixed diet (fresh Digitaria decumbens grass and concentrate) at four proteins to energy ratios. *Animal Research*, 53:111-125.

Jouany, J.P. 1994. Les fermentations dans le rumen et leur optimisation. *INRA Production Animale*, 7 (3): 207 – 225.

Jouany, J.P. and Senaud, J. 1982. In fluence des ciliés du rumen sur la digestion des différents glucides chez le mouton. I. Utilisation des glucides pariétaux (cellulose et hémicellulose) et de l'amidon. *Reproduction, Nutrition Developement*, 22: 735-752.

Jouany, J.P. 1991. Defaunation of the rumen. In: Jouany, J.P. (Ed.), Rumen microbial metabolism and ruminant digestion. Paris, France, Pp: 245.

Jouany, J.P. 1996. Effect of rumen protozoa on nitrogen utilisation by ruminants. *Journal of Nutrition*, 126: 1335-1346.

Jouany, J.P. and Ushida, K. 1999. The role of protozoa in feed digestion. Asian-Aus. *Journal of Animal Sciences*, 12: 113-128.

Krause, D.O. and Russel, J.B. 1996. How many ruminal bacteria are there? *Journal of Dairy Sciences*, 79: 1467-1475

Krause, K.M. and Oetzel, G.R. 2006. Understanding and preventing subacute ruminal acidosis in dairy herds: a review. *Animal Feed Science and Technology*, 126: 215-236

Ogimoto, K and Imai, S. 1981. Atlas of rumen microbiology. Japanese Science Society Press, Tokyo.

Rouissi, H et Guesmi, A. 2004. Etude comparée de la population des protozoaires ciliés dans le rumen des ovins et caprins. *Options méditerranéennes*. Série A. Pp: 57- 59.

SAS User's Guide 1989 version 6.10 for Windows, SAS Inst. Inc., Cary, NC.

Sauvant, D. 2004. Table de composition et de valeur nutritive des matières premières destinées aux animaux d'élevage. *INRA. Production. Animale*. p: 301.

Selmi, H., Hammami, M., Rekik, R., Salah, N., Ben Gara, A and Rouissi, H. 2009. Effet du remplacement du soja par la féverole sur les protozoaires ciliés dans le rumen des béliers de race Sicilo- Sarde. *Livestock Research for Rural Development* 21 (9).

Williams, A.G. and Withers, S.E. 1993. Changes in the rumen microbial population and its activities during the refaunation period after the reintroduction of ciliate protozoa into the rumen of defaunated sheep. *Canadian Journal of Microbiology*, 39: 61-69

Yanagita, K., Kamagata, Y., Kawaharasaki, M., Suzuki, T., Nakamura, Y and Minato, H. 2000. Phylogenetic analysis of methanogens in sheep rumen ecosystem and detection of Methanomicrobium mobile by Fluorescence In Situ Hybridization. *Bioscience, Biotechnology Biochemie*, 64: 1737-1742.

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Seasonal influence on some blood and biochemical parameters of Jerboa (*Jaculus jaculus*) in Saudi Arabia

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Abstract

The aim of this study was to investigate the effect of seasonal variation on the haematological and biochemical parameters in adult wild Jerboa (*Jaculus jaculus*) in Saudi Arabia. Blood samples of 40 Jerboa were collected in January and August for analyzing hematological and biochemical parameters. In hematological parameters, haemoglobin, mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC) and white blood count (WBC) were significantly increased in winter compared with summer season. Whereas, only mean corpuscular volume (MCV) was significantly decreased in winter compared with summer season. Sodium, chloride, bicarbonate, calcium, albumin, globulin and total protein were significantly decreased in winter compared with summer season. Whereas, urea was significantly increased in winter compared with summer season. In conclusion, heat stress during summer caused deterioration in some hematological and serum biochemical constituents of Jerboa (*Jaculus jaculus*).

Keywords: Jerboa, Season, Haematology, Biochemical Parameters

Introduction

Several studies have found that conducting researches on rabbits are beneficial for farmer requirements and animal's welfare. Hence, haematology and serum chemistry are becoming increasingly important diagnostic tools. Blood parameters are used as an aid tool for the diagnosis of infectious and several parasitic diseases. In addition to assess the metabolic condition of animals, haematological and biochemical parameters could be affected by many factors including: sex, age, reproductive status and seasonal variations (Al-Eissa et al., 2008; Wells et al., 1999; Gill and Wanska, 1978; Mira and Mathias, 1994; Cetin et al., 2009). On the other hand, it was reported that haematological parameters were not influenced by sex (Schalm et al., 1975) and gestation (Egbe-nwiyi et al., 2000). In various studies, RBC count, haemoglobin and hematocrit parameters were reported to reach the highest levels during winter months in different rodents (Rewkiewiccz-Dziarska, 1975). In contrast, these parameters were reported to be at the lowest level during winter months in large animals such as horses (Gill and Wanska, 1978) and cows (Rusoff et al., 1954).

The physiological, nutritional and pathological conditions of animals are usually assessed, using haematological and biochemical analyses of their blood (Jain, 1986; Bush, 1991; Cetin, et al., 2010). Nutrition, age, sex, genetics, reproduction, housing, starvation, environmental factors such as stress and transportation are all known to affect haematological and biochemical parameters of tropical and temperate animals (Ogunrinade et al, 1981; Bush, 1991; Ogunsanmi et al, 1994).

Previous studies reported that there is no significant difference in haematological parameters between non-pregnant and pregnant rabbits (Brewer, 2006). Furthermore, haematological parameters for different spices of rabbits are reported by many researchers (Chineke et al., 2006; Cetin et al., 2009; Ahamefule et al., 2006; Solomon et al., 1998; Barlet, 1980). Not much is known about the breeding of jerboas due to their solitary and nocturnal nature. However, breeding is known to occur at least twice a year, between June to July and from October to December.

Due to the limitation and lake of information about jerboa specially (*Jaculus jaculus*), therefore, this study was undertaken to investigate the effect of seasonal variation on the haematological and biochemical parameters of wild Jerboa (*Jaculus jaculus*) in Saudi Arabia to know the best conditions for breeding and

conservation of this species and others similar mammals.

Materials and Methods

Forty healthy adult wild Jerboa (*Jaculus jaculus*) were used in this study, their age could not be determined as they were captured at south of Riyadh, Saudi Arabia. Animals were transferred to the animal house of the faculty of science, King Saud University, Saudi Arabia. Animals were maintained under standard laboratory conditions at a temperature of 22±1ºC, a relative humidity of 45±5% and photoperiod cycle of 10/14 h. They were fed summer ration *ad libitum*. The feed of jerboa was similar in both the summer and winter seasons, thereby limiting the variables to only the season while the other factors such as feed, housing and management of the Jerboa were kept constant. The Jerboas were acclimatized to their new environment for 30 days before the commencement of the study.

In August and January, blood was collected from the saphenous vein into a vessel containing ethylene diamine tetraacetic acid (EDTA) (2mg/ml of blood). RBC and WBC were counted with a haemocytometer. PCV was determined by using the microhaematocrit method. Hb concentration was measured by cyanmethaemoglobin method. MCV, MCH and MCHC were calculated from the parameters of RBC, PCV and Hb. The remaining blood samples were centrifuged at 3000 g for 10 minutes to obtain plasma. Serum electrolytes were determined by standard flame photometry. Chloride was assessed by the method of Schales and Schales (1941), and bicarbonate according to (Toro and Ackermann, 1975). Total protein was determined by using biuret method (Reinhold, 1953). Globulin was calculated by subtracting albumin from total protein. Urea was determined according to method described by Harrison (1947).

Statistical analysis

Data were analyzed by using the SPSS (SPSS Inc., Chicago, IL, USA). Statistical significances between winter and summer were determined by t-test. A P value less than 0.05 was considered significant as mention by Cetin et al. (2009).

Results

Heamatological parameters of jerboa are illustrated in table 1. Hb and MCHC, MCH, WBC were significantly increased in winter compared with summer season. In contrast, mean MCV was significantly decreased compared with summer season. Red blood cells (RBC) count and packed cell volume (PCV) did not differ between the seasons.

Serum sodium, potassium, chloride, bicarbonate and calcium of jerboa are shown in table 2. The levels of sodium, chloride, bicarbonate and calcium were significantly decreased compared with summer season. No significant difference was recorded in serum potassium concentration.

Mean serum total protein, albumin, globulin, albumin and globulin ratio and urea concentration of Jerboa in the two seasons have been presented in table 3. Total protein and albumin decreased significantly in winter seasons. In contrast, only urea increased significantly in summer season. No significant changes in globulin and albumin/globulin ratio were observed.

Table 1: Mean haematological Parameters (Mean ± SE) in Jerboa (*Jaculus jaculus*) in summer and winter seasons

Parameters	Summer season (n=20)	Winter season (n=20)
RBC ($X10^6$/µl)	8.4 ± 0.2	9.09±1.58
PCV (%)	41.7 ± 1.35	38.84±4.02
Hb (g/dl)	14.2± 0.3	17.27±2.63*
MCV (fl)	72.4± 6.9	56.59±17.52*
MCH (pg)	22.0± 3.2	24.32±6.57**
MCHC (g/dl)	34.0± 1.2	41.45±5.52*
WBC ($\times10^3$/µl)	10.733.±8.0	12.22±2.51**

Value significantly different from summer season at *P<0.001 and **P<0.05

Table 2: Plasma electrolytes and minerals (Mean ± SE) in Jerboa (*Jaculus jaculus*) in summer and winter seasons

Parameters	Summer season (n=20)	Winter season (n=20)
Sodium (mmol/l)	138±3.8	65.6±5.3*
Potassium (mmol/l)	4.5±0.13	5.48±0.49
Chloride (mmol/l)	99.3±3.3	54.65±2.33*
Bicarbonate (mmol/l)	25.5±1.8	9.88±0.57*
Calcium (mg/dl)	9.50±0.88	1.25±0.60*

Value significantly different from summer season at *P<0.001 and **P<0.05

Table 3: Serum biochemical parameters (Mean ± SE) of Jerboa (*Jaculus jaculus*) in summer and winter seasons

Parameters	Summer season (n=20)	Winter season (n=20)
Total protein (g/dl)	7.3±1.7	4.77±0.42**
Albumin (g/dl)	4.00±0.60	3.24±0.22*
Globulin (g/dl)	4.11±0.47	4.01±0.44
Albumin/globulin ratio	0.89±0.09	0.89±0.22
Urea (mg/dl)	16.7±3.4	22.32±3.53*

Value significantly different from summer season at *P<0.001 and **P<0.05

Discussion

The obtained data showed significant changes in some heamatological parameters which is in according to the study of Kim et al. (2002) who also reported heamatological changes in rabbits during winter season. Theses changes may be due to the lower water intake during winter season compared to summer season. Previous studies reported that this variation may be related to environmental acclimatization because the winter low ambient temperatures requires a higher metabolic rate for body temperature regulation could stimulates erythropoiesis which would be of great advantage in oxygen transport and delivery to the tissues (Sealander, 1964; MacLean and Lee, 1973; Berry and Jakobson, 1975; Wells et al., 1999; Kim et al., 2002). Total WBC numbers was significantly higher in the Jerboa during the winter season. In contrast, in summer season, Kim et al. (2002) observed decrease in the number of WBC numbers in rabbits. On the other hand, some studies demonstrated that haematological parameters reached the highest value during winter months in rodents (Rewkiewiccz-Dziarska, 1975), whereas, these parameters reached the lowest level in large animals such as horses and cows (Rusoff et al., 1954; Gill and Wanska, 1978; Al-Eissa, 2011). These differences may be due to from the difference in species, intensity of season, diet and other environmental factors.

We observed significant difference in electrolytes in this study. Nevertheless, Jerboas could manage with low levels of plasma electrolyte in the winter season. From this study it seems the Jerboas have adaptive mechanism to manage with the variation in the plasma electrolytes in the summer and winter seasons. Total protein and albumin concentrations were higher during summer than winter season. since the ambient temperatures was higher and relative humidity was lower during summer season, the Jerboas may be dehydrated during summer season which might have elevated the concentration of the plasma proteins as described by Finco, (1989), and Akerejola (1980). Urea was higher in winter season than summer season. This result is similar to observation made Akerejola (1980) and Gring (1991). The increase of serum urea level maybe due to the efficient digestion of dietary protein.

This study is the first report on Jerboa in Saudi Arabia. There are considerable alterations in the haemotoligical and serum biochemistry in both seasons. We suggest further studies on other aspects of this mammal under Saudi Arabia conditions which will help in understanding the disease controlling strategies as this rodent may be a vector of many parasitic diseases in human and other domestic animals.

References

Ahamefule, F., Edouk, G., Usman, A., Amaefule, K. and Oguike, S. 2006. Blood biochemistry and haematology of weaner rabbits fed sun-dried, ensiled and fermented cassava peel based diets. *Pakistan Journal of Nutrition*, 5: 248-253.

Akerejola, O., Umuna, N. and Denis S.M. 1980. Serum biochemical levels of cattle in Northern Nigeria. *Nigeria Veterinary Journal*, 9: 26-31.

Al-Eissa, M., Al-Hamidi, A. and Kandeal, S. 2008. Assessment of reproductive efficiency of the Arabian sand gazelle males (Gazelle Subgutturosa marica). Saudi J. Biological Sci., 15: 85-95.

Al-Eissa, M. 2011. The effect of gestation and season on the haematological and biochemical parameters in domestic rabbits (*Oryctolagus cuniculus). British Biotechnology Journal*, 1(1): 27-34.

Barlet, P. 1980. Plasma calcium, inorganic phosphorus and magnesium levels in pregnant and lactating rabbits. *Reproduction, Nutrition and Development*, 20: 647- 651.

Berry, R.J. and Jakobson, M. 1975. Adaptation and adaptability in wild-living mice *(Mus ntuscirlus). Journal of Zoology*, 176: 391-402.

Brewer, N. 2006. Historical special topic overview on rabbit comparative biology. *Journal of American Association for Laboratory Animal Science*, 45: 8–24.

Bush, M. 1991. Interpretation of Laboratory Results for Small Animal Clinicians. Blackwell Scientific Publication, London.

Cetin, N., Bekyurek, T. and Cetin, E. 2009. Effects of sex, pregnancy and season on some haematological and biochemical blood parameters in angora rabbits. *Scandinavian Journal of Laboratory Animal Science*, 36: 155-162.

Cetin, E., Kanbur. M., Silici, S. and Eraslan, G. 2010. Propetamphos-induced changes in haematological and biochemical parameters of female rats: Protective role of propolis. *Food and Chemical Toxicology*, 48: 1806-1810.

Chineke, C., Ologun, A. and Ikeobi, C. 2006. Haematological parameters in rabbit breeds and crosses in humid tropics. *Pakistan Journal of Biological Sciences*, 9: 2102–2106.

Egbe-nwiyi, N., Nwaosu, S. and Salami, H. 2000. Haematological parameters of apparently healthy sheep and goats as influenced by age and sex in arid zone of Nigeria. *African Journal of Biomedical Research*, 3: 109-115.

Finco, D.R. 1989. Clinical Biochemistry of Domestic Animals. 4th Ed. Academic press, Toronto.

Gill, J. and Wanska, E. 1978. Seasonal changes in erytrocyte, haemoglobin and leukocyte indices in

barren mares of thoroughbred horses. *Bulletin of the Polish Academy of Science*, 26: 347- 353.

Gring, E. 1991. Responses of dairy cows in early lactation to additions of cotton seed meal in Alfa Alfa-based diets. *Journal of Dairy Science*, 74:2580-2587.

Harrison, A. 1947. Chemical Methods in Clinical Medicine. 3rd Ed. Churchill, London.

Jain, N. 1986. Schalm's Veterinary Haematology, 4th Ed. Lea and Febiger, Philadelphia, U.S.A.

Kim, C., Yun, I., Cha, W., Kim, H. and Koh, S. 2002. Haematological changes during normal pregnancy in New Zealand White Rabbits. *Comparative Clinical Pathology*, 11: 98-106.

Maclean, G.S. and Lee, A.K. 1973. Effects of season, temperature and activity on some blood parameters of feral house mice *(Mus musculus). Journal of Mammalogy*, 54: 660-667.

Mira, A., Mathias, M. 1994. Seasonal effects on the hematology and blood plasma proteins of two species of *Mus musculus domesticus* and *M. spretus* (Rodentia: Muridae) from Portugal. *Hystrix-Italian Journal of Mammalogy*, 5: 63-72.

Ogunrinade, A., Fajimi, J. and Adenike, A. 1981. Biochemical indices in the White Fulani (Zebu) cattle in Nigeria. *Revue d'élevage et de médecine vétérinaire des pays tropicaux*, 4: 34-41.

Ogunsanmi, A., Akpavie, S., Anosa, V. 1994. Serum biochemical changes in West African Dwarf sheep experimentally infected with *Trypanosoma brucei*. *Revue d'élevage et de médecine vétérinaire des pays tropicaux*, 47 (*2*): 195- 201.

Reinhold, J. 1953. Standard Method of Clinical Chemistry. 1st Ed. Academic Press. New York. Pp: 88.

Rewkiewiccz-Dziarska, A. 1975. Seasonal changes in hemoglobin and erythrocyte indices in Microtus arvalis. *Bulletin of the Polish Academy of Science*, 23: 481- 486.

Rusoff, L., Johnston, J., Bronton, C. 1954. Blood studies on breeding dairy bulls. Hematocrit, hemoglobin, plasma calcium, plasma inorganic phosphorus, alkaline phosphatase parameters, erythrocyte count and leukocyte count. *Journal of Dairy Science*, 37: 30-36.

Schales, P. and Schales, S. 1941. A simple and accurate method for the determination of chloride in biological fluids. *Journal of Chemistry*, 140: 879-884.

Schalm, W., Jain, N. and Carroll, E. 1975. Veterinary Haematology 4th Ed. Lea and Febiger, Philadelphia.

Sealander, J. 1964. The influence of body size, season, sex, age and other factors upon some blood parameters in small mammals. *Journal of Mammalogy*, 45: 598-616.

Solomon, P., Monsi, A., Zitte, F. 1998. Physiological, haematological and biochemical evaluation of grasscutter and rabbit. Proceedings of the Silver Anniversary Conference of Nigerian Society for Animal Production, March 21-26, Abeokuta, Nigeria, 405-406.

Toro, G. and Ackermann P. 1975. Practical Clinical Chemistry. 1st Ed. Little Brown and Company, Boston.

Wells, Y., Decobecq, P., Decouvelaere, M., Justice, C. and Guittin, P. 1999. Changes in clinical pathology parameters during gestation in the New Zealand white rabbits. *Toxicological Pathology*, 27: 370-379.

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The contribution of dairying to household welfare of the small commercial dairy keepers in Khartoum north province (KNP), Sudan

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Abstract

A total of 53 small livestock commercial producers of which 32 were in Silate, 9 in Kadaro and 12 in Halfaya divisions were randomly selected and interviewed using structured questionnaire. Following this, 9 small commercial households, 3 of each division were selected based on milk production activity. The aim of the research was to study, quantify the socio-economic aspects and to develop recommendations for future research and development of the small commercial households in the peri–urban region of KNP. The study revealed that livestock production especially dairying was ranked first (75.6%) as the most important source of household income in the study area. Income from livestock was used on the farm needs, family needs, house construction, investment and stock replacement. The majority of farmers (71.7%) sold their products at the farm gate homestead or neighbourhood (0-15 km), while 28.3 % at markets far from their location (16 - < 25 km). On average, Silate and Kadaro households earned 214.7 Sudanese Pound (SDG) and 322.5 SDG a year per cow, respectively. In terms of economic profitability, both Silate and Kadaro households engaged in livestock production earned a profit. High variability between the three divisions was observed due to loses of money e.g. Halfaya (-118.6 SDG). It could be concluded that under the current husbandry practices, the contribution of livestock to small commercial farmers in KNP was satisfactory but does not fulfil farmers' goals.

Key words: Commercial Producers, Small Livestock, Socio-Economic Aspects

Introduction

Smallholder urban or peri-urban commercially oriented milk production enterprises are common in and around the cities. Rey et al. (1993) stated that these enterprises involve the production, processing and marketing of milk and milk products to consumers in urban centers. It also has evolved in response to the increasing demand for milk in urban centers as a consequence of increasing urbanization, rising per capita income and increasing costs of imported milk and milk products. De Jong, (1996) reported that smallholder dairy system, in Sub-Saharan Africa is marked by declining farm size, upgrading into dairy breeds and an increasing reliance on purchased feeds, both concentrates and forage, resulting in milk yields per lactation increasing by as much as five times, while milk yield ha-1 of land planted with forage rose by a factor of 40. On the other hand Moorosi et al. (2000) argued that this productivity is in most cases insufficient to ensure food security to urban population let alone its inadequate financial returns. The contribution of UPLP to smallholder household's economy in KNP has not fully been studied. This study will help understand the importance of livestock production in general and in characterizing livestock production systems in KNP in particular.

Materials and Methods

The study was carried out in two of the administrative units of Khartoum North Province (KNP) in the Sudan. From two administrative units Halfaya, Kadaro and Silate divisions were chosen. A total of 90 small and large commercial producers of which 53 small producers were distributed as follow: 32

in Silate, 9 in Kadaro and 12 in Halfaya divisions. The households were randomly selected and interviewed using structured questionnaire. Following this, 9 small commercial households, 3 of each division were selected based on milk production activity as a selection criterion to cover the relative profitability and income contribution of the small commercial households (case studies).The geographical characteristics of the study area were described by (Elniema, 2008). For the purpose of this study, two questionnaires were reproduced. The general questionnaire assessed the basic information at household level for both small commercial householders, while the second one covered the relative profitability and income contribution as suggested by Creswell, (1998). The general questionnaire was pre-tested in the three divisions. The Single-visit, multiple-subject approach to data gathering as described by (Gilbert et al. 1980) were used in this study e.g. taking notes (questionnaires), as well as taking photographs and the help of some key informants in the area complemented by secondary data. The assessment of the economic performance of the small commercial householders was based on the enterprise budget analysis using the accrual accounting methods. The collected survey data were coded and analyzed using Statistical Packaging for the Social Sciences (SPSS/PC version 11.5) for windows.

Results and Discussion

The characteristics of the households surveyed are presented in table 1.The results showed that hundred percent of those responsible for livestock were males. The reason behind this could be attributed to the fact that in the study area, traditionally investment in livestock is male business. The middle aged (31-60 yrs) was the most numerous group of the livestock keepers in the study area (67.8%). Young people (21-30 yrs) (20%) ranked next and then those of retirement age (61-more than 70 yrs) (12.2%). The middle aged (31-60 yrs) was the most numerous group of the livestock keepers in the study area (67.8%). For this category livestock keeping seems to supplement other informal or formal employment (47% of the households). For some older people livestock keeping provides a coping strategy for retirement. This result is in agreement with the findings reported by DFID (2002) in East Africa. Almost a quarter of the investigated HHs heads in the study area did not have any formal education and only 4.4% had Khalwa. The main types of farming systems investigated in this study were: Dekka (small plots constructed from locally available materials) (58%), non-mixed farm (9%), mixed farm with fodder (24%), and mixed farm with fodder and other types of crops (8.9%).

Table 1: Characteristics of households surveyed and households categories

Parameter	%
Age (N=90)	
21-30	20.0
31-40	24.4
41-50	30.0
51-60	13.3
61-70	08.9
More than 70	03.3
Respondents Gender (livestock owner) (N=90)	
Male	100.0
Female	
Female	00.0
Education Level (N=90)	
Illiterate	26.7
Khalwa*	04.4
Primary	26.7
Intermediate	12.2
Secondary	17.8
University	10.0
Higher studies	02.2
Types of farming systems (N=90)	
Dekka	57.8
Non-mixed farm	08.9
Mixed farm – fodder	24.4
Mixed-farm -fodder+ crops	08.9

* Khalwa is a traditional education based on Islamic teachings

In this study concentrate feeds were purchased from local markets as commercial concentrates or on-farm mixed ingredients. The sources of agricultural and industrial by-product were mainly rural markets. This is important in terms of rural-urban linkages, as it could be assumed that livestock feed supply depends on existing relations between urban-peri-urban and rural relations.

The study also revealed three main types of feeding methods (Table 2): these are zero-grazing, grazing and partial grazing. It was shown that 92.5%, 50% and 88.2% of Silate, Kadaro and Halfaya divisions, respectively adopted stall feeding. Feeding methods were highly significantly and negatively correlated with

Table 2: Feeding methods in the study area by region

Area	Feeding system (% of households)				
	Grazing	Partial grazing	Stall feeding	Partial grazing + stall feeding	Poultry keepers (Stall feeding)
Silate (N=53)	0	3.8	92.5	3.8	0.0
Kadaro (N=20)	5	40.0	50.0	0.0	5.0
Halfaya (N=17)	0	00.0	88.2	0.0	11.8

region (r=-.334) (P<0.001). This explains why grazing or partial grazing was not practiced in Halfaya division which is the nearest region to city center, while it existed in Kadaro and Silate divisions (peri-urban areas). The practice which is an exact example of a peri-urban system (Thys et al. 2005) points directly to the availability of pastures around Kadaro and Silate regions.

Livestock production especially dairying was ranked first (75.6%) as the most important source of household income in the study area. The rank of livestock production according to economic importance was highly significantly and positively correlated with type of farming (r=0.338), land size and level of education (P<0.001). The reasons why farmers complemented dairying may be attributed to its immense contribution as a source of income and regular flow of cash and milk for household consumption. Similar results are reported by Leslie et al. (1999) in East African countries. Table 3 in the present study shows the contribution of livestock to welfare of the small commercial farmers. Income from livestock was used on farm needs (feeds, veterinary medicines, and wages), family needs, house construction, investment and stock replacement. The flock dynamics data (During, 2007) which is vital in assessing the viability of the household shows that 94% of the investigated small commercial households sold milk, 5.7% sold eggs and 83% sold manure during the year. In addition to these sources of income empty concentrate bags constitute another source of income. The value of stock itself was the major benefit from livestock keeping. The farmer benefited from this amount of money when forced to sell animals to finance specific occasions e.g. a festivity, build a house or pay school fees. This agreed with the findings of Hanyani-Mlambo et al. (1998) who reported that dairying is an income supplementing to households in African countries.

Milk supply and marketing are influenced by many factors such as environmental (season), location of the farm with regards to marketing points and the availability of means of transportation. Table 4 shows the percent of HHs and quantity of milk production in the small commercial households. The results indicated that milk yield was highly significantly and positively correlated with the number of cross- bred cows (r= 0.818); P<0.001). Milk yield was highly significantly and negatively correlated with farm size (r= -0.587) and type of breed (r= -0.387; P<0.001). It was also shown in this study that 71.7% of farmers sold their products at the farm gate homestead (6-15 km) and 18.9 % at markets far from their location (16-more than 25 km). Similar findings are reported by Waithaka et al. (2000) who stated that livestock products especially milk marketing is mainly informal and it is the most common channel for milk marketing in some African countries.

Table 3: Contribution of livestock to household welfare of the small commercial farmers

Use of income from livestock (N=53)	Frequency	Percent
farm needs (feeds, veterinary	09	17.0
house construction	00	00.0
Investment	00	00.0
stock replacement	01	01.9
family needs + farm needs	21	18.9
family needs + farm needs + house construction	05	09.4
family needs + farm needs + investment	03	05.7
family needs + farm needs + investment+ stock replacement	03	05.7
family needs + farm needs + stock	11	20.8

The case study also revealed that small commercial households in Silate and Kadaro were operating efficiently (Table 5). On average, the Silate and Kadaro households earned 214.7 Sudanese Pound (SDG) and 322.5 SDG a year per cow, respectively. In terms of economic profitability, both Silate and Kadaro households engaged in livestock production earned a profit. However, the results indicate high variability between the three regions because some households were losing money e.g. Halfaya (-118.6 SDG). By spending more money on feed per cow and due to high concentrates prices Halfaya farms were not operating efficiently. They spent 2230 SDG on feed per cow which is 491 SDG more than in Kadaro farms and 1397 SDG more than in Silate farms. This finding is in line with that reported by Doyle (1983) who stated that

Table 4: Percentage and quantity of milk production ton/yr in small commercial households

Area	None	3-10 t/yr	11 - 20 t/yr	21 - 50 t/yr	51 - 100 t/yr
Silate	3.1	25	46.9	21.9	3.1
Kadaro	0	55.6	22.2	22.2	0
Halfaya	16.7	16.7	58.3	8.3	0

Table 5: Partial budget statement (SDG/cow/yr) of small commercial households during the past 12 mo (yr 2007)

Farm operating income per cow	Silate	Kadaro	Halfaya
	(Figures in SDG*)		
Sales of livestock products (1)			
Milk	972	1848	1731
Live animals	00.0	174	192
Manure	33	56.5	242
Empty bags	22	21.7	23
Sub-total	1027	2100	2188
Farm operating expenses (2)			
Feed	833	1739	2230
Disease treatment	35	35.3	38
Insemination	0	3.1	0
Labour & opportunity cost for family members	111	174	154
Sub-total	979	1951.4	2422
Net cash operating income (3) = (1-2)	48	148.6	-234
Value of dairy products consumed by HH (4)	166.7	173.9	115.4
Gross margin (Value of Net cash operating income and consumption) (5)= (3+4)	214.7	322.5	-118.6

*SDG = Sudanese Pound (1$US = 2 SDG)

feeding more concentrates to high yielding cows increased overall lactation yield but decreased profit per cow. The major constraints according to the results obtained in this study were high concentrates prices (74.4%), high taxes (55.6%), poor extension coverage (51.1%), small land area (51.1%) and pressures from governmental health authorities (48.9%).

It can be concluded that under the current husbandry practices, the contribution of livestock to small-scale farms in KNP from the perspective of overall development through income and employment generation, food security, asset accumulation and improving human nutrition was satisfactory but does not fullfil farmers' goals.

In order to improve the competitiveness of small commercial livestock producers and sustain high productivity and profitability, development of innovations (technical, institutional and policy) are essential.

References

Creswell, J. W. 1998. Qualitative inquiry and research design, Sage, London.

De Jong, R. 1996. Dairy stock development and milk production with smallholders. Ph.D. thesis. Wageningen Agricultural University, the Netherlands. Pp:308.

DFID, 2002. Peri-urban and urban livestock keeping in East Africa: a coping strategy for the poor? Scoping study commissioned by the livestock production program. Department for International Development, Palace Street, London SW1E 5HE.

Doyle, C.J. 1983. Evaluating feeding strategies for dairy cows: A modeling approach. *Animal Production*, 36: 47-57.

Elniema, A.M. 2008. Surveys on some livestock keeping practices in urban and peri-urban parts of Khartoum North Province, Sudan. PhD Thesis. University of Khartoum.

Gilbert, E.H., Norman, D.W, and Winch F.E. 1980. Farming system research: A Critical Appraisal. MSU Rural Development Papers 6. Department of Agricultural Economics, Michigan University, East Lansing, Michigan, USA. 135 + xiii pp.

Hanyani-Mlambo, B T., Sibanda, S. and Østergaard, V. 1998. Socio-economic aspects of smallholder dairying in Zimbabwe. *Livestock Research for Rural development*, Vol 10, November 2.

Leslie, J., Swai, E.S. Karimuribo, E. and Bell, C. 1999. Tanga and Southern Highland Dairy Development programmes: Socio- Economic Aspects and Farmer perception of Dairy cattle keeping and Animal

diseases, DFID/NRRD-Animal Health Research Programme.

Moorosi, L.E., Schwalbach, L.M.J. and Greyling, J.P.C. 2000. Sustainable animal agriculture and crisis mitigation in livestock-dependent systems in southern Africa. Proceedings of the regional conference held at Malawi Institute of Management, Lilongwe, Malawi 30 October to 1 November.

Rey, B.W., Thorpe, J., Smith, B., Shapiro, P., Osuji, G. and Agyemang, K. 1993. Improvement of dairy production to satisfy the growing demand in Sub-Saharan Africa: A conceptual framework for research. International Livestock centre for Africa (ILCA), Addis Ababa, Ethiopia.

SPSS, 2002. Advanced Models 11.5. SPSS Inc. Chicago USA. Pp:129.

Thys, E., Queadraogo, M., Speybroeck, N. and Geerts, S. 2005. Socio-economic determinants of urban household livestock keeping in semi-arid Western Africa. Journal of Arid Environments. 63: 475-496.

Waithaka, M. M., Nyangaga, J. N., Staal, S. J., Wokabi, A. W., Njubi, D., Muriuki, K. G., Njoroge, L. N. and Wanjohi, P. N. 2002. Characterization of dairy systems in the Western Kenya region. SDP Collaborative Research Report. MoARD/KARI/ ILRI. Pp: 73.

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The performance of poultry egg farms after the 2006 avian influenza outbreak in north central, Nigeria

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Abstract

The study assessed the performance of the poultry egg farms after the outbreak of avian influenza in 2006 in the north central part of Nigeria. Seventeen poultry (17) farms were purposefully sampled for the study. The net farm income model, simple descriptive statistics and data envelopment analysis were used as analytical tools. The result shows that the poultry farms are making profits after the losses obtained due to the outbreak of avian influenza (AVI). The revenue from eggs and spent layers constitutes 52.3 % and 47.7 % of the total revenue respectively. The medium size farms are however making higher profits and are more technically efficient than the small size poultry farms. The technical efficiency scores for the small scale farms range from 0.23-1 with a mean of 0.51, while that for the medium size farms range from 0.38-1 with a mean of 0.73. The major constraints affecting poultry egg production include; fluctuations in egg production and high cost of feeds as well as vaccines. The study concluded that the performance of poultry egg farms in Nigeria can be enhanced through improvements in technical efficiency or an increase in scale of operation. The provision of subsidies to poultry farmers by the government was however recommended to ease the high production cost.

Key words: Avian Influenza, Egg, Poultry, Nigeria

Introduction

Poultry production provides gainful employment and income to a sizeable proportion of the population. The high demand for poultry products, the success of exotic breeds and the ease of mastering the factors, make poultry business a very attractive enterprise (Sani et al., 2000). Poultry eggs have also attained industrial importance as a major ingredient in the baking of confectionaries and the use of the egg albumen in making of shampoo and book binding (Mayhew and Penny, 1988). Poultry egg is however an excellent rich source of animal protein of high biological value in respect of lipids, vitamins such as A, D, B, Phosphorus and other nutritionally important substances it contains. Poultry products (meat and eggs) provide the much needed animal protein to mankind. Poultry eggs contribute to palatability of many dishes by adding about the same amount of animal protein as pork and poultry meat does (Alabi and Isa, 2002).

Despite the significance of the poultry egg production enterprises to the national economy, animal protein consumption in Nigeria is below the United Nations Food and Agricultural Organization recommended minimum of 20g for developing countries as against the 75g optimal daily requirement for normal growth and development (FAO, 1992). According to Olayemi (1998), the average animal protein intake per caput per day in Nigeria was mere 7.6g. In addition, poultry farms in Nigeria suffered a severe setback with the outbreak of the Avian Influenza in 2006. This further compounded the already precarious protein deficiency prevailing in the country. However, poultry farmers are gradually bouncing back but the total recovery of the sector may take some time and will require efforts from the government, non governmental organizations and most importantly the poultry farmers themselves. The study is significant, essentially in the sense that it can serve as a guide on the nature of interventions to be provided to revamp the poultry industry in Nigeria after the avian influenza outbreak.

The objective of the study was to assess the current performance of poultry egg farms especially after the 2006 outbreak of avian influenza in north central Nigeria. In addition, the constraints affecting the poultry industry were also identified. The performance of the poultry farms was assessed by examining the cost and returns as well as the technical efficiency in egg

production. These variables were examined because, in order for a firm to maximize profit, it must produce the maximum output given the level of inputs employed (i.e. be technically efficient) (Kumbhaker and Lovell, 2000). Furthermore, the estimation of technical efficiency will reveal the potentials for increase in egg production which obviously diminished with the outbreak of avian influenza in 2006.

Materials and Methods

The study was conducted in Lafia which is located within the Guinea savanna zone in north central Nigeria. The area has an estimated land area of about 2733km^2. Lafia has an annual temperature of about 32^{0}C, which is favorable for agricultural production. Annual average rainfall is about 1288mm. A purposive sampling technique was adopted in selecting seventeen (17) poultry farms in the study area. This was because after the outbreak of avian influenza in 2006, some poultry farmers became skeptical especially with regards to the provision of information on their experiences during the outbreak. Thus, only the poultry farmers willing to be interviewed were used for the study. Data was collected with an interview schedule. Data were collected on socio-economic variables such as age, educational qualifications, number of birds, motive of production, sources of chicks, breeds of birds etc, inputs variables which include; labour, medication, day old chicks, feeds and the number of eggs collected. Simple descriptive statistics, Net Farm Income model, Data Envelopment Analysis and a five point Likert scale were used to analyze the data collected.

Data Envelopment Analysis

Data Envelopment Analysis is a non parametric method of measuring efficiency using mathematical programming rather than regression analysis. Farell (1957) introduced a linear-programming model to measure the technical efficiency of a firm with reference to a bench mark technology characterized by constant returns to scale. Charnes et al. (1978) introduced the method of Data Envelopment Analysis (DEA) to circumvent the problem of efficiency measurement for decision making units (DMUs) with multiple input and multiple outputs in the absence of market prices. They coined out the phrase, decision making units, in order to include non market agencies like schools, hospitals and courts which produce identifiable and measurable outputs from measurable inputs but generally lack market prices of outputs (and often some inputs as well). A DMU is regarded as a firm or production unit (Yusuf and Malomo, 2007).

The output-oriented model estimates the proportional increase in outputs as inputs remains unchanged. Assuming that there is data available on K inputs and M outputs in each of the N decision making units (i.e. poultry farms) and input and output vectors are represented by the vectors x and y, respectively for the ith farm. The data for all farms may be denoted by the K N input matrix (X) and M N output matrix (Y). The envelope form of output-oriented VRS DEA model which is the most widely used is then specified according to Coelli, et al. (1998) and Sharma et al. (1999) as follows:

$\text{Min}\theta\lambda\ \theta$

$\text{St} \quad -y_1 + Y\lambda \geq 0$

$\theta x_1 - X\lambda \geq 0$

$NI'\lambda = 1$

$\lambda \geq 0$

Where the value of θ obtained signifies the efficiency score for the ith DMU. It will satisfy $\theta \leq 1$with a value of 1 indicating a point on the frontier hence a technically efficient DMU (Farrell, 1957). Thus, the linear programming problem needs to be solved N times and a value of θ is provided for each farm (DMU) in the sample.

The Net Farm Income was used to determine the cost and returns of poultry egg production. Net Farm Income is the surplus resulting from business operation, which could be withdrawn without reducing the future scale of the business. Net Farm Income is the difference between the gross income and the total cost of production. Thus:

NFI = GI–TVC-TFC

Where:

NFI = Net Income

GI = Gross income (Income from eggs, spent layers and poultry droppings).

TVC = Total Variable Cost

TFC = Total Fixed Cost

The Variable Cost includes the costs of the following: Labour, feeds, medication and litter materials. While the Fixed Cost considered include the depreciated costs of Feeders and Drinkers. Due to inadequate record keeping, the depreciated cost of poultry housing was however not considered for the study. The straight line method of depreciation is expressed as follows.

$$D = \frac{\text{Initial Cost} - \text{Salvage Value}}{\text{Life span (n)}}$$

Inputs considered are:

Cost of day old chicks (N), Feeds (kg), Water (litre), Liter materials (kg)/Bag, Labour (Man day/hour), Cost of medication (N). The outputs considered are: Egg (Number of crates), Spent layers (N) and Poultry droppings (N).

The respondents also gave their perceptions on the level of severity of the constraints affecting poultry eggs production with the aid of a five point Likert scale of strongly disagreed (1), Disagreed (2); No opinion (3); Agreed (4) and Strongly agreed (5). A Likert scale is a

psychometric scale commonly used in questionnaires, and is the most widely used scale in survey research, such that the term is often used interchangeably with rating scale even though the two are not synonymous. When responding to a Likert questionnaire item, respondents specify their level of agreement to a statement. The scale is named after its inventor, psychologist Rensis Likert. Often five ordered response levels are used, but the scale can range from three to ten levels. Perception scores were thereafter computed for each constraint. The grand mean perception score was then computed by dividing the sum of all the mean perception scores by 12. A constraint is considered a major constraint if its mean perception score was greater than the grand mean score and a minor constraint if the reverse is the case.

Results and Discussion

The sources of day-old chicks for the sampled farms are presented in Table 1. The result shows that majority of farmers (52.9%) obtained their day old chicks from Jos, a town in located in the north central part of Nigeria, and about 200 km away from the study area. This is due to the proximity of Lafia to Jos. Others obtained their day-old chicks from Niyya farm (about 400 km away, also in the North Central Nigeria) and Zartech farm in Ibadan, southwestern Nigeria which is about 900km from the study area. Majority of the sampled farmers obtained their stock from day old. None of the farmers purchased their birds at one week and at the point of lay.

Table 1: Source of day old chicks

Source of Chicks	Frequency	Percentage
Jos (ECWA farms Ltd)	09.0	52.9
Kaduna (Niyya farms)	02.0	11.8
Ogun (Ota farms)	04.0	23.5
Ibadan (Zartech farms)	02.0	11.8
Total	17.0	100.0

Table 2: Size of flock/scale of operation

Range and scale of operation	Frequency	Percentage
Small scale farms (100 – 499 Birds)	05.0	29.5
Medium Scale (500 – 4999 Birds	12.0	70.5
Total	17.0	100.0

From the 17 sampled farms, 12 farms (70.5 percent) are medium scale farms, while only 5 farms (29.5) are small scale farms Table 3. There were no large scale farms within the study area at the time of the survey. In addition, this finding implies that the outbreak of AVI could have resulted into changes in the scale or size of poultry farms in the study area.

The result in Table 3 shows that the deep litter system of poultry production was found to be the most preferred system in the study area, it accounted for 94.1 percent out of the number of sampled farms. This, according to the respondents, is due to high cost of the Battery cage system.

Table 3: System of production by the farmers in the study area

System of Production	Frequency	Percentage
Deep litter system	16.0	94.1
Battery cage system	00.0	00.0
Both	01.0	05.9
Total	17.0	100.0

The cost and returns component in poultry egg production are presented in Table 4. The result shows that the total variable cost (N404920) accounted for more than 90% of the total cost (N408684.1). The total variable cost was however dominated by the cost of Day old Chicks, which was about 67.4% of the variable cost. The same pattern was also observed in both the small and medium size poultry farms. The total revenue was N803333.3, and the revenue from the sales of eggs constituted about 52.3%. The remaining 47.7% represents the revenue from the sales of spent layers. In terms of net returns, the poultry farms irrespective of size were all making profits after the outbreak of AVI but the net returns obtained were lower than the values that Rahman and Yakubu (2004) reported in the study area before the outbreak of AVI. However, the medium size farms obtain higher net returns compared to the small scale farms. This implies that the poultry farms are gradually regaining the confidence of their consumers as returns are once again in the positive territories. In a study by Ojo et al. (2007), it was observed the total revenue from poultry products before the outbreak of the influenza virus in Nigeria was far greater than what it was after the outbreak. After the outbreak, poultry farmers ran into a great loss (negative returns) due to the fact that poultry producers lost the confidence of their consumers and couldn't make as much as they were earning before the outbreak. Most importantly, the positive returns obtained in this study clearly shows the effectiveness of the efforts of the government at all levels in Nigeria as well as numerous organisations such as the World Health Organisation and the Food and Agricultural Organisations in curbing the deadly AVI outbreak in Nigeria. However, further assistance is required especially by NGOs on issues such as bio safety or bio security on poultry farms *vis a vis* the on farm formulation of poultry feeds in Nigeria.

All the poultry farmers in the study area were categorized based on the technical efficiency scores obtained from the DEAP software (Table 5). The technical efficiency scores for the small scale farms

Table 4: Cost and returns in poultry egg production

Inputs	Small scale COST (₦)	Medium scale COST (₦)	All COST (₦)	%
Feeds	33132.0	77308.0	110,440.0	27.3
Medication/Vaccines	2112.0	3168.0	5280.0	01.3
Labour	6525.0	7975.0	14500.0	03.6
Water	225.0	275.0	500.0	00.1
Litter materials	360.0	840.0	1200.0	00.3
Day old chicks	109,200.0	163800.0	273,000.0	67.4
Total Variable Cost	151,554.0	253,366.0	404,920.0	100.0
Fixed Cost				
Feeders	623.9	762.6	1386.5	37.0
Drinkers	832.2	1545.44	2377.6	63.0
Total Fixed Cost	1456.1	2308.0	3764.1	100.0
Total Cost	153,010.1	255,674.0	408,684.1	
Returns on eggs	167,933.3	251,899.9	419,833.3	52.3
Returns on spent layers	134,225.0	249,275.0	383,500.0	47.7
Total Revenue	302,158.32	501,174.98	803,333.3	100.0
Net Returns	149,148.23	245,500.94	94,6492.2	

Table 5: Technical efficiency scores in poultry egg production

Class interval	Frequency	
	Small Scale Farms	Medium Scale Farms
– 0.35	01.0 (20.0)	00.0 (00.0)
0.36 – 0.69	03.0 (60.0)	05.0 (42.0)
0.70 – 1.00	01.0 (20.0)	07.0 (58.0)
Total	05.0 (100.0)	12.0 (100.0)
Mean	51.0	73.0

Table 6: Constraints affecting poultry egg production

Constraints	Remarks	
	Small scale farms	Medium scale farms
A. High mortality of chicks	1.17 NC	2.76C
B. Egg eating by layers	2.00 NC	3.11NC
C. Cannibalism and pecking	2.05 NC	3.25NC
D. Disease outbreak	2.53 NC	4.29C
E. Fluctuation in egg production	4.16 C	2.16C
F. High cost of feeds	4.20 C	4.15C
G. High cost of vaccines	3.91 C	2.96C
H. Low market demand	2.56 NC	1.54NC
I. Inadequate capital for expansion	4.41 C	4.35C
J. Inadequate access to credit	4.12 C	4.22C
K. Inadequate extension services	4.12C	2.70 NC
L High cost of labour	4.16 C	2.53NC

Key: C = Major constraint NC = Minor constraint

range from 0.23-1 with a mean of 0.51, while that for the medium size farms range from 0.38-1 with a mean of 0.73. This implies that the medium size poultry farms were technically more efficient than the small sized poultry farms. The mean technical efficiency score for all the sampled farms was 0.62. This result implies that egg output in the study area can be increased by about 38% with the existing level of input usage. However, egg output can be increased by 49% and 27% for the small and medium size farms respectively. This will only be possible if the poultry farmers adopt the techniques and management practices of the best practiced poultry farms in the study area (farms with efficiency scores of 1 i.e., 100%). Majority of the small scale poultry farmers (60%) clustered toward a technical efficiency of between 0.36 – 0.69. On the other hand, majority of the medium scale farms (58%) had high efficiency scores of between 70-100% percent. This suggests that technical efficiency increases with farm size among the sample poultry farmers in the study area. The finding concurs with that of Helfand (2003) who observed that farm efficiency initially falls and then increases as farm size increases.

An examination of the constraints listed in Table 6 shows that the five major constraints affecting both the small and medium size poultry farms after the AVI outbreak in the study area at the time of survey include; fluctuation in egg production (Item E), high cost of feeds (Item F), high cost of vaccines (Item G), inadequate capital for expansion (Item I) and inadequate access to credit (Item J). The high cost of inputs especially feeds and vaccines can prevent any planned increase in the scale of production. A peculiar problem faced by the small scale farms was inadequate extension services. Generally speaking in Nigeria,

extension services tend to favour crop farmers in terms of both the frequency of extension visits and technologies introduced. Inadequate access to extension services by the small size farms can also be responsible for the observed low level of technical efficiency compared to the medium size farms.

Conclusion

The production of poultry egg after the Avian Influenza outbreak in North central Nigeria is still profitable and there exists a significant scope to increase poultry egg production and profitability especially through improvements in technical efficiency and scale of operation. In addition, the provision of subsidies to poultry farmers by the government on inputs such as feeds and vaccines can go a long way to reduce the cost of production.

References

Alabi, R.A. and Isa A.O. 2002. Poultry production constraints: The case of Esan West L.G.A. of Edo state, Nigeria. *African Journal of Livestock Extension,* 1:58-61

Charnes, A., Cooper, W.W. and Rhodes, E. 1978. Measuring the efficiency of decision making Units. *European Journal of operation Research,* 2: 429 – 444.

Coelli, T.J., Rao, D. S. and Battese, G. E. 1998. *An Introduction to Efficiency and Productivity Analysis*. Kluver Academic Publishers, Norwell, MC.

FAO. 1992. FAO production year book. Volume 45, Rome.

Farell, M.J. 1957. The measurement of Productive Efficiency. *Journal of Royal Statistical Society,* Series A (general) 21: 253-81

Helfand, M.S. 2003. Farm Size and the Determinants of Productive Efficiency in the Brazilian Center-West Contributed Paper Selected for Presentation at the 25th International Conference of Agricultural Economists, Durban, South Africa. August, 16-22.

Mayhew, S. and Penny A. 1988. Tropical and sub-tropical foods. Macmillan Publishers Ltd: London.

Mijindadi, N.B. 1981. Production Efficiency of Farms in Northern Nigeria unpublished PhD Thesis, Cornel University, USA.

Kumbhaker, S.C. and Lovell, C.A.K. 2000. Stochastic Frontier Analysis. Cambridge, University Press UK.

Olayemi, J.K. 1998. Food Security in Nigeria. Research Report No. 2. Development Policy Centre, Ibadan. Pp: 1-78.

Rahman, S.A and Yakubu, A. 2004. Analysis of poultry egg production, distribution and consumption in parts of Nasarawa state, Nigeria. *International Journal of Natural and Applied Sciences,* 1(1):1-4.

Sharma, K.R., Leung, P.S. and Zaleski, H.M. 1999. Technical, Allocative and Economic Efficiency in Swine Production in Hawaii: A comparison of parametric and non parametric Approach. *Agricultural Economics,* 20 (1):23-35.

Sani, R.M., Tahir, I. and Kushwa S. 2000. Economics of Poultry Production in Bauchi state: A case study of Bauchi L.G.A. *Nigeria Journal of Animal Production,* 27 (1): 109-133.

Yusuf S.A. and Malomo, O. 2007. Technical Efficiency of Poultry Egg Production in Ogun state: A Data Envelopment Analysis (DEA) Approach. *International Journal of Poultry Science* 6(9):622-629.

Ojo, O.M., Ojezele, M.O. and Okoruwa, V.O. 2007. The Economic Effect of Avian Influenza on Poultry Production in Southwest Nigeria.

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A survey of West African Dwarf (WAD) goats enterprises in Lafia area, Nasarawa State, Nigeria

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Abstract

West African Dwarf (WAD) Goat enterprises were studied using data collected from 120 households where goats are kept. The result revealed that majority of the households heads were male and married, with an average of 46 years and had up to eight years experience in goat production. A very few were members of cooperative societies. Contact with extension agents by the respondents was also minimal, while 40% rear goats for both home consumption and income generation. Goats were kept by the respondents under semi intensive and extensive feeding systems. The average number of goats kept per household was 12. Majority of the respondents sell their goats at home and the selling price was determined by the prevailing market price or by reproductive value. Feed shortage was the major constraint militating against goat production in the study area. There is a high potential to increase the productivity of goats if the technical and managerial constraints can be solved by providing better quality feeds and improved extension service delivery.

Keywords: Ownership, Flock size, Feeding System, Marketing, Constraints

Introduction

Goat production is a traditional farming activity in the humid areas of West Africa and the system aims at producing meat and milk for the teeming population of the region (Gomez-Cabrera, 2003). Goat meat is an important and preferred source of protein in the humid tropics particularly Southern Nigeria. This is because small ruminants (sheep and goats) are the dominant livestock species with an estimated population of about 14 million (Bryma, 2001). Although the intensive, extensive and semi-intensive systems have been used for goat production, current socio-economic conditions have persuaded farmers to employ various feeding systems for sustainable goat production (Ugarte et al., 2001). Small ruminant production is also one of the several farm activities undertaken in humid West Africa where household food needs are met from cereals, root crops and legumes while small ruminants and other livestock are rarely integrated with crop production and account for a small portion of household expenditures (Von kaufman and Francis, 1989). Perhaps the most common small-scale goat production system is that described as traditional, low-input extensive or subsistence system, based on free grazing of roadside and bush forages complemented with kitchen waste (peels of tubers and fruits) and good residues. Another common system of production is the intensive cut and carry feeding of tethered or confined animals, found in densely populated areas where almost all available land is devoted to cultivation. In such densely populated areas, small ruminants are tethered or confined to protect crops and are therefore hand fed (Ademosun, 1988).

The dominant breed of goat in Africa particularly in Nigeria is the WAD goats (Reynolds and Adediran, 1993). A study on the reasons for keeping WAD goats carried out by Matthewmen (1977) indicating that 91% of farmers interviewed gave cash income as the main reason for keeping goats while Okali and Sumberg (1985) also concluded that small ruminants are one of a limited number of sources of income to be used for capital investment. Goat meat production is influenced by many factors including sex, breed, age and nutritional status. Genetic factors and levels of feeding are probably the most important factor influencing growth and thus meat production (FAO, 1999).

It has been estimated that out of a total of 379,000 metric tonnes of meat production from domestic ruminants, 17% of it is obtained from goats (FAO, 1999). The nutrition of goats and sheep is thus the most important factor affecting the performance of these species (Aschalew et al., 2000). This is because feed is the major principal limiting factor in most parts of the

tropics where small ruminants are seldom allowed to express their genetic potentials apart from disease (Ngategize, 1989). The objectives of ensuring high performance through adequate control of nutrition is determined by three related considerations, the availability of nutrients, types of feeding systems and levels of feed management (Devendra, 1985).

Livestock farmers in developing countries are faced with various challenges that led to a considerable fall in the production of certain livestock species. Most of the problems originated from high cost of production due to increase in prices of locally available feed ingredients (Alli-Balogun, et al., 2003). Increase in the human population and the scarcity of production resources exert severe pressure on the small scale farmers and threaten their existence (Alhassan, 1985; Agishi, 1985). Increasing demand for animal protein and the ever increasing competition for land resources call for major structural changes in the agricultural sector. Livestock production and research have been geared towards increasing livestock numbers, rather than raising and intensifying the productivity of individuals' animal breeds and species. Even when research is carried out on ruminants, it has always been to address production of cattle and sheep, little is done to address species like goats (Kosgey et al., 2005). Given the importance of goats to the socioeconomic milieu of the population, a study of goat production and feeding patterns deserves attention. Based on the foregoing, the objectives of the study are to: describe the socio-economic characteristics of respondents, determine the respondents' reasons for keeping goats, identify the goat feeding systems in the study area, determine the flock size and composition of goats and to identify the constraints to goat production in the study area.

Methodology

Lafia is located in the southern part of Nasarawa State, Nigeria and lies within latitude $09^0$33N and $09^0$33E. The main occupation of the inhabitants is farming. It has a population of 330,712 people (NPC, 2006). Data were collected using structured questionnaire administered to 120 purposively selected households where goats were kept. Data collected from the household heads include: gender, age, marital status, occupation, educational level, membership of co-operatives, year of membership, extension contact, ownership system, management practices, reasons for keeping goats and constraint to goat production. Descriptive statistics were used to analyze the data.

Results and Discussion

The socio-economic characteristics of respondents (household heads) are shown in Table 1. The average age of the respondents was 46 years, 83.3% of the respondents were married and have an average of eight years of experience in goat production. The respondents had one form of education or the other implying that a significant proportion of the respondents were literate.

Table 1: Socio-economic characteristics of respondents

	Minimum	Maximum	Mean	SD	CV (%)
Age (years)	30	80	46	2.2	4.78
Membership of cooperative society (years)	0	3	1.10	0.22	20
Years of experience in goat production	4	20	8	7.26	90.62
Gender	Frequency		Percentage		
Male	88		73.3		
Female	32		26.7		
Marital status					
Married	100		83.3		
Widowed	8		6.7		
Divorced	12		10.0		
Education					
Primary	20		16.7		
Secondary	12		10.0		
Tertiary	64		53.3		
None	24		20.0		
Membership of co-operatives					
Yes	12		10.0		
No	108		90.0		
Extension contact					
Contact	24		20.0		
Non contact	96		80.0		

Table 2: Reasons for keeping goats

Reason	Frequency	Percentage
Home consumption	32	26.7
Income generation	40	33.3
Both	48	40.0

Majority of the respondents were not members of farmers' cooperative societies and have had little or no contact with extension agents. This agrees with the findings of Devendra (1988) who observed that goats are for a long time been neglected by extension workers. The respondents' reasons for keeping goats is

presented in Table 2, the result is similar with that obtained from a survey of traditional small stocks farmers by Nsoso et al. (2004) in Botswana, which reported that most farmers sell their goats because of cash needs (income generation). The present findings on the other hand differs from the results of a study on rural community farming systems in South Africa which indicated that meat consumption was the major reason for keeping goats (Alli-Balogun et al., 2003). The goat ownership pattern and feeding system in the study area are presented in Table 3. The major owners of goats are women (50%). Majority (66.7%) of the respondents practiced the semi-intensive feeding system, while 33.3% practiced the extensive system. This might be attributed to the higher cost of production under the semi-intensive system (Roynalds and Adediran, 1994). Majority (59.1%) of the respondents sold their goats at home while 40.9% sold at the nearest market place. The goat selling price was determined either by the prevailing market price or through the reproductive value of goats.

The flock size and composition is presented in Table 4. Total flock size was 1360 goats, with kids accountable for 33.3% followed by weaners with the total flock size of 24.1%. The individual household keeps an average of 4 kids, 3 weaners, 2 bucks and 3 does. Farmers kept their number of goats depending on the availability of labour and land. The number varied from 2 to 12 goats per household. However, this figure was much lower than the figure reported by Phimphachalhvongsod (2001), who found that number of goats per household ranged from 2 to 30 heads. Nsoso et al. (2004) also reported that most small stockholder farmers hold 1 to 40 goats per household in Kweneny district of Botswana. Farmers in the study area mainly retained female goats in the flock for replacement purposes. The ratio of females to males was 2:1. The proportion of does was low when compared to the findings of Bryman (2001) who reported a doe to buck ratio of 11:1 and close to 4:1 ratio for an agro-pastoral society in South Ethiopian, as reported by Peacock (2005). The constraints faced by the respondent are shown in Table 5. Lack of feeds, theft and diseases were the major problems faced by goat keepers in the study area.

Conclusion

Base on the findings of the study it can be concluded that inadequate feeds limits goats' production and productivity in the study area and only a few of the respondents have had contact with extension agents.

Recommendations

1. There is a high potential to increase the productivity of goats, if the technical and managerial constraints can be solved by providing better quality feeds.
2. Agricultural institutions have concentrated their training on beef and dairy development, such attitudes should change and more personnel should be trained specifically in goat management at all levels.
3. Extension staff should be trained at the worker, officer and specialist levels. Once staffs are trained, dissemination of information to farmers should be the next step.

References

Ademosun, A.A. 1988. Appropriate management systems for the West African Dwarf goat in the humid tropics. In: Smith, O. B. and Bosman, H. G. (eds), goat production in the humid tropics proceedings of a workshop at the University of Ile-Ife, Ile-Ife, Nigeria, 20 -24 July 1987. Centre for Agricultural publishing and Documentation (PUDOC), Wagenigen, The Netherlands Pp: 21 - 28.

Agishi, E.C. 1985. Forage resources of Nigeria rangeland. Proceedings of the National Conference of small ruminant production, Oct, 6 – 10, Zaria, Nigeria. Pp: 115 – 140.

Alhassan, W. S. 1985. The potential of Agro-industrial by-products and crop residues for sheep and goat production in Nigeria. Proceedings of the National Conference on Small Ruminant Production in Nigeria, (NCSRPN' 85), Zaria. Pp: 165-183.

Alli-Balogun, J.K., Lakpini, C.A.M., Alawa, J.P., Mohammed, A. and Nwanta, J.A. 2003. Evualation of cassava foliage as a protein supplement for sheep, *Nigerian Journal of Animal Production*, 30:37-46.

Aschalew, T., Sisay, L., Ameha, S., Abebe, M. and Zinash, S. 2000. National goat research strategy in Ethiopia. In: The opportunities and challenges of enhancing goat production in East Africa-A conference held at Debub University Awassa, Ethiopia. November 10-12. Pp: 1-5.

Bryman, A. 2001. Social research methods. Oxford University press Inc, New York, P: 540.

Devendra, C. 1985. Forage supplements: potential value in feeding systems based on crop residues and agro-industrial by-products in south-East Asia. In: Wanapat, M. and Devendra, C. (eds) Relevance of crop residues as animals feeds in developing countries. Proceedings of a workshop held at Khon Koen, Thailand, 29 November -2 December 1984. Funny press, Bangkok, Thailand Pp: 221 – 248.

Food and Agricultural organization (FAO). 1999. Production year book, volume 52, Rome, Italy.

Gomez-Cabrera, A. 2003. Intensification des system de production du lait en conditions non favourables. Experience dans la valle des pedroches (cordue, Espagre) in prospects for a sustainable Dairy sector

in the Mediterranean. EAAP publication, 99: 114-124.

Kosgey, I.S., Baker, R.L., Udo, H.M.J. and Van Arendonk, J.A.M. 2005. Success and failure of small ruminant breeding programmes in the tropics: *Small Ruminant Research*, 60(1-2):25-43.

Matthewman, R.W. 1977. A survey of small livestock production of the village level in the deived savanna and lowland forest zones of southwest Nigeria. Study No. 24, Department of Agriculture and Horticulture, University of Reading, Reading, UK.

National Population Census (NPC). 2006. National Population and Housing Census. Federal Republic of Nigeria.

Ngategize, P.K. 1989. Constraint identification and analysis in African small ruminant systems. In: Wilson R.T and A. Melaku (eds), Africa small ruminant research and development. Proceedings of a conference held at Bananda, Cameroon, 18-25, January. ILCA. (international Livestock Center for Africa), Addis Ababa, Ethiopia Pp: 7-22.

Nsoso, S.J., Monkhei, M. and Tlhwaafalo, B.E. 2004. A survey of traditional small stock farmers in Molelopole North, Kweneng district, Botswana: Demographic parameters, market practices and marketing channels. *Livestock Research for Rural Development*, Vol. 16, Art. # 100.

Okali, C. and Sumberg, J.E. 1985. Sheep and goat, man and woman: Household relations and small ruminant development in southwest Nigeria. *Agricultural systems*, 18: 39-59.

Peacock, C. 2005. Goats-A pathway out of poverty. *Small Ruminant Research*, 60(1-2):179-186.

Phimphachanhvongsod, V. 2001. The potential of *Glircidia sepium* as a feed for goats in smallholder farming system in Laos. Unpublished MSc. Thesis in Tropical Livestock Systems. SLU. Department of Animal Nutrition and Management, Uppsala, Sweden.

Reynolds, L. and Adediran, S. 1994. Composition of village goat herds in southwest Nigeria. *Small Ruminant Research*, 13(1):49-53.

Sumberg, J.E. 1985. Small ruminants feed production in a farming systems context. In: Sumberg, J. E. and Cassaday, K. (eds), sheep and goats in humid West Africa. Proceedings of the workshop on small Ruminant production systems in the humid zone of West Africa held in Ibadan, Nigeria, 23-26 January 1984. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. Pp: 34 – 37.

Ugarte, E., Ruiz, R., Gabina, D. and Beltran de Heredia, I. 2001. Impact of high yielding forage breeds on the Spanish dairy sheep industry. *Livestock Production Science*, 71:3-10.

Von Kaufman, R, and Francis, P. 1989. The element of an effective extension service to sheep and goat production in the humid tropics of West Africa. In: Timon VM and Baker, R. P. (eds), sheep and goat meat production in the humid tropics of West Africa, FAO Animal production and Health Paper 70. FAO (Food and Agricultural organization of the United Nations), Rome, Italy Pp: 128 141.