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Original Article

Comparison of Broiler Performance in Two Conventional and Environmentally Controlled Modern Broiler Houses in Tropics

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ABSTRACT

The purpose of this study was to evaluate broiler performance, environmental conditions and litter quality in two conventional and environmentally controlled condition modern broiler houses. Two consecutive experiments were conducted using 60800 one day old broiler chicks (Ross 308 strain) on a commercial poultry farm included two types of conventional and environmentally controlled modern broiler houses during summer and winter seasons of Shoush, Khuzestan province of Iran. In each experiment, a total of 30400 day-old broilers were placed into both houses. Average temperature and relative humidity of the ambient and inside of the conventional and environmentally controlled condition modern houses during summer and winter at two experiments were 39.4ºC, 30.5ºC, 29.3 ºC and 40.1%, 45.3%, 44.4%, and 12.9ºC, 28.5ºC, 28.6 ºC and 36.8%, 45.2%, 39.5 %, respectively. Bird performance including live body weight, feed intake, feed conversion ratio, mortality rate, production efficiency index and litter pH, moisture content and air ammonia levels were not significantly affected by types of the houses. However, the chickens grown in the environmentally controlled condition modern house, although raised at higher stocking density (20 *vs*. 16 Birds/m^2) than conventional house, had numerically lower mortality rate and greater production efficiency index probably due to improved environmental conditions trough proper ventilation applied in environmentally controlled condition modern house than conventional house. In conclusions, application of environmentally controlled condition modern house in addition of greater production efficiency index and less mortality rate can be useful in increasing stocking density of broiler chickens compared to conventional houses.

Keywords: Poultry house, environmental condition, ventilation, performance, broiler chicken.

INTRODUCTION

Improvement in animal breeding, nutrition and animal husbandry has led to change in modern poultry from the past birds. Accordingly, modern poultry particularly broiler chickens under intensive production are susceptible to many disorders, stressors and diseases more than ever before (Lin *et al*., 2006).Consequently, poultry in unfavorable environmental conditions cannot show their true genetic potential, therefore, leading to economic losses (Feddes *et al*., 2002). Providing a suitable place for growing the birds is one of important and basic issues in poultry production (Lacy and Czarick, 1992). The main reason to building houses for poultry is to provide protection from the weather. Many parameters such as temperature, humidity, etc. affect environmental conditions of within poultry house. Most of these parameters are dynamic and will frequently be changing depending on the weather conditions, season, location, time of day, etc. (Estevez, 2007). Effects of these parameters on poultry health, welfare and performance well are documented (Shane, 1994). One of the key parameters affecting poultry house environment is weather conditions. It has been indicated that any deviation from optimal environmental conditions controlling can have deleterious impacts on poultry welfare, health and performance. Some negative consequences of these variations from natural amplitudes are heat stress, cold stress, wet litter, ammonia emissions, etc. (Czarick and Lacy, 1990; Lacy and Czarick, 1992; Akyus, 2009).

Because of heat stress condition in tropics in comparison with moderate regions, typically lower densities are applying in broiler production. For example, in summer of Khuzestan province of Iran, stocking density of 10 to 14 Birds/m^2 is common in conventional houses in order to reduce heat stress effects on birds whereas, higher densities are typical at cooler seasons of the year which make problems such as wet litter and ammonia emissions which caused by poor ventilation and suddenly lost heat of within the house due to increasing ventilation rate for air exchange.

Poultry producers have experienced increased production efficiency that is somewhat attributable to improvement in housing technology and equipment (Liang *et al*., 2013). Nowadays, modern poultry houses with good construction insulation, ventilation design, within environmentally conditions control system and automatic equipments inside of the house provide the possibility of rearing the birds at higher stocking density (Puron *et al*., 1995; Estevez, 2007; Liang *et al*., 2013). Some researchers have introduced applying environmentally controlled condition poultry houses as an alternative way to achieve good performance and increasing stocking density in tropic areas (Czarick and Lacy, 1990; Puron *et al*., 1995; 1997). Therefore, the aim of this study was to comparing broiler performance, air and litter quality in two conventional and environmentally controlled condition modern broiler houses at different seasons in Khuzestan province of Iran.

MATERIALS AND METHODS

Housing and experimental procedure

This study was performed on a commercial broiler farm where both conventional and environmentally controlled conditions modern houses existed side by side. Building characteristics, ventilation system and equipments of both broiler houses are presented in Table 1. Two consecutive experiments were conducted using Ross 308 broiler chickens (n =60800) in two 42 days periods during summer and winter seasons of Shoush, Khuzestan province of Iran. In each experiment, a total of 30400 one day-old broiler chicks provided from a same local hatchery and were placed into both houses. Three jet heater were applied in both houses to supplying required heat for the birds. Setting the temperature in conventional house relied upon imbedded usual thermostats and an intelligent controlling system using a combination of house static pressure controlled sidewall inlets, foggers, minimum,

transitional and tunnel ventilation fans were applied in environmentally controlled condition modern house.

Table 1. Building characteristics, ventilation design and equipments of broiler houses

Characteristics	Environmentally controlled	Conventional
House sidewalls (R-value, diameter)	Sandwich panel polyurethane (R7, 5cm)	Brick (R3.2, 32cm)
Roof type	Hangar (glass wool insulation + galvanized sheet)	Usual (brick housing)
Floor type	Concrete floor	Concrete floor
House width × length (m)	16×65	12×50
House Height (m)	2.8 (3.5 m in center)	3
Ventilation system	Combination of tunnel, transversal and minimum	Cross ventilation system (conventional)
Fans numbers and capacity (m^3/h)	5 (15000) & 6 (44000)	25 (7500)
Maximum ventilating capacity (m^3/h)	339000	187500
Evaporative cooling system	Cooling pad & misting fogging nozzles	Manual evaporative cooling system (traditional)
Numbers and surface area of evaporative cooling system (m^2)	2 (1×20)	25 (1×2)
Housing capacity (Birds)	20800	9600
Stocking density (Birds/m^2)	20	16

Bird Husbandry

Rearing management and composition of diets in both houses at each season were similar. All of the broiler chickens fed with a basal corn-soybean meal diet during 1-42 d of age. Corn and soybean meal-based diet were formulated to meet nutritional requirements of broilers according to NRC (1994) broiler recommendation. The composition of experimental diets and its nutritive characteristics are presented in Table 2.

Table 2. Composition and calculated analysis of diets in the both experiments

Item	Starter (1-7 d)	Grower 1 (8-14 d)	Finisher (15-28 d)	Withdrawal (28-42 d)
Ingredient, g/100g				
Yellow corn	53.5	57.0	59.5	63.3
Soybean meal (48% CP)	39.45	36.7	34.7	31.6
Soybean oil	2.5	2.0	1.5	1.0
Dicalciumphosphate	1.24	1.19	1.13	1.04
Oyster sell	1.50	1.55	1.60	1.50
Salt	0.24	0.21	0.20	0.15
DL-Methionine	0.15	0.08	0.10	0.14
L-Lysine	0.87	0.77	0.77	0.77
Vitamin premix[1]	0.25	0.25	0.25	0.25
Mineral premix[2]	0.25	0.25	0.25	0.25
Calculated nutrient				
ME, kcal/kg	3,000	3,000	3,000	3,000
CP, %	21.7	20.7	20.0	19.0
TSAA, %	0.90	0.80	0.70	0.65
Lys, %	1.10	1.00	0.90	0.85
Ca, %	0.93	0.93	0.93	0.87
available P, %	0.45	0.43	0.41	0.39

[1]The vitamin premix supplied the following per kilogram of diet: vitamin A, 8,000 IU; vitamin D3, 3,500 IU; vitamin E, 70 IU; vitamin K3, 5 mg; thiamine, 2 mg; riboflavin, 5 mg; vitamin B6, 1 mg; vitamin B12, 0.015 mg; niacin, 30 mg; choline chloride, 1000 mg; vitamin C, 300 mg; calcium D-pantothenate, 10 mg; folic acid, 1 mg.
[2]The mineral premix supplied the following per kilogram of diet: Fe, 250 mg; Zn, 150 mg; Cu, 100 mg; I, 1 mg, Se, 0.15 mg.

Feed and water were provided *ad libitum*. All diets were provided as mash form. In 2 first days of the two experiments, lighting schedule was continuous and afterward, a 23L: 1D lighting schedule was provided to end of the experiment.

Husbandry management in both houses at each season was identical. The conditions and standards of rearing used in this research were approved by the Ethics Committee for Animal Experiments of the Animal Science Research Institute of Iran.

Measurement of broiler performance parameters

At day 42 of age in each experiment, 5% of broilers in each house were weighed. Feed intake of each house was determined. Feed conversion ratio was calculated without adjusting for daily mortality.

Measured parameters on broiler houses and litter

Average, maximum and minimum dry bulb temperature and relative humidity of ambient and inside of the houses (front, middle and back) were weekly recorded during both summer and winter seasons (Table 3, 4).

Table 3. Temperature and relative humidity (RH) values of broiler houses during summer

Weeks	Conventional house				Modern houses				Ambient			
	Temp (ºC)			RH (%)	Temp (ºC)			RH (%)	Temp (ºC)			RH (%)
	Max	Min	Avg		Max	Min	Avg		Max	Min	Avg	
1	33.5	31.0	32.3	33.0	33.6	30.5	32.1	35.5	47.0	43.0	44.6	36.5
2	31.0	30.0	30.7	32.5	30.5	29.2	30.2	37.5	42.1	39.0	40.8	38.0
3	30.7	29.4	30.0	38.5	30.4	29.0	29.7	40.2	39.0	37.0	37.8	39.2
4	31.7	30.5	30.9	47.7	29.8	29.0	29.1	45.0	40.0	36.5	37.6	40.5
5	30.5	28.6	29.7	56.5	28.5	27.0	27.7	48.6	39.0	37.0	37.7	40.7
6	30.3	29.0	29.6	63.7	27.5	27.0	27.2	59.8	39.0	38.0	38.0	45.4

At day 42 of age, litter samples were collected from different positions of each house for determination of pH (1:10 litter per distillated water) and moisture content (at 105°C for 24 h). Each litter sample consisted of 12 subsamples of litter. The subsamples were collected from 4 positions of front, middle and back of each house.

Table 4. Temperature and relative humidity (RH) values of broiler houses during winter

Weeks	Conventional house				Modern houses				Ambient			
	Temp (ºC)			RH (%)	Temp (ºC)			RH (%)	Temp (ºC)			RH (%)
	Max	Min	Avg		Max	Min	Avg		Max	Min	Avg	
1	32.5	31.9	32.1	30.7	32.3	32.7	32.0	25.8	23.1	8.5	14	25.0
2	31.5	30.5	30.9	45.6	31.2	30.1	30.5	37.5	22.2	6.3	13.2	34.7
3	30.5	27.2	28.3	42.1	30.7	28.5	28.5	36.0	21.3	5.2	12.5	35.2
4	28.7	27.1	27.7	52.7	29.4	27.2	27.5	40.5	19.0	5.7	13.7	43.5
5	27.5	26.0	26.7	50.5	28.2	26.7	26.6	46.5	18.5	6.0	12.1	45.1
6	26.7	25.7	26.2	49.6	26.9	26.1	26.5	44.2	16.4	5.8	11.7	37.5

At day 42 of age, for measuring of ammonia levels in each house, first, all of the heating and ventilation systems turned off for one minute, then, an air sample (at height of 40 cm of litter) was drawn into an ammonia detector tube (Ammonia detector tube, 3La type, Gastec Co, Japan) by a manual pump (Gas sampling pump, GV-100S, Gastec Co, Japan). Corrected ammonia levels were determined after atmospheric pressure and temperature corrections.

Statistical Analysis

Data were analyzed according to the t-test procedure of SAS software, version 6.12 and effects were considered statistically significant when $P < 0.05$.

RESULTS AND DISCUSSION

Data of temperature and relative humidity were presented in table 3 and 4. Average temperature and relative humidity of the ambient and inside of the conventional and environmentally controlled modern broiler houses during summer and winter in both experiment were 39.4ºC, 30.5ºC, 29.3 ºC and 40.1%, 45.3%, 44.4%, and 12.9ºC, 28.5ºC, 28.6 ºC and 36.8%, 45.2%, 39.5 %, respectively.

There were no considerable differences in temperature (average, minimum and maximum) and relative humidity percentage values between both houses at summer and winter seasons. However, temperature and relative humidity controlling in environmentally controlled condition modern house partially was in better situation than conventional house at summer so that, maximum and average temperature (about 2 ºC) and relative humidity (2 to 4 %) in the last two weeks of study were lower than conventional house at summer.

During winter season, there were no substantially differences in temperature and relative humidity between both houses. Ventilation rate should be minimal in winter mounts of cool weather and the airflow over litter or manure in cool weather may be helpful in controlling moisture and ammonia levels.

As providing optimal environmental conditions of within poultry house are required for good rearing and high quality performance, hence, paying attention to good design and using appropriate equipments such as good structural insulation, ventilation (minimum, tunnel and transitional) systems, ventilation air inlets, evaporative pad cooling, foggers, etc. according to weather conditions of each area are important for providing optimum environmental conditions (Czarick and Lacy, 1990; Lacy and Czarick, 1992).

Broiler performance included live body weight, feed intake, feed conversion ratio, mortality rate and production efficiency index were not affected by broiler house type (Table 5).

Table 5. Comparison of broiler performance in two conventional and environmentally controlled conditions modern broiler houses during different seasons at day 42[1]

Parameter	Broiler house		P-value
	Conventional	Environmentally controlled conditions modern	
	Summer		
Live body weight (g)	1940.6±17.91	1944.9±14.34	0.853
Feed Intake (g/bird)	3526.2	3454.1	-
FCR (g/g)	2.06	2.03	-
Mortality rate (%)	27.52	25.96	-
production efficiency ratio	184.3	192.9	-
Litter moisture (%)	34.62±3.35	40.42±4.24	0.550
Litter pH	8.40±0.12	8.43±0.06	0.124
Air ammonia (ppm)	13.40±1.31	13.89±1.46	0.814
	Winter		
Live body weight (g)	1939.6±10.62	1967.2±14.96	0.142
Feed Intake (g/bird)	3542.2	3448.4	-
FCR (g/g)	2.07	2.00	-
Mortality rate (%)	17.80	11.45	-
production efficiency ratio	207.8	236.7	-
Litter moisture (%)	54.03±4.34	55.64±3.96	0.815
Litter pH	8.08±0.21	8.24±0.11	0.151
Air ammonia (ppm)	14.76±0.99	11.79±2.54	0.319

[1] None of these mean differences are statistically significant.

However, the broilers grown at environmentally controlled conditions broiler house, although raised at higher stocking density (20 *vs.* 16 Birds/m^2) than conventional broiler house, had numerically lower mortality rate and greater production efficiency index probably due to improved environmental conditions mainly due to better insolation of the house and

proper ventilation applied in environmentally controlled conditions modern house compared to conventional house. Moreover, higher air velocity in modern broiler house in comparison to conventional broiler house may have made more coolness for birds which it is in agreement with previous studies (Lacy and Czarick, 1992; Furlan *et al*., 2000; Farhadi *et al*., 2012).

Tunnel ventilation is the best accessible management tool to prevent heat stress and mortality in broilers during hot periods of year (Lacy and Czarick, 1992). Lott *et al*., (1998) showed that broilers were raised in a tunnel ventilation system (higher air velocity on the birds) presented better weight gain and feed conversion ratio than the birds raised in a conventional system. In recent study, birds in environmentally controlled condition modern broiler house were grown at higher stocking density than conventional house (20 *vs*. 16 Birds/m^2, respectively).

Although the chickens grown in the both houses did not show significant differences in growth performance, however, based on literature reviewed, numerous studies clearly pointed out the effects of increasing stocking density on poultry particularly broiler chickens. As the consequences, high stocking density may lead to increasing deleterious impacts on environmental condition within the house and litter quality and negatively influence poultry welfare, health and performance (Shanawany, 1988; Bilgili and Hess, 1995; Dozier *et al*., 2005; Feddes *et al*., 2002; Knizatova *et al*., 2010).

In some studies, subsequent decline in air quality within poultry house have been reported by increasing stocking density (Zuidhof *et al*., 1995; Dawkins *et al*., 2004). Zuidhof *et al*., (1995) reported that subsequent decreased air quality due to stocking density increases; negatively affected turkey performance and increasing ventilation rate reduced the negative effects of increasing stocking density on birds. Finally, they suggested that ventilation rate had a greater effect on turkey performance than stocking density. Dawkins *et al*., (2004) concluded that environmental conditions includes air quality had more direct impact on broiler well-being than stocking density *per se*.

In the present study, house type had no any significant influence on measured parameters of litter and air of within broiler house included moisture percentage, pH and ammonia emissions. It seems that proper environmental condition in modern house and lower stocking density in conventional house caused no significant difference in litter quality between experimental broiler houses. Regards to the contributed factors in broiler production such as housing, environment, and management practices are closely intertwined in the production of broilers; therefore it is difficult to recognize the full contribution of each individual factor (Liang *et al*., 2013).

CONCLUSION

In conclusions, environmentally controlled modern broiler house with better environmental condition increased production efficiency index and lowered mortality rate. Moreover, possibility of raising the broilers at higher stocking density achieved without any reductions in performance. However, in this case needs to further studies related to economics of the construction and applied equipments in operating the modern houses and costs of energy usage should be considered.

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Original Article

Beef cattle development initiatives: a case of Matobo A2 Resettlement farms in Zimbabwe

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ABSTRACT

The study was carried out to examine various practices that resettled A2 farmers have adopted to enhance cattle rearing in Matobo district in Matabeleland south province in Zimbabwe. A multi-stage random sampling method was used to select 60 a smallholder farmers to which a structured questionnaire was randomly administered. Statistical Package for Social Sciences, SPSS was used for data computation. It was observed that 47% of the farmers keep local (indigenous) breeds and 67% of the participants indicated that farmers retain steers for draught purposes. There was no significant difference ($P<0.05$) between the numbers of cattle sold to private butcheries and the one sold to private buyers. Farmers face challenges in cattle feeding especially during winter. Informal cattle marketing systems have resulted in low prices offered to cattle on sale. There is need for farmers to form cooperatives so that they can gain value from their cattle production business.

Keywords: Cattle, smallholder, Resettlement, A2 farms.

INTRODUCTION

Livestock play an important role in the socio-economy of the small holder farmers in the communal and resettled areas of Zimbabwe through provision of draught power, milk, meat, occasional sales and use at social functions (Sibanda, 2008 and Barret, 1991). Livestock are a source of risk aversion which allows for survival and adaptability in the event of calamities such as droughts and floods which may cause crop failure.

In African culture livestock ownership is a standard measure of wealth and power. However, the need for development of viable cattle production initiatives seems to be a challenge to farmers who own large numbers of indigenous cattle breeds in Zimbabwe , for

example in the area under study, a total of 1 232 cattle died in 2012 due to drought and starvation (Livestock Production Department, 2011).

The Fast Track Land Reform Programmed (FTLRP) that started in year 2000 radically changed the agrarian structure in Zimbabwe and provided an opportunity for small holder communal farmers (A2 farmers) to engage in commercial livestock production to some farmers.

This was because the new resettlement farms (A2 farms) are relatively bigger in size than the previous farm holdings (in communal areas), have better grazing and water resources and, to a certain extent, provide a possibility for better control of livestock breeding and other husbandry practices (Scoones *et al*. 2010). New resettlement areas thus provide a new opportunity to revive the beef production enterprise in Zimbabwe.

However, the new cattle production farmers seem to have capacity gaps to sustainably engage in viable cattle production. This paper seeks to explore beef cattle development initiatives that can be employed by cattle producing farmers to enhance cattle production in Matobo district. These strategies can then be collectively adopted with relevant modification by farmers in other semi arid regions to improve cattle production.

MATERIALS AND METHODS

Study sites

Matobo district is located south of Bulawayo and is bordered by Gwanda on the East and Mangwe district on the South. It lies along the latitude 21^{o} south, longitude 280 30' east (Figure 1).The Southern part of the district is dry and in Natural region 5.

The Northern side of the district is in Natural region 4 and receives more rainfall compared to the South. This is a low lying area on the Northern part of the district closer to Bulawayo town. The average rainfall received in the area is 466 mm per annum.

The study sites are located are ward 23 and 24 located about 70km and 134 km from Bulawayo respectively, in the southeastern part of Matobo District in Matabeleland South Province.

The district has a total carrying capacity of 870 LUs (LPD report, 2012) and wards population is 99 836 (World Bank, 2006). Ward 24 has an area of about 25 700ha and is found in Natural Farming Region 5, receiving rainfall of less than 500mm a year.

Ward 23 comprises mostly of A1 farmers with A2 constituting 17%. Ward 23 has an area of about 18 320 hectares and comprises of 22 - A1 farmers and 8 -A2 farmers. The outstanding feature of rainfall in the area is its marked variability and unpredictability from one year to another.

Low rainfall interspersed with long dry spells and high summer temperatures of up to 40 degrees means that the area is generally dry.

Vegetation

The area under study is suitable for cattle ranching because of its expanse sweet pastures. The physiognomic type is Tree Bush Savannah (TBS), mostly on the northern side of ward 23 with predominantly Mopane, Combretums and Acacia trees.

The most dominant grass species are the *Panicum maximum*, *Eragrostis curvula and Hypperrhenia filipendula* with pockets of setaria and cross grasses. *Heteropogon cortutus* is scattered on mostly rocky and kopjes in the northwestern side of ward 23.

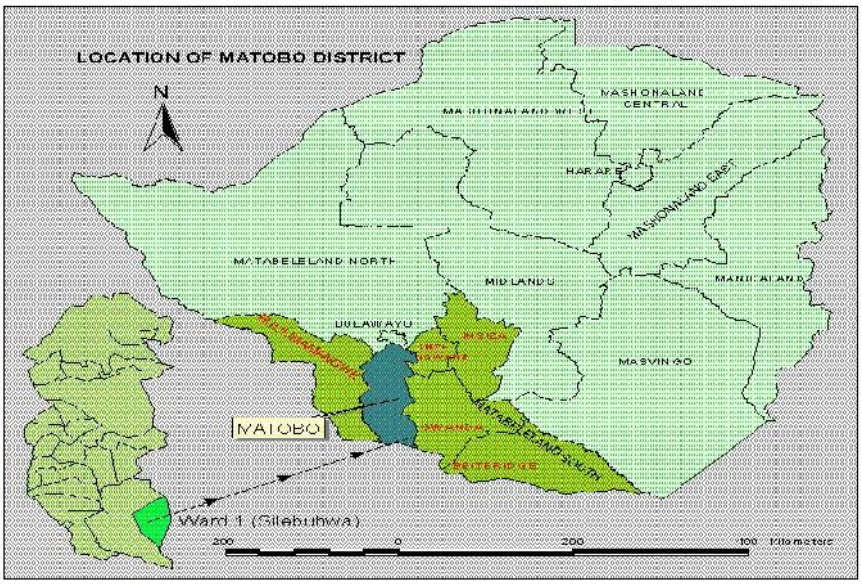


Figure 1: Location of Matobo district

Objectives

The objectives and key strategies to the study are outlined in Table 1.

Table 1. Objectives and strategies to adoption of cattle development initiatives in Matobo district within period 2012/13

	Objective	Strategies
i	Enhancing economic returns from cattle by scaling up existing good practices	Promoting good stockman-ship and cattle husbandry practices.
ii	Enhancing economic returns by diversifying existing system	Enhancing productivity by minimizing inbreeding in cattle Introduction of ONBS Introducing AI in selected cows and heifers Semi-intensive feeding scheme and supplementary feeding
iii	Enhancing economic returns by introducing sound herd health management	Scaling up production by minimizing preventable diseases and monitoring grazing capacities Institutionalizing health care by block veterinary dispensary Monitoring and managing trans-boundary livestock movement
iv	Enhancing economic returns by improving feed situation	CB of farmers on technologies of fodder production Enhancing fodder availability at HH level through backyard hedge rows of fodder trees CB on preservation and storage of hay and fodder

SWOT analysis of cattle farmers in Matobo district

Farmers in the district predominantly keep mixed non-descript herd of indigenous cattle breeds. Although the animals are hard they have been subjected to inbreeding and intense selection for individual growth and have suffered great losses in maternal performance. Bratton (1994); Chimoyo (1991) and Cheater (1984) note that Zebu cattle have been produced

in situations where their greatest attribute is the ability to survive the harsh environment. Consequently their contributions to commercial beef production have generally been their maternal influence in early calf growth and their merit in adaptation to tropical and sub-tropical environment (Khombe, 2008) .Cattle are allowed to graze during the day in open paddocks and kraaled over night to prevent them from predators (such as leopard, hyena and the Cheetahs) that would have strayed from Matobo National Park. Due to these fears from predators and sometimes poachers, cattle graze for about 4 – 6 hours per day.

Table 2. SWOT analysis for cattle farmers in the Matobo district during the 2012/3 period

Strength	Weakness	Opportunity	Threat
– Large numbers of local breed (average of 15 herd per household) – Cattle preference for drought , milk and meat production	– Low herd average body weights – Inbreeding – High mortality rates – Low slaughter weights and poor carcass grade – Extended marketable age – Producers are unaware of cattle fattening schemes	– Selective grading of cattle breed population – CB to impact skills on herd health management – Provision of supplementary feeding in winter and dry season	– Cattle markets through the middle person (s) – Drought – Clorisdiosis diseases and parasites (ticks, tapeworms, liver flukes and roundworms)

Materials and methods

A qualitative and quantitative approach was used during the research. A preliminary survey of ex-communal farmers that have settled under A2 settlement model in ward 23 and 24 of Matabeleland South province was carried out. The questionnaire was piloted before it was served to selected farmers within the wards.

Sampling frame work

From within each ward resettlement models were stratified into A1 and A2 models and numbered. According to Seinfeld (1988) stratification of research subjects simplifies data analysis since the participants would be grouped according to similar type and model. Research subjects (farmers) were subsequently randomly selected from within each ward. Questionnaires as the main tool of collecting primary data were randomly administered to 60 research subjects of the A1 and A2 resettlement models. Observation recording forms, guide for focus group moderator and content analysis guide were used to assist in qualitative data collection. Creswell (2004) notes that information collected during the course of focus group, like that collected during the face to face interviews is raw data. Therefore, information collected from these interviews was analyzed using the Statistics Package for Social Sciences (SPSS) and descriptive statistics using Microsoft excel.

RESULTS AND DISCUSSION

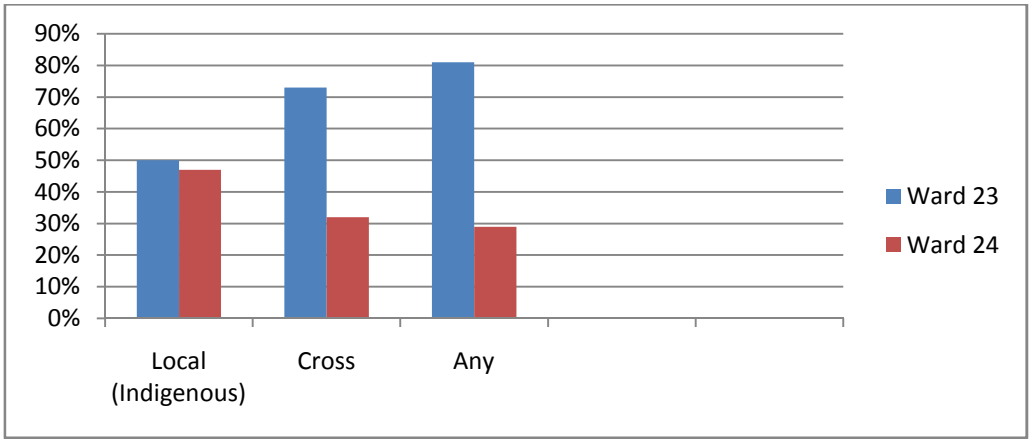
Cattle keeping

Farmers within the district keep large numbers of mixed cattle breeds, abundantly non-descript. There is no defined breeding policy and farmers seem to be concerned about cattle numbers than ‘cattle types’. Cattle are kept in kraals during the night and are released to the grazing areas during the day. Farmers employ ‘communal grazing’ system where herders spend the rest of the day tending cattle in the grazing areas. Herd class composition is highly skewed with more male animals than female animals. The observation made was that about 67% of the respondents highlighted that steers are retained for drought power (during land

tillage and sometimes pulling scotch carts). Most farmers (>80%) milk the animals during summer.

Breed Preferences

Farmers have different tastes and preferences for various breeds. Most farmers (47 %) in both ward 23 and 24 prefer local breeds. The reason cited is that they are hard and can tolerate harsh climate conditions and parasites. Indigenous breeds are also tamable, hence are suitable for drought purposes.



N = 26 (Ward 22); N = 34 (Ward 23)

Figure 2. Breed preferences by small holder-farmers during the 2012/13 period in Matobo district in Zimbabwe

Cattle Marketing

The most routes through which cattle are marketed is through the middle person. Farmers from both wards emphasized that they are willing to sell cattle only if they come across emergent reasons and formal market channel was not a priority, they preferred private sale or local market. No significant difference in willingness was found between these two study areas.

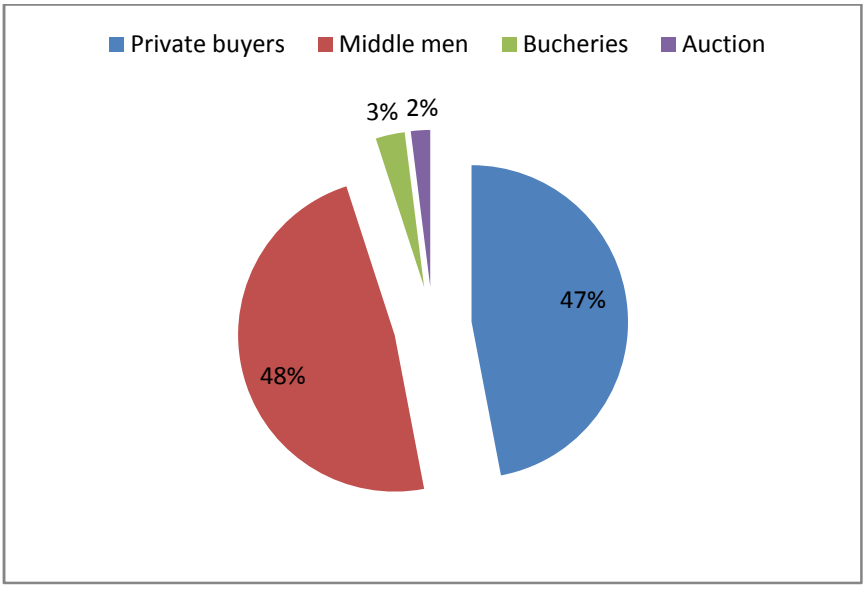


Figure 3. Cattle marketing routes by A2 smallholder farmers at Matobo District in Zimbabwe

during the period 2012/ 13

Farmers' challenges in cattle production

There is a built in perception among the farmers that their cattle breeds are of poor quality and hence have a low potential to fetch high prizes on the market. As such most of the cattle are sold through the middle person who offers relatively low prizes. 20% of the farmers cited poor availability of market information and absence of an efficient low-risk distribution and payment system. It was noted that most cattle owners (>73%) have skewed herd compositions with large percentages of male (uncatsrated) to female animals. This unbalanced herd class impacts negatively in cattle breeding. Tawonezvi (2003) reports that a successful cattle production system should maintain an optimal cow to bull ratio of 1:25. Livestock productivity and bulling ratio of up to 30 cows per one breeding bull have been mentioned elsewhere (World bank, 2006) as such there is serious inbreeding amongst the herds resulting in poor quality stock.

Grazing availability and management was the most challenge facing farmers in Matobo district. Ward (2008) has identified nutrition as the major success factor towards cattle production in semi-arid areas. Scant grazing has both resulted in high mortalities of more 23% in cattle between 6 months to two and half years and low stocking densities of up to 10 ha per Livestock Unit (LU). Uncontrolled breeding – where cows run with the bull throughout the year has resulted in calves dropped during the time when there is not sufficient grazing. As a result high calf mortality (60%) has been recorded with some farmers losing all the calves born in that year. Calves which survive have low weaning weights and poor growth. While Sibanda (2005) and Khombe (2008) reports calf's birth weight estimates to be 7% of the mature body mass of the dam- it was generally noted that the calves which succumbed to poverty were born will farm less weight. Tick borne disease and predators have been a challenge in particular in ward 23. This is partly as a result of the proximity of the area to Matobo National Park – where carriers of tick born disease are the wild game and due to poor dipping management. 2% of the farmers in ward 24 cited malignant fever disease (vectored by wild beast) as a threat to their livestock. The following table shows farmers' response challenges they are facing in cattle production in Matobo district.

Table 3. Challenges faced by smallholder cattle farmers during the period 2012/13 in Matobo district in Zimbabwe

Challenges	MATOBO WARD 23	MATOBO WARD 24
N	26	34
Infrastructure		
Dams	+++	+++
Paddock fence	++	+
Cattle handling facilities	++	+
Cattle management		
Lack of grazing management	+++	+++
Cattle feed shortages	+++	+++
Inadequate veterinary services	++	+
Cattle theft	+	+
Predators	+++	+++
Low calving rates	++	+
Low weaning weights	+	+
Cattle marketing		
Middle person	+++	+++
Low prizes	+	++

Key: + - lowest importance; +++ highest importance

CONCLUSION

Cattle production in arid and semi arid region of Zimbabwe requires farmers to up their management levels particularly during the dry season. Supplementation of rangeland feed with high protein concentrate will ensure high survivability of livestock during time of drought. Smallholder farmers require capacity building particularly in areas of animal husbandry and marketing systems so that they can benefit from their cattle production enterprises.

RECOMMENDATIONS

Matobo district has good geo-physical and vegetation landscape for cattle production. However, the region faces perennial dry spells that makes cattle production difficult. Farmers are required to implement programmes that will abate loss of cattle during the dry season by preserving supplementary fodder, avoiding wild fires and culling old aged animals. Breeding for hardness (chimoyo et al, 1999) can be another strategy that farmers can employ to save animals from drought. Farmers also need to monitor the stocking densities and paddock infrastructure. This will ensure that grazing is available to cattle for the greater part of the year. Health care is important particularly on tick born related disease, which accounts for more than 20% of cattle deaths. Capacity building on use and calibration of dip acaricides ensures that farmers are able to apply the correct dosages to eradicate the parasites. Profit realization from cattle enterprise can be obtained by selling of cattle to formal market such as Cold Storage Company, CC sales and Agric Auctions. These cattle development initiatives, if adopted can improve cattle production within the district.

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Original Article

Evaluation of Heat Tolerance of Heterogeneous Rabbit Population Raised in Southwestern Nigeria

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ABSTRACT

The study was conducted to evaluate heat tolerance of heterogeneous rabbit population raised in Southwestern Nigeria. Eighty-eight rabbits (fifty-four adult does, fifteen adult bucks and nineteen growers) were used for the study which was conducted during rain and dry seasons (early and late rain as well as early and late dry seasons). Ambient temperature and relative humidity were monitored across these seasons using dry bulb thermometer and wet and dry hygrometer respectively. Physiological parameters (rectal temperature, respiratory rate and heart rate) to obtain categorical heat stress indices were taken on each animal. Data collected on physiological traits of the animals were analyzed using statistical analysis system. One-way analysis of variance (ANOVA) was performed to compare variations in physiological traits of the animals as influenced by season, sex, age and coat colour of the rabbits. Duncan's Multiple Range test was used to separate the means where significance was indicated. There were no significant effects ($p > 0.05$) of coat colour, age and sex of the animals on their rectal temperature. However, season of the year had significant effects on rectal temperature of the rabbits. The heart rate and respiratory rate of the animals were significantly affected ($p<0.05$) by coat colour, age, sex and season. The coat colour, age and sex of composite population of rabbits as well as seasons of production were adjudged to be important sources of variation in evaluating heat tolerance of the rabbits.

Keywords: Heterogenuos population, physiological traits season, tolerance.

INTRODUCTION

Domestic animals are homeotherms that tend to maintain a constant body temperature through a balance of heat gain or loss. Homeotherms have optimal temperature zones for production within which no additional energy above maintenance is expended to warm or cool the body (West, 2003). The environment surrounding an animal at any particular instant

influences the amount of heat exchange between it and the environment. Under humid tropical climatic conditions, high temperature and relative humidity are major environmental factors that result in heat stress which in turn influence the productivity and physiological development of animals. In such an environment, rabbits are susceptible to heat stress since they have few functional sweat glands and have difficulty in elimination of excess body heat (McNitt *et al*., 2000; Marai *et al*., 2002). Rabbits are highly prone to heat stress in arid and tropical environments where a tremendous potential exists for small-scale meat rabbit enterprises to alleviate hunger and poverty in lesser-developed countries (Jackson *et al*., 2008).

Stocks of rabbits used in many developing countries are composite or heterogeneous populations derived either from crosses between local breeds and exotic meat type, commercial rabbits or from crosses among exotic rabbit breeds (Lukefahr and Cheeke, 1991; Lukefahr, 2000). Heterogeneous stocks are the result of years of planned and unplanned crosses among different exotic (and / or local or indigenous) breeds of rabbits introduced to most developing nations by colonial settlers and Christian Missionaries, Lukefahr and Cheeke (1991) and more recently, by some agencies like the Heifer Project International, and the United State Agency for International Development (USAID) over fifty years ago. Hence this study sought to evaluation of heat tolerance of heterogeneous rabbits raised in Southwestern Nigeria

MATERIALS AND METHODS

The study was conducted at the Rabbit Unit of the Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife, Nigeria (Latitude 07^0 28^I N and Longitude 04^0 33^I E) . Based on the recordings of farm ambient temperature and relative humidity, the whole study period was divided into four seasons (early rain, late rain, early dry and late dry seasons) to compare parameters in normal and heat stress conditions. Temperature and relative humidity in the rabbitry were monitored across seasons (rain and dry) and across day periods (minimum temperature in the morning and maximum temperature in the afternoon) two to three days apart by dry bulb thermometer and wet and dry hygrometer respectively. As far as possible, these instruments were maintained in an empty cage to provide a record of the temperature and relative humidity experienced by the rabbits.

Rabbits for this study were a composite or heterogeneous population reared in Southwestern Nigeria that are products of non-specific crosses of New Zealand White, California, Chinchilla and Flemish giant (Somade and Adesina, 1990; Odubote *et al.*, 1995). A total of eighty-eight rabbits were used at the start of the experiment, their ages range from six months to one year with weight range of 1.0-2.9 kg comprising of fifty-four adult does, fifteen adult bucks and nineteen growers.

The cool part of the day for this study was considered to be 7:30 am, whilst the hot part of the day was determined by taking ambient temperature readings at an hour intervals from 7:30 am to 5:30 pm daily over three continuous days. The hot part of the day was found to be 1:30 pm.

Physiological parameters to obtain categorical heat stress indices were taken on each animal and these include; rectal temperature, respiratory rate and heart rate. These physiological parameters were measured two times a week to avoid undue stress to the animals. The rectal temperature was measured using a digital rectal thermometer inserted into the rectum and left in position till the thermometer gave beeping sound, thereafter the reading was taken. Respiration rate was recorded as the number of frequency of flank movements per 20 seconds and later was calculated as breaths / minute (Thwaites *et al*., 1990). Heart rate was also recorded as beats per seconds by placing the stethoscope on the chest of the rabbits to determine the rhythmic beats of the heart which was later calculated as beats / minute (Thwaites *et al*., 1990).

Data collected on physiological characteristics traits of the animals were analyzed using statistical analysis system (SAS, 2004). One-way analysis of variance (ANOVA) was performed to compare variations in physiological traits of the animals as influenced by season, sex, age and coat colour of the rabbits. Duncan's Multiple Range test was used to separate the means where significance was indicated. The summary statistics for climatic variations were also analysed within each season.

RESULTS AND DISCUSSION

Effects of coat colour on physiological traits of composite rabbits

There was no significant effect ($p > 0.05$) of coat colour on rectal temperature of composite rabbit population (Table 1). However, highest rectal temperature (39.63 ± 0.37^0C) was obtained in rabbits with white coat while the least was obtained in black and white rabbits (39.12 ± 0.08^0C). The result of this study is contrary to findings of some authors; Shafie *et al*. (1970) who reported significant differences between coat colour in heat tolerance of rabbits; Obeidah (1975) also reported estimated heritability for heat tolerance character of 0.12 for body temperature in young Giza white rabbits, implying that this trait is lowly heritable, and highly influenced by the environment. The heart rate of the rabbits was significantly affected ($p < 0.05$) by coat colour such that highest heart rate (163.60±8.37 beats/min) was obtained in brown rabbits and the lowest heart rate was obtained in black rabbits (125.45 ± 2.47 beats / min). This result agreed with result of Shafie *et al*. (1970) who reported that Baladi white rabbits had lower pulse rate than Baladi red rabbits. Also, the respiratory rates of these animals were significantly affected ($p < 0.05$) by their coat colour. Shafie *et al*. (1970) reported significant effects of coat colour on respiratory rate of Baladi rabbit.

Table 1. Effects of coat colour on physiological traits of composite rabbits

Traits	Coat colour			
	Black	White	Brown	Black and White
Rectal temperature (^{0}C)	39.27±0.07	39.63±0.37	39.40±0.29	39.12±0.08
Heart rate (beats/min)	125.45 ± 2.47^b	128.82 ± 1.33^b	163.60 ± 8.37^a	135.89 ± 1.50^b
Respiratory rate (breath/min)	93.67 ± 1.30^b	94.55 ± 0.74^b	108.40 ± 3.89^a	97.83 ± 1.50^b

Effects of age on physiological traits of composite rabbits

The age of the rabbits had no significant effects ($p>0.05$) on rectal temperature of the rabbits; however, growers had the highest rectal temperature, followed by the adult and the lowest rectal temperature was obtained in wearers. The results imply a trend for increasing heat tolerance as rabbits mature. This result disagreed with the reports of Cardiasis and Sinclair (1972) who reported significant differences ($P<0.05$) in body temperature adult and rabbit kits. Heart rate and respiratory rate of the animals were significantly affected ($p<0.05$) by their age (Table 2).

Table 2. Effects of age on physiological traits of composite rabbits

Traits	Age		
	Adult	Grower	Wearer
Rectal temperature (^{0}C)	39.67±0.32	38.89±0.07	39.25±0.11
Heart rate (beats / min)	133.82 ± 1.26^a	127.55 ± 2.42^a	94.24 ± 1.11^a
Respiratory rate (breath / min)	96.65 ± 0.67^a	94.72 ± 1.48^a	79.93 ± 1.04^b

Effects of sex on physiological traits of composite rabbits

Sex of the rabbits had no significant effects ($p>0.05$) on the rectal temperature of the animals. Contrarily, Johnson *et al*. (1957) reported sex difference with body temperature of rabbits. However, both heart rate and respiratory rate of the rabbits were significantly affected ($p<0.05$) by their sex.

Table 3. Effects of sex on physiological traits of composite rabbits

Traits	Sex	
	Doe	Buck
Rectal temperature (^{0}C)	39.51±0.32	39.37±0.06
Heart rate (beats / min)	132.94±1.27^a	120.94±1.94^b
Respiratory rate (breath / min)	96.84±0.71^a	90.25±0.98^a

Effects of season on physiological traits of composite rabbits

Seasons of the year had significant effects ($p<0.05$) on the physiological traits of these animals. The rectal temperature of the animals during the dry season differed from that of the rainy season. Frangiadaki *et al*. (2003) reported significant difference ($P<0.001$) in rectal temperature of rabbits in hot and cold seasons. Also, higher values of heart rate were recorded in dry season (late and early) which depict the hot-dry conditions. The result obtained in this study agreed with studies conducted on heat tolerance of chicken by Boa-Amponsem (1992) who reported that pulse rate is relatively less effective under hot-humid conditions as compared to hot-dry conditions. Similarly, the respiratory rate also differed with seasons. Frangiadaki *et al*. (2003) reported that respiration rate was highly affected by monthly air temperature changes due to the fact that respiratory rate is considered as one of the major physiological reactions which can keep body temperature within the normal range.

Table 4. Effects of season on physiological traits of composite rabbits

Traits	Season			
	Early Dry	Late Dry	Early Rain	Late Rain
Rectal temperature (^{0}C)	40.07±0.06^a	39.22±0.70^b	39.45±0.06^{ab}	39.41±0.06^{ab}
Heart rate (beats / min)	158.69±2.19^a	162.56±1.66^a	96.46±0.77^b	96.01±0.58^b
Respiratory rate (breath / min)	124.23±1.74^a	77.94±0.37^b	101.84±0.65^d	80.54±0.48^c

CONCLUSION

The coat colour, age and sex of composite population of rabbits as well as seasons of production were adjudged to be important sources of variation in evaluating heat tolerance of the rabbits.

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Original Article

Effect of Selenium and Vitamin E Injection during Late Pregnancy on Immune System and Productive Performances of Sanjabi Ewes and Their Lambs

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ABSTRACT

This study was preformed to investigate the effect of selenium and vitamin E supplementation during late pregnancy on plasma and colostrum selenium concentrations and immune system of Sanjabi ewes and their lambs. Twenty seven Sanjabi ewes were randomly assigned to three treatments groups. Four and two weeks before expected lambing, ewes were injected intramuscularly 0 ml (C) 5 ml (T1), 10 ml (T2) selenium and vitamin E respectively. Each ml of the supplement containing of 0.5 mg Se as sodium selenite and 50 mg vitamin E as D, L-alpha-tocopheryl acetate. Plasma and colostrum Se concentrations, colostrum and plasma IgG concentrations, white blood cell and differential leukocyte counts were measured. The results showed that plasma Se concentrations were significantly increased in T2 compared with controls as well as plasma Se concentration of lambs of treatments were significantly increased compared with lambs of control. The colostrum Se concentrations were significantly increased in Se supplemented groups compared with control. White blood cell counts was higher in lambs of T2 when compared with controls ($P<0.05$). The colostrum IgG concentrations at one hour postpartum were higher in T2 compared with controls ($P<0.05$). The mean colostrum production at one hour postpartum did not differ between ewes but the mean colostrum production at 10 and 18 hours postpartum increased in ewes of T2 group ($P<0.05$). The length of restless prepartum and length of gestation in supplemented ewes were shorter than controls.

Selenium and vitamin E injection during late pregnancy at the level of 10 ml could have influenced passive immune system and ewes and lambs performance.

Keywords: Selenium, White blood cell, Immunoglobulin G, Colostrum, production, Sheep.

INTRODUCTION

Selenium (Se) is an important trace mineral, acting in synergism with vitamin E which inhibits the oxidation of membrane polyunsaturated fatty acids and DNA by oxygen radicals produced during aerobic metabolism (Florence, 1995). Selenium has a biological function related to vitamin E in that Se is an essential component of glutathione peroxidase, an enzyme involved in detoxification of hydrogen peroxide and lipid hydro peroxidase. Moreover, Se is a component of selenoproteins and is involved in immune and neuropsychological function in animals (Meschy, 2000). Enjalbert *et al*. (1999) reported that Se and vitamin E supplementation enhances the levels of Se in beef cattle serum. Evidence from the literature and practical experiences suggests that nutritional factors are perhaps the most crucial, in terms of their direct effects on the reproductive phenomenon (Rastogi, 2007). Dietary supplementation of selenium and vitamin E are shown to be highly effective in increasing reproductive performance by improving litter size and total number of piglets born (Kim and Mahan, 2001). Koyuncu and Yerlikaya (2007) observed increased numbers of ewes exhibiting estrus, and higher pregnancy, lambing and twining rates when ewes were given a selenium injection before breeding. Although it is well established that Se supplementation of deficient ewes enhances ewe reproductive performance, the effects of Se source and supplementation rate on reproductive performance have not been investigated. Moeini *et al*., (2009) reported that Se supplementation had no effect on gestation lengths, services per conception, retained fetal membrane and open days in heifer injected Se and vitamin E supplementation 4 weeks before expected calving. Selenium and vitamin E status in the parturient period and during early life is important for health and performance of cows and their offspring (Lacetera *et al*., 1996).

A positive effect of Se on haematological indicators was observed by several authors (Li *et al*., 1990; Chen and Lin, 2000; Tras *et al*., 2000), but not confirmed by others (Hu *et al*., 1984; Pisek *et al*., 2008). The role of Se and vitamin E as antioxidants may explain its importance in immune responses. Selenium deficiency plays a role in numerous economically important livestock diseases, problems that include impaired fertility, abortion, retained placenta and neonatal weakness (McDowell *et al*., 1996; Atwill Reynolds., 2004). According to Boland *et al*, (2005) high Se and vitamin E intake by pregnant ewes reduced the lamb serum IgG values and the efficiency of IgG absorption. Selenium supplementation may boost passive immunity by enhancing IgG absorption in the newborn lambs (Rock *et al*., 2001). It has also been reported that an adequate supply of Se in combination with vitamin E in cows at late pregnancy, increased colostral and post-suckle serum IgG concentrations (Sweeker *et al*., 1995). In recent years, research on the physiological role of Se has been aimed with organic and inorganic forms of Se in the processes of immunity including the functions of white blood cell (WBC) (Kachuee, 2011; Pisek *et al*., 2008). Most of the available information in this field is based on studies outside the Middle East, where the conditions for livestock are different, for example, in housing systems, feeding, climate, and management. According to Moeini *et al*., (2011b) a high level of Se and vitamin E in heifers in late of pregnancy had positive effect on immune system. Kachuee, (2011) reported that the WBC counts, neutrophils and lymphocytes counts were higher in kids of goats in Se supplemented group when compared with the control group at birth day and 7 days of age ($P>0.05$), but changes of the mean serum IgG concentrations did not differ among goats and kids ($P>0.05$). Fazaeli and Talebian, (2009) showed that Se and vitamin E supplementation had positive effects on the productive and reproductive performance in Iranian ewes. The objective of this study was to determine the effect of different levels of Se and vitamin E supplementation at the late of pregnancy on plasma Se and IgG concentrations, colostrums Se and IgG concentrations, white blood cell and differential leukocyte counts, production and reproductive performance of Sanjabi ewes and their lambs.

MATERIALS AND METHODS

This experiment was performed at Mehregan Research Station of Jihad in Kermanshah province in west of Iran. Twenty seven fat tail Sanjabi ewes were randomly assigned to three treatments groups. Ewes in three groups were homogeneous for age, weight and were fed alfalfa hay, wheat straw, oat and concentrate (corn, soybean meal, barley, bran) providing 2.93 Mcal ME and 156 g/kg DM and crud protein, respectively according their requirements and body weight (NRC, 1985). The Se concentration of the diet was 0.07±0.01 mg/Kg DM, (Table 1). Estrous was synchronized with two intramuscular injections of prostaglandin given 9 days apart. The estrous behavior was detected by testing the ewes every 12 hour with vasectomies' rams from the day of the second PG injection and from day 15 of the next estrous cycle. Four and two weeks before expected lambing, ewes were injected intramuscularly 0 ml (C), 5 ml (T1), 10 ml (T2) with a Se and vitamin E solution (each ml of the supplement containing of 0.5 mg Se as sodium selenite and 50 mg vitamin E as D, L-alpha-tocopheryl acetate). The length of restless (showing sign of gestation) pre partum and length of gestation in all ewes were monitored. Live weight at birth, weaning weight (after 60 days) and average daily gain of lambs were recorded.

Table 1: Nutrient composition (DM basis) of alfalfa hay, concentrate and oat

Nutrient	Alfalfa hay	Wheat straw	Oat	Concentrate
% DM	92.53	93.66	93.11	88.1
%CP	15.30	3.21	10.33	18
%CF	32.15	40.10	6.03	-
Ca%	1.87	0.43	0.18	0.33
P%	0.20	0.09	0.31	0.29
Se , mg/kg	0.09	-	0.07	0.07

Blood samples were collected from the jugular vein of ewes four weeks before the expected time of lambing (before administration supplement) and on lambing day. Blood samples were collected in vacuum tubes, venoject (Sterile Terumo Europe, Leuven, Belgium), early in the morning before feeding. Blood samples of the lambs were drawn from their jugular vein at birth (before suckling) and at 7 days of age. Blood samples were centrifuged for 15 min at 1000 rpm. The plasma and colostrums samples stored at −20 ˚C until analysis. The ewes were milked by hand and colostrum production was recorded for 18 hours after lambing. Colostrum samples were collected from ewes in 1, 10 and 18 hours after lambing. Selenium concentrations in plasma and colostrums were measured by working standards for inductively coupled plasma optical emission spectrometry (ICP-OES). The standard solutions containing 1000 ppm for each tested element obtained from Perkin elmer (USA) according to the method described by Kachuee *et al* (2012). Colostrums and plasma IgG concentrations were measured by sandwich ELISA method, in accordance with the technique described by John (2009).

Differential leukocyte counts were performed on routinely prepared Giemsa-stained blood films using the cross-sectional technique (Jain, 1986). The experimental design randomized the complete block with 9 replicates and three treatments. The means were separated and compared using Duncan's multiple range tests when ANOVA indicated significant at $P< 0.05$.

The differences between treatment groups were estimated using the followed model:

$$\mathbf{Xij = \mu + Tj + \varepsilon ij}$$

Where:

Xij : dependent variable

μ : overall mean

Tj : effect of treatment

εij : random error

The statistical analyses were performed with SPSS package 18 (2009).

RESULTS AND DISCUSSION

Plasma and colostrum Se concentrations of ewes and lambs are shown in Table 2 and indicate plasma Se concentrations of ewes before injection did not differ but by lambing day, the mean plasma Se concentrations were higher in T2 compared with control ewes (P<0.05). The mean values of colostrum Se concentrations in ewes were higher in treated groups compared with controls (P < 0.05). Plasma Se concentrations of new born lambs were higher for both supplemented groups compared with controls (P<0.05), although by 7 days of age this was only significant for the T2 lambs (P<0.05).

Table 2: Mean plasma and colostrum Se concentrations of ewes and lambs (µg / L)

Time	Control	T1	T2
Ewes- 4 weeks before Lambing	68±3.6^{a}	69±4.1^{a}	67±3.5^{a}
Ewes-lambing day	54±4.2^{b}	71±2.5^{ab}	83±3.8^{a}
Lambs- at birth day	49±1.7^{b}	62±3.4^{a}	67±2^{a}
Lambs-7 days of age	56±4.6^{b}	65±5.1^{ab}	72±4^{a}
Colostrum	116±6.5^{b}	140±8.2^{a}	142±7.5^{a}

Mean ± standard error
Means with different superscripts in the same row differ at P < 0.05

The results of the present study demonstrated that Se supplementation enhanced the amount of selenium in milk and colostrum, which is in line with results from other studies (Kachoee *et al*., 2013; Meyer *et al*., 2011). Placental and colostrum transfer of Se from ewe to lamb has been shown to occur even when the dam is deficient in selenium (Abd El-Ghany and Tortora, 2010). Plasma IgG concentration (Table 3) did not differ significantly between groups at 4 weeks before or at lambing although IgG concentrations did fall in the last 4 weeks of pregnancy.

Table 3: Plasma and colostrums IgG concentrations of ewes and lambs (mg/dl)

Items	Control	T1	T2
Ewes -4 weeks before lambing	2040±94	1995±90	2025±88
Ewes-Lambing day	1815±87	1860±83	1880±68
Lambs at birth	101±4.43	106±5.59	110±6.31
Lambs at 7 days of age	1180±59	1200±39	1160±61
Colostrums; 1 hour postpartum(g/L)	86.48±0.84^{b}	86.78±0.81^{b}	90.01±1^{a}
10 hours postpartum	51.04±1.32	50.30±1.06	50.25±1.19
18 hours postpartum	21.04±0.92	20.4±0.81	19.9±0.74

Mean ± standard error , Means with different superscripts in the same row differ at P < 0.05
(Control = 0 ml Se+VE), (T1 = 5 ml Se+VE), (T2 = 10 ml Se+VE)

The lambs from treated ewes had higher plasma Se concentrations compared with controls (P<0.05), this fact was in agreement with previous reports (Abdelrahman and Kincaid, 1995; Davis *et al*., 2006). Moeini *et al*., (2011b) reported that serum selenium concentrations in heifers and their calves did not differ among all groups before injection of selenium and vitamin E supplement, but at calving, the serum selenium concentration increased in the supplemented groups. Knowles *et al*., (1999) and Juniper *et al*., (2006) showed a similar result in dairy cows. The plasma Se concentrations of control lambs were slightly above the normal range (40-50 µg / L) reported by other studies (Izadyar 1987, Jalilian *et al*., 2012). Close correlations existed between the Se concentration in blood of calves and in dams at birth (Kincaid and Rock, 1999). Davis *et al*. (2006) showed Se concentrations in the plasma of lambs were affected by dietary Se concentrations of their dams. Further Kim and Mahan, (2001) reported elevated serum and tissue Se concentrations in neonate pigs when dietary Se levels of sows were increased. Like blood and tissue, Se in milk is affected by dietary Se level (Givens *et al*., 2004). Placental and colostrums transfer of Se from ewe to lamb has been shown to occur even when the dam is deficient in selenium (Abd El-Ghany and Tortora-

Perez, 2010). The efficiency of placental transfer of Se is highly dependent on the levels and the chemical form of selenium supplementation. Dietary Se supplementation of pregnant beef cows, markedly increased Se concentrations in colostrum and milk (Ammerman *et al*., 1980). Colostrums Se concentrations were affected by Se supplementation of the ewe's diet and increased linearly as dietary Se increased (Davis *et al*., 2006). The results of our trial are further supported by Mahan (2000), who demonstrated that colostrums Se concentrations were increased by increasing Se in pre partum and postpartum sow's diet.

The plasma IgG concentrations of treated ewes did not differ significantly at 4 weeks before lambing and at lambing day (Tables 3). The plasma IgG concentrations in all groups of ewes decreased during the last 4 weeks of pregnancy. In present study, treatments did not affect the plasma IgG concentrations of lambs at birth. However, plasma IgG concentration at 7 days of life was higher in supplemented groups than when recorded immediately after birth before the first colostrum feeding. This is not surprising, because the placental structure in ruminants does not permit IgG transportation from mother to fetus. The placenta acts as a barrier to the in utero transmission of IgG in lambs, and lambs are born with negligible quantities of IgG in plasma (Schultz *et al*., 1973), therefore depend on the successful transfer of colostral IgG to provide them with immunity in early days and weeks of life, and following the ingestion of colostrums, an increase in plasma IgG titers was observed (Boland *et al*., 2005).

Adequate Se status of the newborn not only ensures prevention of nutritional myopathy, but also decreases associated losses in lamb productivity. Lambs from Se-supplemented ewes show faster progression to stand and nurse compared to lambs from non Se-supplemented ewes leading to an overall decrease in lamb mortality (Munoz *et al*., 2009). The mean colostrum IgG concentrations of ewes have been shown in Table 3. The mean of colostrum IgG concentrations at one hour postpartum was higher in T2 compare with controls. Moeini *et al*. (2011b) reported the mean of colostrum IgG concentrations at one hour postpartum did not differ between treatments.

The mean colostrum production is shown in Table 4. The mean colostrum production at one hour postpartum did not differ between ewes but the colostrum production at 10 and 18 hours postpartum was higher in ewes of T2 group ($P<0.05$). The colostrum production was affected by Se and vitamin E supplement; although Weiss, (2003), Kachuee, (2011) and Bourne *et al*., (2007) indicated that Se supplementation had no significant effect on milk production.

Table 4: Mean colostrum productions of ewes (ml)

Time	Control	T1	T2
1 hour postpartum	501.66±6.61	507.77±7.02	503.88±5.18
10 hours postpartum	591.11±6.27^{b}	602.77±5.89^{b}	652±5.83^{a}
18 hours postpartum	522.77±6.51^{b}	530±3.22^{b}	608±3.72^{a}

Mean ± standard error, Means with different superscripts in the same row differ at ($P < 0.05$)
(Control = 0 ml Se+VE), (T1 = 5 ml Se+VE), (T2 = 10 ml Se+VE)

The leukocyte count of ewes 4 weeks before lambing and at lambing day is shown in Table 5. The results indicated that the changes of mean values of WBC counts and the percent of types of WBC did not significantly differ between treatments four weeks before expected lambing and at lambing day. The leukocyte count of lambs of treated ewes at birth day and on 7 days of age is shown in Table 6. The WBC counts were higher in lambs of ewes in T2 group compared with control group but the percent of types of WBC did not significantly differ between lambs of treated ewes at 7 days of age ($P>0.05$). Kachuee, (2011) reported that the WBC counts, neutrophils and lymphocytes counts were higher in kids of goats in selenomethionin group compared with the controls on birth day and 7 days of age ($P<0.05$).The higher WBC and Lymphocyte cell counts could be related to the protection of cell membrane and intracellular organclles by the antioxidant effects of Se and thus increase

their lifespan. Fazaeli and Talebian, (2009) showed that the combination of vitamin E and Se were more effective than Se supplement to improve immune system.

Table 5: Leukocyte counts in treated ewes four weeks before lambing and at lambing day

Parameters	Control	T1	T2
Ewes before lambing ;			
White blood cell count	9333±494	9355±370	9388 ±385
Neutrophile %	33.3±3.04	31.3 ±1.3	31.2±1.06
Lymphocyte %	65.7±3/2	67.1±1.2	66.8±1.01
Monocyte %	2 ±0.70	2.25 ±0.62	2.25±0.62
Eosinophile %	1±0	1.25±0.25	1.5±0.28
Ewes at lambing day;			
White blood cell count	9966±676	10098 ±541	10100 ±417
Neutrophile %	32.66±4.1	31.83±2.06	30.5±3.3
Lymphocyte %	66.5±1.6	67.33±2	68.5 ±2.4
Monocyte%	1.5 ±0.60	1.5±0.60	2 ±0
Eosinophile%	1±0	1±0	1±0

Mean ± standard error
(Control = 0 ml Se+VE), (T1 = 5 ml Se+VE), (T2 = 10 ml Se+VE)

Faixova *et al*., (2007) reported that supplementation of lambs with Se-yeast had no positive effect on WBC counts. The results presented here show a positive effect of Se and vitamin E on WBC in lambs of treated ewes at 7 days of age (Table 6). In addition, Se is known to act as a scavenger of free radicals within cell membranes, having a protective effect against oxidative damage (Smith *et al*., 1997). Mohri *et al*., (2005) reported that Se and vitamin E supplementation affected on WBC counts in third weeks of calves' life. In another study, WBC counts were significantly higher in Se and vitamin E injected groups of rats than in the control (Cay and Naziroglu, 1999).

Table 6: Leukocyte counts in lambs at birth and at 7 days of age

Parameters	Control	T1	T2
lambs at birth;			
White blood cell count	5060±437	5300±206	5500 ±394
Neutrophile %	58.25±3.7	54.75±4.8	56.8±2.3
Lymphocyte%	40.25±3.2	44 ±4.1	44.2 ±3
Monocyte %	1 ±0	1.5±0.38	2.33 ±0.80
Eosinophile %	1±0	1±0	1±0
lambs at 7 days of age;			
White blood cell count	7925±443^{b}	8600±533^{ab}	9176 ±308^{a}
Neutrophile %	30 ±2.7	29.25±1.8	31.4±2
Lymphocyte %	68.75±3.8	69.25±2	68.2±2.25
Monocyte %	1 ±0	1.66 ±0.5	2 ±0
Eosinophile %	1±0	1±0	0

Mean ± standard error
(Control = 0 ml Se+VE), (T1 = 5 ml Se+VE), (T2 = 10 ml Se+VE)

The lambs birth weight, average daily gain; gestation length and length of restless prepartum are shown in Table 7. The lamb's birth weight did not differ between treatments. The gestation in T2 group was shorter than control groups ($P<0.05$). The length of restless prepartum until lambing in Se supplemented ewes was shorter than control group ($P<0.05$).

Average daily weight gain of lambs up to 60 days of age increased in lambs of supplemented ewes compared with control group (P<0.05)(Table 7).

Table 7: The mean birth weight, daily weight gain, gestation length and length of restless postpartum until lambing

Items	Control	T1	T2
Length of gestation(day)	156±1.2[a]	154±1.04[a]	150±0.45[b]
length of restless pre partum until lambing(minutes)	44±2.3[a]	39±0.89[b]	37±0.72[b]
Birth weight(kg)	3.7±0.21	3.9±0.36	4.1±0.25
Daily weight gain of lambs (g)(for 60 days)	266.8±8.1[b]	300.9±9.4[a]	308.5±8.7[a]

Mean ± standard error
Means with different superscripts in the same row differ at (P < 0.05)
Control = 0 ml Se+VE), (T1 = 5 ml Se+VE), (T2 = 10 ml Se+VE)

Dominguez-Vara *et al*., (2009) found no differences in growth response in weaned lambs supplemented with 0.3 mg/kg Se yeast in the finishing diet, when compared with non Se supplemented lambs. Similar result were found with Christaldi *et al*., (2005) whereby no effect of Se supplementation on growth rate was observed in growing and finishing lambs supplemented with increasing amounts of sodium selenite. In contrast Abd El-Ghany and Tortora-Perez, (2010) and Gabryszuk and Klewiec, (2002) suggest that growth as a result of Se supplementation is most noticeable in the first two weeks of age, although other studies suggest that enhanced growth from Se supplementation can be detected in lambs up to one year of age (Munoz *et al*., 2009; Kumar *et al*.,2009). Koyuncu and Yerlikaya, (2007) suggested that ewes supplemented with Se and vitamin E had a positive effect on daily weight gain and body weight up to 60 days of age.

CONCLUSION

Selenium and vitamin E supplementation at the late of pregnancy of ewes caused a higher Se status at parturition. The colostrums Se concentrations were significantly increased in Se supplemented ewes with higher colostrums production. Lambs born to ewes given Se and vitamin E in late pregnancy had higher Se status at birth and 7 days of age. White blood cell counts were higher in lambs of supplemented ewes, and the mean colostrums IgG concentrations at one hour postpartum were higher in supplemented ewes. In conclusion, it seems selenium and vitamin E supplementation at the levels of 10 ml improves passive immune system and colostrums production.

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Original Article

Microbial Contamination of Fresh Meat Processed in Public Abattoir and Slaughter Slab System of Operations

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ABSTRACT

The comparison of microbial contamination of fresh meat processed was carried out in public abattoir and slaughter slab system of operations. The meat samples were analyzed for Aerobic plate counts, coliform yeast and mould. The results indicate that the counts were significantly ($p < 0.05$) higher than the standards. The mean Aerobic plate counts (APC), Conliform, mould and yeast counts after 4 hours in the abattoir was 2.0×10^5 cfu/gm, 3.6×10^3 cfu/gm and 1.2×10^2 cfu/gm for public abattoir. While 6.0×10^3 cfu/gm, 4.2×10^3 cfu/gm and 5.0×10^5 cfu/gm for APC, conform and mould and yeast counts, in slaughter slab. The high counts are indications of contamination through poor hygienic practices which could be through slaughtering, cutting process, unsterile knives and cutlass, handling of meat using dirty hands, cloths and utensils, sneezing, coughing, dirty floor and tables etc. Adequate cleanliness of all the surfaces and sterilize equipment used for slaughtering and processing will reduced microbial activities in fresh meat.

Keywords: Microbial contamination, abattoir, slaughter, fresh meat, environment, hygienic.

INTRODUCTION

Meat is defined as the flesh of animals which are suitable for use as food (Forrest *et al.*, 1975). It is one of the most nutritious foods used for human consumption and an excellent source of high quality protein. It also contains large amounts as well as fats and carbohydrate for energy (Ikeme, 1990). Meat serves as an excellent medium for microbial contamination, growth and spoilage. The degree of bacterial contamination of the carcass depends only when the initial bacterial counts is low. The contamination of meat could be sourced from the air, environment of the operations, the slaughter slabs, unsterile knives and cutlass, equipment and utensils, clothing and hands of personnel, the hides and hooves, the gastrointestinal tract of the animals, the wash water, butchers and from poor hygienic practices (Johanson *et al.*, 1983).

According to Patterson and Gibbs (1978), heavily contaminated sites in an abattoir are the water supply to the lair age, animal hair, blood, rumen contents, soil and fecal materials from hooves in abattoirs. Johansson *et al., (*1983) have found *E. Coli, Proteus SPP, Streptococcus faecatis* and *Cl. perfringens* in all effluent samples. Strains of Y. enterolitica were reported by Newton (1979) from sampling of meat - works environment. Obanu (1980) describes a typical situation in Nigeria, the abattoirs are usually located in the open market, a centre of activity, where air is strikingly polluted and heavily charged with spoilage and pathogenic bacteria, yeast and moulds. Skinning, evisceration and cutting up of the carcass are often carried out on filthy slaughter floor or on equally filthy platforms and tables.

Usually, many more hands than necessary are involved in these operations, each hand being a source of contamination the stinking odor and nauseating environment of these persons and places are familiar. It is against this background that this study was carried out to compare the level of microbial contamination of fresh meat processed in public abattoir and slaughter slab system of operations.

MATERIALS AND METHODS

For the purpose of meat sampling in abattoir, two sample sites were selected for the study site X - Ughelli main market (public abattoir system) and site Y- Agbarho meat market (slaughter slab system). A total of twenty samples of 250 g each were collected from public abattoir and fifteen samples of 250 g each were collected from slaughter slab at intervals of 2 hours each using sterile beakers and immediately placed in ice cooler while being transported to the laboratory for analysis. Twenty-five grams of representative stock samples meat were weighed aseptically and homogenized in 225 ml of 0.1 % peptone water using a blender to give 1:10 or 10" Dilution tend fold serial dilutions were made and the dilutions plated. The plates were incubated at 37°C for total viable count, 30°C for mould and 28°C for yeast and coliform counts (Maikai *et al.*, 2005).

The meat samples were analyzed for total viable bacteria using nutrient agar, yeast and mould using malt agar and McConkey agar for coliforms (Harrigan and MacCance, 1976). Representative colonies on nutrient agar plates were picked with sterile wire loop. They were streaked into nutrient agar plates and incubated at 37°C. This procedure was repeated till pure colonies were obtained using heat fixed smears the morphology and grams reaction were examined under the microscope and the isolated cultures inoculated into nutrients agar slants and incubated for 24 hours before identification test, congulase test, motility test, spore staining, indole, methyl red, vogest-proskauer and citrate utilization test were done (Harrigan and McCance, 1976).

RESULTS AND DISCUSSION

Table 1 presents the changes in microbial level of fresh meat processed 4 hours during slaughtering operations.

The mean Aerobic plate count (APC), coliform, mould and yeast counts are 2.0×l05 cfu/gm, 3.6×103 cfu/gm and 1.2×102 Kcfu/gm respectively. While slaughter slab system at the end of 4 hours had the mean Aerobic plate count (APC), coliform, mould and yeast counts of 6.0×103 cfu/gm, 4.2×103 cfu/gm and 5.0×105 cfu/gm respectively (Table 2).

Table 1: Changes in Microbial Content of Fresh Meat in Public Abattoir Situated at Ughelli main Market

Time in hrs	APCAt 37°Ccfu/gm	Coliform Coun cfu/gm	Mould & Yeast Count cfu/gm
0	1.3×104	1.2×102	3.0×103
2	4.0×l03	2.2×103	4.2×103
4	2.0×105	3.6×103	1.2×102

Average of means of three counts APC = Aerobic Plate Count

Microbiological standard for fresh meat should not exceed 1×105 cfu/gm, for APC and 1×102 cfu/m for coliforms as reported by Jay (1978). The use of coliform count in assessing the microbiological safety and quality of food (meat) was also reported by Mossel *et al.*, (1962).

Table 2: Changes in Microbial Content of Fresh Meat in Slaughter Slab Situated at Agbarho Meat Market

Time in hrs	APCAt 370C cfu/gm	Coliform Count cfu/gm	Mould & Yeast Count cfu/gm
0	3.6×10^3	2.0×10^4	4.1×10^3
2	2.8×10^4	2.2×10^3	3.0×10^4
4	2.0×10^3	4.2×10^3	5.0×10^5

Average means of three counts APC = Aerobic Plate Count.

Comparing the changes in microbial levels in public abattoir system with the microbial contamination standards, it was discovered that the counts are higher than the given standard in the literature. Slaughter slab also had higher counts. These results tend to agree with Makai et al. (2005), reported that there was higher counts of microbial levels in Kawo and Tudun wada abattoirs in Kaduna, and Zango abattoir in Zaria.

But the mean of APC (6.0×103 cfu/gm), coliform (4.2×103 cfu/gm) mould and yeast (5.0×105 cfu/gm) counts respectively in slaughter slab was higher than public abattoir system. This can be attributed to the fact that operations performed during slaughtering, cutting process and handling of carcass were under poor hygienic conditions.

In slaughter slab system, the increase in counts after 4 hours could also be as a result of microbial contamination through the closet river water (Agbarho river) used, the air environment, the unsterilized areas of operation, unsterile knives and cutlass, the hides and hooves, the gastrointestinal tract of the animal, perching of flies, sneezing and coughing can introduce this micro-organisms in the meat surface.

The lower counts in public abattoir compared to slaughter slab system of operations, may be as a result of facilities provided by the local government council for the smooth operation and veterinary personnel under the supervision of sanitary control of the site. The initial microbial contamination of meat in public abattoirs may also results from the introduction of microorganisms into the vascular system for failure to sterilize their knives and cutlass during the process of sticking and bleeding. Since blood continues to circulate for a short period of time following sticking, the introduced micro-organisms may be disseminated throughout much of the animal body.

CONCLUSION AND RECOMMENDATIONS

From the findings, we therefore conclude that fresh meat provide highly favorable media for the growth and multiplication of micro-organisms. Apart from the external surface and the gastrointestinal and respiratory tracts, the tissues of living animals are essentially free of microorganisms. During slaughtering, the defensive barrier of the skin and mucous membrane is loss and the meat gets contaminated with various microorganisms from external sources such as type of wash water, unsterile knives, rumen content, environmental polluted air, equipment and utensils, clothing's and hands of butchers and poor hygienic practices contribute to bacteriological contamination of meat-works environment. This contamination occurs in almost every operation performed during the slaughtering, cutting, processing and handling of carcass.

It is recommended that careful instruction for cleaning the environment, tools and equipment, and utensils should be followed appropriately. Recommendations for good sanitizing agents and disinfectants may be necessary in some instances. Adequate cleanliness of all the surfaces and equipment use before and after slaughtering and processing is also necessary. The local Government and community authority should provide the necessary facilities and chemical (repellant) to eliminate houseflies. These are only sure ways of enhancing the quality of meat and the overall well-being of the consumers.

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Original Article

Morphometric Variations Exist Among Native Cattle of Bhutan

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ABSTRACT

For effective conservation and utilization of cattle gene pool consisting of native characterization is important. Therefore, the objective of the study was to assess some morphometric variations in Bhutanese native cattle breed. A total 101 adult animals were included belong to Mithun (5), Siri (bull = 14, cow = 14), Siri cow cross Mithun bull (bull = 20, cow = 20), first backcross hybrids (bull = 14, cow = 14). ANOVA was performed to test the level of significance among the populations. Bulls were superior to cows in body and head sizes and shapes. Among seven populations, Jatsha and Mithun were proportionately larger. On contrary, Thrabum (Siri cows) were comparatively smaller in body sizes and shapes ($p < 0.05$). Moreover, dendrogram suggest that the populations could be clustered into two main groups. Hence, this information will assist in developing conservation strategies for native cattle in Bhutan.

Keywords: Breeding; conservation, morphometric trait, performance

INTRODUCTION

Native cattle play social and cultural roles and is ranked as the most valued animal in Bhutanese farming system (Dorji and Gyeltsehen, 2012). Of late, farmers prefer to keep Jersey and their crosses. In addition, beginning of superior cattle (improved breed) sourcing to dairy group member has motivated the farmers to take up dairy farming. For example, raw materials for shed construction are provided to those dairy farmers receiving the animal from the government. On contrary, local cattle (Siri, *Bos indicus*) survival might be threatened.

The local cattle are adaptable and ability to survive and perform under poor conditions (Ndumu et *al.*, 2008; Hadiuzzaman *et al.*, 2010; Kayastha *et al.*, 2011). Besides, the country's rough steep terrain and use of farm machineries is less possible thus, bull are used as draft animal. Mithun (*Bos frontalis*) has been used for crossing with Siri cow to produce hybrid vigour (Jatsha and Jatsham for male and female, respectively). Jatsha are sterile and are powerful animal than the Siri bull which is perfectly designed for draft purpose. Jatsham produces more milk than her dam and they are further backcrossed with Siri bull to produce Yangkum (female) and Yangku (male). Scientific research should be performed with respect

to body measures for its genetic potential in these populations. Therefore, the purpose of this study was to determine the morphometric variations among Bhutanese common cattle population. These will be essential while developing conservation strategy for Bhutanese native cattle. Moreover, the morphometric measurements could be used to estimate the body weight (Assan, 2013).

MATERIALS AND METHODS

Population and sample sizes

We used four Bhutanese indigenous cattle breeds from the Shingkar block, Zhemgang district. Body measurements for seven populations include; Mithun bull (*Mencha* local name; n = 5), Siri bull (Thrapa, n = 14), Siri cow (Thrabum, n = 14), Siri cow cross Mithun bull progeny male (Jatsha, n = 20), Siri cow cross Mithun bull progeny female (Jatsham, n = 20), first backcross male hybrid from Jatsham and Siri bull (Yangku, n = 14) and first backcross female hybrid from Jatsham and Siri bull (Yangkum, n = 14) as indicated in Table 1. For each animal, body morphology variables were measured as per Yakubu *et al.* (2010), Tolenkhomba *et al*. (2012) and FAO (2012) method. Herder assistance provided during the experiment minimized cattle handling problems.

Table 1. Indigenous cattle breeds in Bhutan

Sl. No	Sire	Dam	F1 progeny male	F1 progeny female
1	Thrapa	Thrabum	Thrapa	Thrabum
2	Mithun	Thrabum	Jatsha	Jatsham
3	Thrapa	Jatsham	Yangku	Yangkum

Statistical analysis

Shapiro-Wilk test (Manikandan, 2010) of SPSS 16 (2007) was used to test for data normality. On deviation from the null hypothesis, data were transformed to log10 anchored at 1 (Osborne, 2010). Hereafter, all the statistical analyse were involved with the transformed data (Manikandan, 2010) and then transformed to original data on completion of analysis. A dendrogram was constructed based on hierarchical clustering method.

RESULTS AND DISCUSSION

Shapes of the head and body linear traits measured in Jatsha and Mithun were higher among seven populations (Table 2). For instance, wither height was the tallest with 128.50 cm (Jatsha), followed by 127.96 cm (Mithun). While the shortest wither height in Thrabum were significantly different from the rest ($p < 005$). Similarly, body length, horn length, head length, arm length, ear length, elbow length and tail length in Thrabum were the lowest among the populations (Table 2). Furthermore, Jatsha and Jatsham were significantly higher in body measures than their parent except for lengths of ear, arm and head ($p < 0.05$). Overall, it was observed that the progeny of Siri cross Mithun have produced proportionately larger body and head size.

The body length, wither height, ear length, tail length, neck circumference, pes length and head length of Siri cow was lower than Manipur local cow (Tolenkhomba *et al*., 2012). Even, lengths of tail and head and neck circumference of Jatsham and Yangkum were lower than the above investigators. On the other hand, body length, wither height, ear length, neck length, elbow length, pes length, thigh length and arm length of Jatsham and Yangkum were comparatively greater than local cows of Maipur (Tolenkhomba *et al*., 2012). Three local cow populations have body and ear length which was closer to Red Chittagong cows in Bag *et al*. (2010) study. But, the length of horn (10.82 cm) and length of tail (92.29 cm) of Red Chittagong cows (Bag *et al*., 2010) was shorter and longer, respectively than the Bhutanese local cows.

Table 2. Body measurements in Bhutanese native population (mean ± SE)

Parameters (cm)	Jatsham	Jatsha	Yangkum	Yangku	Thrabum	Thrapa	Mithun
Body length	107.07±0.92^{a}	113.04±0.82^{b}	105.32±1.34^{a}	108.31±1.30^{a}	100.24±0.80^{c}	105.54±1.24^{a}	118.56±0.88^{b}
Wither height	124.45±0.72^{a}	128.50±1.00^{a}	113.91±1.02^{b}	115.10±2.21^{b}	101.11±1.04^{c}	110.94±1.48^{b}	127.96±0.99^{a}
Ear length	16.22±0.46^{ab}	18.09±0.47^{ab}	16.44±0.94^{ab}	17.10±0.38^{ab}	14.95±0.28^{a}	15.51±0.35^{a}	21.10±0.73^{b}
Tail length	80.89±0.71^{a}	87.12±1.38^{c}	71.16±1.45^{b}	71.02±1.50^{b}	67.23±1.42^{b}	71.56±1.44^{b}	81.36±2.32^{ac}
Neck circumference	56.82±0.52^{a}	62.92±0.92^{c}	56.47±1.40^{a}	55.44±1.17^{a}	46.44±0.91^{b}	54.53±1.17^{a}	68.70±2.00^{c}
Neck length	36.81±1.22^{a}	39.20±1.43^{a}	31.43±0.71^{b}	31.65±0.97^{b}	27.69±0.52^{bc}	27.34±0.55^{c}	39.98±1.20^{a}
Arm length	33.81±0.78^{a}	36.74±0.82^{abc}	33.17±0.96^{ab}	34.43±0.97^{ab}	31.28±0.61^{a}	33.35±0.96^{ab}	40.48±1.63^{c}
Elbow length	40.55±0.81^{a}	42.15±0.81^{a}	31.66±1.12^{b}	31.12±1.48^{b}	29.04±0.74^{b}	29.81±0.97^{b}	42.62±1.46^{a}
Thigh length	35.15±0.63^{a}	48.91±0.97^{b}	40.81±1.11^{c}	40.98±1.58^{c}	42.58±0.84^{c}	48.94±1.07^{b}	43.98±1.34^{bc}
Pes length	36.22±0.72^{ab}	38.50±0.69^{ab}	32.74±0.95^{a}	35.39±0.99^{ab}	24.44±0.65^{c}	23.66±0.88^{c}	37.80±1.87^{ab}
Head length	33.67±0.61^{a}	36.59±0.95^{ab}	32.37±0.77^{a}	34.73±0.80^{ab}	30.93±0.71^{a}	32.64±0.63^{a}	40.10±1.30^{b}
Horn length	27.45±0.79^{c}	36.46±0.75^{d}	19.73±0.71^{b}	31.64±0.97^{e}	14.71±0.61^{a}	17.69±0.63^{b}	31.38±1.46^{cde}

$^{a, b, c, d, e}$ superscript row, level of significance at $p<.05$. SE, standard error

Thrapa and Yangku ear length of about 16 cm was close to Red Chittagong's bull (Bag *et al*., 2010) study. Body length of Red Chittagong bull measured 130 cm which is relatively longer than Bhutanese native bulls. On the other hand, tail and horn lengths of Red Chittagong's bull were comparatively shorter than present findings. Mithun bull's length of body, head and horn and height of wither from our present study were lower that the Northeast Indian Mithun (Gupta *et al*., 1996). Differences in recorded traits from the earlier investigator could be attributed to breed, environment and husbandry condition variations.

Data general trends represented for sexual dimorphism in all three populations. Body traits were significantly greater in some morphometric variables for male bulls (Table 2). This is in support to Gupta *et al*., (1996) and Bag *et al*., (2010) study. There were few exception; Siri bull's neck length and pes length were shorter than the cow's but, there were no significance of difference ($p < 0.05$). Yangkum were superior to Yangku in neck circumference, elbow length and tail length.

We could also classify the seven populations into two main clusters; first cluster consisting of Yangkum, Yangku, Thrabum, Thrapa and Jatsham while Jatsha and Mithun forms another group. The dendrogram informs that the first backcross hybrids (Yangku and Yangkum) were morphometrically closer to Siri (Thrapa and Thrabum). Genetically, backcross hybrids are supposed to be about 75% closer to Siri. Furthermore, a bigger distance was observed between Mithun and Siri (Figure 1). We may appropriately restate that the Bhutanese native cattle populations are morphological different from the neighbouring Indian state cattle hence, they should be important for conservation for effective utilization of cattle resources.

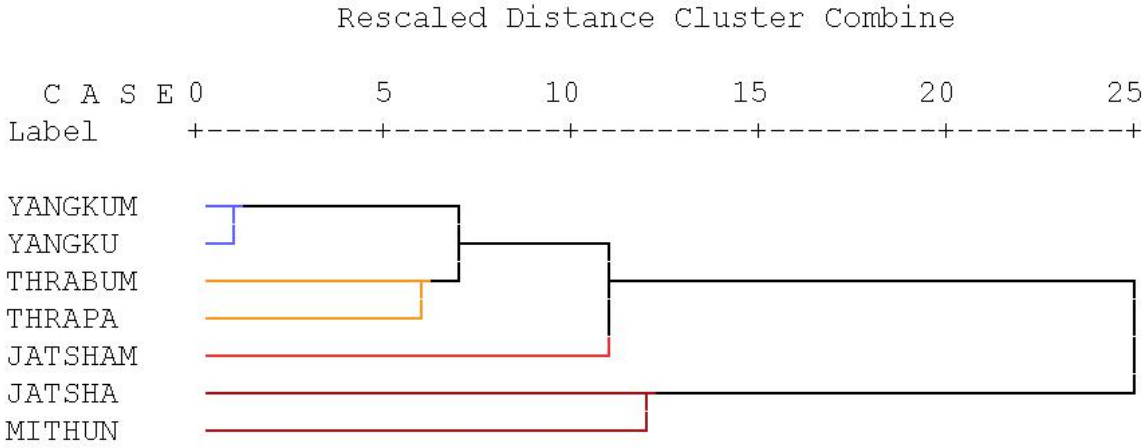

Figure 1. Dendrogram clustering among seven populations

CONCLUSION

Some physical body and head traits recorded for adult Bhutanese native cattle was alike to native cattle of Assam and Bangladesh but, variations exist which might be due to difference in breed, husbandry conditions and environment

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Original Article

Broiler Chicken Growth Performance, Ileal Microbial Population and Serum Enzyme Activity Affected By Dietary Source of NonStarch Polysaccharides As Supplemented With or Without Enzymes

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ABSTRACT

An experiment was conducted to evaluate the effect of different dietary source of Non-starch polysaccharides with or without enzymes on growth performance, ileal microbial population, and serum enzyme activity of broiler chickens. A total number of 625 unsexed broiler chicken (Ross-308) were randomly assigned to 5 treatments with 5 replicates and 25 birds per each unit, using a CRD statistical design. Treatments were included control, wheat (W), wheat+ enzyme (WE), barley (B), and barley+ enzyme (BE). Feed intake and body weight gain were significantly increased, as well as feed conversion ratio decreased by diets supplemented with enzymes rather diets without enzymes ($P<0.05$). The inclusion of W and B in diets led to significantly increased the total intestinal bacteria or gram negative and coliform bacteria as well as decreased the\number of lactic acid bacteria at 42 days of age ($P<0.05$). Serum enzyme activity of amylase and lipase were significantly increased after feeding chickens by diets contained W and B rather control or WE and BE at 42 days of age ($P<0.05$). The results of present study have shown that supplementation of W and B with enzymes completely restored the situation and neutralized the negative effects of W and B on growth performance, intestinal microbial population and serum enzyme activity of broiler chickens.

Keywords: broiler, enzyme activity, growth, micro biota, NSP.

INTRODUCTION

Broiler feeding with wheat and barley are common practice in many countries because they are good energetic cereals which grow on site and reduce feed costs (Ahmadi *et al*., 2013). The major corn-producing countries such as the United State and Brazil have been recently shifted using of corn to ethanol fuel producing. This diversion along with increased world's demand for this cereal has resulted in rise of corn price and consequently feed cost for

poultry industry (Donohue and Cunningham, 2009). Wheat and barley as alternative cereals can be easily replaced for corn in poultry diets. These cereals can locally grow in most parts of the world as well as they have remarkably lower water requirement than corn (Yin *et al*., 2000; Lin *et al*., 2010).

Wheat and barley as major sources of energy in poultry diets have considerable amount of non-starch polysaccharides (NSPs), which generally considered as anti-nutritional factors (Mirzaie *et al*., 2012; Ahmadi *et al*., 2013). The major component of NSPs is water soluble NSPs (arabinoxylan in wheat and β- glucans in barley), as which reduces digestion efficiency and production proficiency. (Choct, 1997; Moharrery *et al*., 2005). The NSPs content in these cereal grains may have adverse effects on the utilization of nutrients which thus limits their inclusion level in poultry rations. Increase feeding levels of NSPs in diets directly influences on growth, gut microbial characteristics as affected other physiological characteristics such as enzyme activities (Olukosi *et al*., 2007; Mirzaie *et al*., 2012). Reports indicate that a complex blend of NSPs degrading enzymes requires obtaining satisfactory gain and other performances (Ravindran *et al*., 1999; Slominski, 2011). In the present study, equal amount of wheat and barley and nearly similar fractions of NSP from those were included in broiler diets with and without multi-enzyme to compare the effects on growth performance, ileal bacterial population and serum enzyme activity.

MATERIAL AND METHODS

Experimental Design and Birds

A total of 625 unsexed broiler chicken (Ross-308) were randomly divided to 5 treatments with 5 replicates of 25 birds in each. Treatments were included of control (corn-soy basal diet), and the inclusion of wheat (W), wheat+ enzyme (WE), barley (B), and barley+ enzyme (BE) at levels of 15 and 20 percent in starter and grower periods respectively. Diets were designed as starter (1 to 21 days of age) and grower (22 to 42 days of age) based on NRC (1994) recommendations to meet their nutrient requirements (Table 1). Combo® multi-enzyme was used contained 1000 unit phytase and 180 unit multi-glycanase activities. Feed and water offered ad libitum in all period of experiment. Body weight gain (BWG), feed intake (FI), feed conversion ratio (FCR), and mortality were measured. The lighting schedule was 23 h light / 1 h darkness at 32^{o}C the first day. This was subsequently reduced 3oC each week until third week. Thereafter it was constant.

Microbial Sampling and Incubation

On day 42 of the experiment, two birds from each replicate were slaughtered by cervical dislocation and ileum contents were collected. Contents were gently removed into sterile sampling tubes and immediately transferred on ice to the laboratory. Serial dilutions of 1 g sample (10-4 to 10-7) were made. Selective media of Nutrient Agar, MacConkey Agar, Eosin methylene Blue Agar, Rogosa Agar, and Reinforced Clostridial Agar were included to detect the total number of bacteria, coliforms, gram-negative, lactic acid bacteria, and clostridium, respectively. Total number of bacteria, coliforms and lactic acid bacteria were counted after aerobic incubation for 24 h at 37^{o}C. Gram-negative bacteria were counted after incubation for 48 h at 37^{o}C and clostridium were counted after anaerobic incubation for 24 h at 37^{o}C.

Serum Enzyme Activity

At 42 days of age, two birds from each replicate were randomly selected and blood samples were taken via wing vein. Blood samples were transferred to vial tubes containing sodium heparin. The tubes were centrifuged at 5,000 × g for 20 min, and the supernatant was discarded. Serum amylase (EC 3.2.1.1) and lipase (EC 3.1.1.3) activity were determined by use of specific kits (Biosystem Company, Spanish).

Table 1. Diet composition at different periods of the experiment

Diets	experimental diets during 1-21days					experimental diets during 22-42days				
Ingredients(%)/Treatment	control	wheat	Barley	Wheat + enzyme	Barley + enzyme	control	wheat	Barley	Wheat + enzyme	Barley + enzyme
Corn grain	56	44.6	45	44.6	45	58	40	42	40	42
Soybean meal (45% CP/kg)	36.8	35.05	34	35.05	34	32	30.5	29.3	30.5	29.3
Soybean oil	2	1.35	2	1.35	2	2.9	2.85	3.47	2.85	3.47
Wheat	-	15	-	15	-	-	20	-	20	-
Barley	-	-	15	-	15	-	-	20	-	20
Enzyme[1]	-	-	-	+	+	-	-	-	+	+
Dicalcium phosphate	2	2	2	2	2	2.5	2.5	2.5	2.5	2.5
Oyster shell	1	1	1	1	1	1	1	1	1	1
Sodium chloride	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Potassium carbonate	-	0.05	0.05	0.05	0.05	0.1	0.1	0.1	0.1	0.1
DL-Methionine	0.17	0.15	0.15	0.15	0.15	0.25	0.25	0.25	0.25	0.25
L-Lysine HCL	0.1	-	-	-	-	0.1	0.1	0.1	0.1	0.1
Premix[2]	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Inert	1.13	-	-	-	-	2.35	1.90	0.48	1.90	0.48
Calculated Analysis										
Metabolizable energy (kcal/kg)	2900	2900	2900	2900	2900	2980	2980	2980	2980	2980
Crude protein	21	21	21	21	21	19	19	19	19	19
Met + Cys	0.95	0.84	0.83	0.84	0.83	0.85	0.85	0.84	0.85	0.84
Lysine	1.32	1.19	1.18	1.19	1.18	1.20	1.20	1.11	1.20	1.11
Calcium	0.98	0.94	0.94	0.94	0.94	1.03	1.02	1.02	1.02	1.02
Available phosphorus	0.53	0.53	0.50	0.53	0.50	0.65	0.62	0.61	0.62	0.61
Sodium	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Chloride	0.22	0.23	0.24	0.23	0.24	0.22	0.23	0.23	0.23	0.23
Potassium	0.95	0.95	0.96	0.95	0.96	0.87	0.87	0.87	0.87	0.87
DEB=(Na+K)-Cl (meq/kg)[3]	230	230	230	230	230	231	231	231	231	231
Total NSP	12.43	12.89	12.96	12.89	12.96	11.62	12.11	12.65	12.11	12.65

[1]Enzymes contained 1000 unit Phytase and 180 unit Multi-glycanase and added at level 0.1% on top of ingredients in enzyme supplemented diets.[2]Supplied the following per kilogram of diet: vitamin A 44,000 IU, vitamin D3 17,000 IU, vitamin E 440 mg, vitamin K3 40 mg, vitamin B12 70 mg, vitamin B1 65 mg, vitamin B2 32 mg, Pantothenic acid 49 mg, Niacin 122 mg, vitamin B6 65 mg, Biotin 22 mg, Choline Chloride 27 mg: 650 mg of Mn, 250 mg of Zn, 125 mg of Fe, 110 mg of Cu, 60 mg of Se, 68 mg of I, and 21 mg of Co. [3]DEB: Dietary Electrolyte Balance

Statistical Analyses

All data were analyzed for normal distribution using the NORMAL option of the UNIVARIATE procedure of GLM procedure of SAS software (SAS Inst. Inc., Cary, NC). A completely randomized design was employed. Pen was used as the experimental unit and data were analyzed by GLM procedure. Logarithmic (log 10) transformation was applied for microbial colony forming unit (CFU). Duncan's multiple range test were used for comparison of means ($P<0.05$).

RESULTS

The effect of dietary treatments on broiler chicken performance is shown at Table 2. The results indicated that the diets contained W or B led to significantly decreases in FI and BWG as well as significantly increases in FCR rather other diets ($P<0.05$). WE and BE diets which supplemented with enzymes resulted in significantly increases in FI and BWG as well as significantly decreases in FCR rather W and B diets ($P<0.05$).

Table 2. Effect of diets on broiler chicken performance at 42 days of age

Treatment	FI[1] (g/d per bird)	BWG[2] (g/d per bird)	FCR[3]	Mortality(%)
Control	92.70[a]	53.23[a]	1.74[b]	4.45
W[4]	87.63[b]	46.92[b]	1.88[a]	4
WE[5]	92.10[a]	51.40[a]	1.79[b]	3.67
B[6]	87.83[b]	47.01[b]	1.88[a]	4
BE[7]	92.17[a]	51.31[a]	1.78[b]	3.45
SEM	1.51	1.32	0.054	1.22
P-value	0.037	0.041	0.016	0.110

Means with common letters in the same column are not significantly different ($P<0.05$). SEM: Standard error of the means. [1]Feed intake, [2]Body weight gain, [3]Feed conversion ratio, [4]Wheat, [5]Wheat+enzyme, [6]Barley [7]Barley+Enzyme.

Table 3 showed the effect of diets on ileal micro flora population at 42 days of age. Diets contained W or B caused to significantly increases in total number of bacteria, gram-negative, coliforms, and clostridium bacteria as well as significantly decreases in lactic acid bacteria population rather other diets (P<0.05). WE and BE diets caused to significantly decreases in total number of bacteria, gram-negative, coliforms, and clostridium bacteria as well as significantly increases in lactic acid bacteria population rather other diets (P<0.05).

Table 3. Ileal microflora in response to diets at 42 days of age (Log 10 cfu/g of digesta)

Treatment	Total number of bacteria	Gram Negative	Coliforms	Lactobacillus	Clostridium
Control	6.67[b]	5.31[b]	5.07[b]	4.91[b]	4.86[b]
W[1]	7.13[a]	6.33[a]	6.32[a]	3.87[c]	5.69[a]
WE[2]	5.33[c]	5.21[b]	5.21[b]	5.20[a]	4.83[b]
B[3]	7.17[a]	6.24[a]	6.13[a]	3.93[c]	5.86[a]
BE[4]	5.75[c]	5.27[b]	4.56[c]	5.49[a]	4.78[b]
SEM	0.156	0.129	0.121	0.144	0.172
P-value	0.021	0.051	0.018	0.029	0.015

Means with common letters in the same column are not significantly different (P<0.05). SEM: Standard error of the means. [1]Wheat, [2]Wheat+enzyme, [3]Barley,and [4]Barley+Enzyme.

The effects of diets on the serum amylase and lipase enzyme activity are presented at Table 4. The inclusion of W and B in diets led to significantly increases in serum enzyme activity rather control (P<0.05). WE and BE diets which supplemented with enzymes led to significantly decreases in serum amylase and lipase enzyme activity rather W and B diets (P<0.05).

Table 4. Effect of diets on the serum enzyme activity of broilers at 42 days of age

Treatment	Amylase (U/L)	Lipase (U/L)
Control	22.94[c]	10[c]
W[1]	48.60[a]	21.84[a]
WE[2]	35.23[b]	17.63[b]
B[3]	46.32[a]	20.84[a]
BE[4]	37.71[b]	18.73[b]
SEM	2.62	1.44
P-value	0.012	0.003

Means with common letters in the same column are not significantly different (P<0.05). SEM: Standard error of the means. [1]Wheat, [2]Wheat+enzyme, [3]Barley,and [4]Barley+Enzyme.

DISCUSSION

Soluble NSPs of wheat and barley have negative effects on broiler performance (Yin *et al*., 2000; Lin *et al*., 2010; Mirzaie *et al*., 2012). Results reported in Table 2, indicated that W and B diets have more deleterious impact on voluntary feed intake of broiler chickens than other diets. Birds fed on W or B diet consumed lower feed intake, consequently they had lower BWG compared to other diets due to presence of soluble NSPs in their constituent NSP. The growth performance indices are consistent with the viscosity of ileal digesta, which negatively affected by soluble NSPs (Silva and Smithard, 1996; Jamroz *et al*., 2002; Jadalla *et al*., 2014). Results showed that depolymerization of the NSP constitutes of W and B diets were successful, which subsequently led to reduce digesta viscisity and significant improvements in FI and BWG of broilers. Multi-enzymes (including xylanases, β- glucanases and cellulose), release the encapsulated nutrients and reduce digesta viscisity. These processes are further facilitated by the action of phytases (Ravindran *et al*., 1999; Slominiski, 2011).

Results of this experiment indicated that W and B diets increased the total number of bacteria and the population of gram negative, coliform and clostridium bacteria, conversely decreased the population of lactic acid bacteria in the intestinal digesta compared to other diets. Inversely, birds fed on corn or WE and BE diets had higher number of lactic acid bacteria (table 3). Water soluble NSPs increase digesta viscosity in the gut which creates ideal

environment for maximum proliferation of bacteria, especially for anaerobic species such as clostridium (Jaroni *et al*., 1999; Langhout, 1999; Choct *et al*., 2006). A slow moving digesta with low oxygen tension could provide a stable media where fermentative microbes such as anaerobic bacteria can establish. These microbial changes result in reduced nutrients available for host and produces of detrimental byproducts (Choct *et al*., 2006). Supplementation of W and B diets with multi-enzymes significantly reduced the negative effects of soluble NSPs on viscosity and proliferation of bacteria in the intestine through breakdown of NSP polymers. These findings are in accordance with several reports. (Lin *et al*., 2010; Mirzaie *et al*., 2011 ; 2012).

Serum α-amylase and lipase activities of broiler chickens significantly increased after consuming of W and B diets compared to control or WE and BE diets (table 4). Presence of adequate enzymes in the blood is very important for digestibility of nutrients . But increasing gut viscosity because of viscous nature of water soluble NSPs impedes enzyme capability to hydrolyze nutrients and transmission of hydrolyzed products to the intestinal mucosa (Moharrery *et al*., 2005; Olukosi *et al*., 2007; Mirzaie *et al*. 2011). This in turn, increases the output of hepatic and pancreatic juice and enzyme activity either in intestine or in serum in mono-gastric animals (Li *et al*., 2004). Researchers have shown that enzyme activity depends on dietary nutrient source and presence of anti-nutrients such as NSPs in the gut (Brenes *et al*., 1993a; Zhao *et al*., 2007; Lin *et al*., 2010). Hence it can be concluded that the inclusion of W and B to broiler diets result in increased of soluble NSP content and consequently increased the digesta viscosity and the activity of enzymes both in intestine and in serum (Jaroni *et al*., 1999; Zhao *et al*., 2007; Lin *et al*., 2010). Enzyme supplementation of W and B diets modulates these changes. These observations were in line with relevant reports (Silva and Smithard, 1996; Li *et al*., 2004; Zhao *et al*., 2007; Lin *et al*., 2010).

CONCLUSION

In conclusion, results of the present experiment indicated that the adverse effects of W and B diets on broiler chicken performance. Total number of bacteria, number of gram negative, coliform and clostridium in intestinal digesta increased, but conversely decreased the number of lactic acid bacteria in birds fed on W and B diets. Besides, have been increased the serum α-amylase and lipase activities in birds fed on W and B diets. These changes remarkably restored by supplementing W and B diets with NSP-degrading multi-enzymes.

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Review Article

Application of herbs and phytogenic feed additives in poultry production-A Review

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ABSTRACT

During the last decade, herbs and phytogenic compounds have attracted a lot of attention for their potential role as alternatives to antibiotic growth promoters (AGPs) in monogastric animals. AGPs have been an integral part of the poultry feed industry for more than fifty years. However, AGPs alternatives have been searched since antibiotics prolonged use has precipitated the development of resistant strains within groups of primary pathogenic or opportunistic bacteria and the breakdown of the symbiosis between animals and desirable flora. Many non-therapeutic substitutes (prebiotics, probiotics and symbiotics), especially plants extracts from a wide variety of herbs, spices and derivatives, have already been used since the antiquity. They were appreciated for their specific aroma and various medicinal properties. Recent studies on these compounds have shown some positive effects (antimicrobial, antioxidant and regulator of the gut flora) in poultry production. This indicates that plant extracts can be considered as growth promoters; however evaluation procedures of their therapeutic/beneficial effects, their toxicity and interactions with prescription drugs have to be improved.

Keywords: growth promoters, herbs, phytogenics, poultry production.

INTRODUCTION

The industrialization of poultry husbandry and the improvement of feed nutritional efficiency have accelerated the introduction of feed additives which became widely used in animal feed for many decades. The objective outlined by scientists, is to increase production (eggs, meat) while maintaining animals in good health. The use of antibiotics in poultry feed as a growth promoter is beneficial in improvement of production parameters and diseases prevention. However this large utilization has led to the increasing resistance of pathogens to antibiotics and the accumulation of antibiotic residues in animal products and in the environment. This situation requires the world to restrict using AGPs in animal feed (Nisha, 2008).

The nutritional value of raw materials available to livestock is closely linked to the quality and size of the microbial flora especially in the host animal digestive tract and its environment. Unlike ruminants, poultry do not have a natural bacterial flora capable of degrading all nutrients. These animals are characterized by a resistor and a limited immunity against infection due to colonization by pathogenic microorganisms. This is why, the use of AGPs for the inhibition of pathogenic bacteria has been recommended in order to improve production performance and animal health. Nevertheless, this is no longer possible after the observation made by the WHO on antimicrobial resistance in both animals and humans. From 2006, the European Union banned systematically the use of AGPs in animal feed (http://www.efsa.europa.eu/en/topics/topic/amr.htm).

The removal of AGPs from animal feed may affect their productions performance and foster the resurgence of pathogens causing illness and economic losses in farms.

In this context, herbs and plant extracts are searched to be incorporated in poultry feed as growth promoters such as probiotics and prebiotics (Alloui, 2013).

Herbs and plant extracts represent a new class of additives in poultry feed. Their uses are still limited in relation to their mode of action and aspects of application. In addition, complications may be encountered due to various changes in botanical origins, transformations and compositions of plants and their extracts. Most of the investigations have studied the interactions of various active compounds and their physiological impacts and effects on production performance (Figueiredo *et al*., 2008)

The hypothesis that phytogenic compounds could improve the food palatability has not been demonstrated. Furthermore, it is believed that the phytogenic compounds can improve the digestive enzyme activity and nutrient absorption.

Many studies have demonstrated their antioxidant and antimicrobial activity in vitro but in vivo these results are limited.

In addition, other effects such as anti-inflammatory, anti-fungal, anti-infectious and anti-toxigenic have been confirmed in some researches (Giannenas *et al*., 2003; 2004; Lopez - Bote, 2004; Burt, 2004; Lee *et al*., 2004; Walace, 2005; Naidoo *et al*., 2008; Ayachi *et al*., 2009; Arczewska-Wlosek and Swiatkiewicz , 2012; Ahmed *et al*., 2013; Khan, 2014).

All these assumptions are being addressed by the project ‘’REPLACE’’ in the EU programs framework. The objective of this project is to examine the possibility of using plants and their extracts as natural alternatives to antimicrobials in animal feed (http://www.replace-eu.com).

The aim of this work is to provide a synthesis of current knowledge in the scientific literature demonstrating the efficiency of plants or their extracts, to replace AGPs in poultry feed.

Definition and regulation of phytogenics feed additives (PFA)

Herbs and plant extracts used in animal feed, called today phytogenics feed additives (PFA), are defined as compounds of plant origin incorporated into animal feed to enhance livestock productivity through the improvement of digestibility, nutrient absorption and elimination of pathogens residents in the animal gut (Kamel, 2001; Balunas and Kinghorn, 2005; Athanasiadou *et al*., 2007) .

The large variety of plant compounds used as PFA are assembled according to their origin and treatment, such as herbs and spices (eg: garlic, anise, cinnamon, coriander, oregano, chili, pepper, rosemary and thyme) but also essential oils or oleoresins (Kamel, 2000). Another category of compounds are extracted exclusively from fruits. They are represented by water soluble polyphenols (flavonoids) which can also be used in animal feed (Lopez –Bote, 2004).

The content of active substances in these products can vary greatly depending on what part of the plant is used (grains, leaves, roots, bark, flowers, or buds), the harvest season and geographical origin. The technique of treatment (cold, steam distillation, extraction or maceration with non-aqueous solvents…) also changes the active substances and related compounds in the final product (Windisch *et al*., 2008).

The use of feed additives is generally subjected to regulatory restrictions. In general, they are considered as products applied by the farmer to healthy animals for nutritional purposes on a permanent basis, in contrast with veterinary drugs which are applied for the prophylaxis and treatment of diagnosed diseases under veterinary supervision for a limited time followed by a waiting period.

In the EU, these feed additives must demonstrate the identity and traceability of the entire commercial product, the claimed nutritional effects in addition to proofs of absence of interaction with other compounds. They must be tolerated by the animals, the users (farmers, manufacturers of animal feed) and the environment (European Commission, 2003).

Problems using these plant extracts in animal feed may occur and cause physiological disturbances in animals, in relation with biochemical interactions within the animal organism. This is why the study of their use in diets will focus not only on their antioxidant, antimicrobial activities and their beneficial effects on palatability and intestinal functions, but also on their effectiveness to promote animal growth as AGPs.

Antioxidant action of PFA

The antioxidant properties of herbs and spices have been largely described by Craig (1999), Nakatani (2000) , Lambert *et al*., (2001) ; Ruberto *et al*., (2002) ; Wei and Shibamoto (2007). Among the varieties of plants with antioxidant constituents, plants of the *Labiatae* families (like mint) have attracted a great interest. Their antioxidative activities are due to phenolic terpenes (Cuppett and Hall, 1998). Other herbs species with antioxidative properties such as thyme and oregano contain large amounts of monoterpenes, thymol and carvacrol (Ruberto *et al*., 2002; Rahim *et al*., 2011). Plants rich with flavonoids such as green tea and other Chinese herbs have been described as natural antioxidant (Nakatani, 2000; Piao *et al*., 2006; Wei and Shibamoto, 2007).

Black pepper (*Piper nigrum*), red pepper (*Capsicum annuum* L) and chili (*Capsicum fretuscene*) contain also several antioxidative compounds (Nakatani, 1994) but in many of these plants, the parts containing the active substances are of a very fragrant and/or spicy taste leading to restrictions of their use in animal feed.

The antioxidant properties of several PFA can contribute to dietary lipids protection from oxidation. This aspect has not been described in poultry feed; however *Labiatae* plants used as antioxidants in feed diet of small animals is very encouraging (Cuppett and Hall, 1998).

The activity of *Labiatae* phenolic compounds in improving the stability of animal products has been demonstrated in broiler chickens by several authors (Botsoglou *et al*., 2002a; Botsoglou *et al*., 2003; Basmacioglu *et al*., 2004; Giannenas *et al*., 2005; Florou - Paneri *et al*., 2006). The oxidative stability was also demonstrated with other PFA (Botsoglou *et al*., 2004; Govaris *et al*., 2004; Schiavone *et al*., 2007). However, it is uncertain whether these phytogenics antioxidants can replace commonly used antioxidants in feeds (α - tocopherol) in common feeding practices.

The use of PFA as an antioxidant is not only important for the poultry health, but also for the oxidative stability of their products (meat). Supplementation of turkey feed with 200 mg extract of oregano / kg feed significantly decreases lipid per-oxidation during refrigerated storage of fresh and cooked meat (Botsoglou *et al*., 2003).

The use of PFA instead of antioxidants is costly. However, this economic impact can be reduced by intensifying systemic needed plants and developing new technological processes of extraction.

Actions on palatability and digestion of FPA

Some PFA were sometimes seen as having a role to improve the taste and feed palatability. This implies an improvement in poultry production performance. The number of studies that tested the effect of plant extracts on palatability is very limited in this specie.

In general, an increase in feed intake in chickens is much more due to additives such as organic acids, probiotics and prebiotics (Catala - Gregori *et al*., 2007). Thus, the assumption that herbs, spices and extracts improve the feed palatability does not seem to be justified in general (Windisch *et al*., 2008).

A wide range of PFA is known to exert beneficial actions on the gastrointestinal tract, such as spasmolytic, laxative or against flatulence (Chrubasik *et al*., 2005). In Chinese medicine, cinnamon (*Cinnamonum cassia zeylanicum*) was used against diarrhea and reduced appetite. Smith-Palmer *et al*., (1998) found cinnamon extract, thyme and clove to be efficient against several bacteria. Furthermore, stimulation of the digestive secretions of bile, mucus, saliva and improvement of enzymes activities are of great nutritional interest (Platel and Srinivasan, 2004).

Other researchers have shown that essential oils used in chickens have positively influenced the activity of trypsin and amylase (Lee *et al*., 2003; Jang *et al*., 2004; Jamroz *et al*., 2005). It was also found that the phytogenic additives have a stimulatory effect on intestinal mucus in chickens. This effect is assumed to influence the adhesion of pathogens and in consequence help to stabilize the microbial equilibrium in the chicken gut (Jamroz *et al*., 2006).

These improvements could also be due to morphological changes induced in the gut such as villi and crypts size modifications in the jejunum and colon of PFA ingesting chickens (Jamroz *et al*., 2006).

Srivastava *et al*., (1995); Kumar and Berwal, (1998) showed that the use of garlic oil (*Allium sativum*) have anti-tumoral and anti-oxidative properties. Similarly, a British study showed a positive effect of garlic on growth and feed intake in chickens (Lewis *et al*., 2003). These authors concluded that garlic may have a positive effect on the gut flora by reducing pathogenic bacteria explaining the improved chicken performances.

All these observations encourage the assumption that these additives may favorably affect the gut functions, but the number of in vivo studies in poultry is still limited.

Antimicrobial and immune actions of FPA

PFA are well known for their antimicrobial effects in vitro against important pathogens but also against fungi (Allen *et al*., 1997; Smith -Palmer *et al*., 1998; Cosentino *et al*., 1999; Waldenstedt, 1998, 2003; Giannenas and Kyriazakis, 2009).

Most studies show a greater sensitivity of Gram + bacteria compared to Gram- (Shelef, 1983; Zaika, 1988; Smith -Palmer *et al*., 1998; Ceylan and Fung, 2004). This does not mean that the plant extracts are not active on Gram - bacteria, but the dosage should be higher. In addition, the antimicrobial activity is dependent on the physico-chemical characteristics of plant compounds and bacterial strains used (Sari *et al*., 2006). Burt and Reindeers (2003) observed an antibacterial effect of essential oils of oregano and thyme against *E. coli* (Gram -) at a dose of 0.6 ml / L.

Ayachi *et al*., (2009) studied the in vitro effect of some extracts of berries, dates and thyme to fight against *E. coli* and *Salmonella* isolates from chicken. These authors concluded that only the thyme would be effective against *Salmonella*.

Thyme would work with the most active compounds (thymol and carvacrol) against fungi such as *Candida albicans* (Cosentino *et al*., 1999). Other investigations have demonstrated the effectiveness of walnut leaves (*Juglandaceae*) to reduce the proliferation of *Clostridium perfrengens* in chickens but also to enhance the growth of these birds (Lovland and Kaldhusdal, 2001 ; Engberg *et al*., 2007; Mathis *et al*., 2007). Clove frequently used as a spice is very rich in eugenol. It is used as an antibacterial in human and veterinary medicine (Nascimento *et al*., 2000; Rhayour *et al*., 2003).

The essential oil of oregano contains about 60% carvacrol and 10% thymol with a demonstrated effectiveness against some strains of salmonella (Koscova *et al*., 2006) located in the digestive tract of chicken. However, to have a good efficacy against several types of

microorganisms, it is interesting to combine several extracts devoid of chemical incompatibility. The same way as antibiotics, antibacterials from plants do not distinguish between commensal and pathogenic bacteria. It is worth-noting that, as other bacteria, the lactobacilli and bifidobacteria are less sensitive to plant extracts, which is reassuring, because they are used as probiotics.

PFA are an interesting solution to clean the digestive tract of birds which is very useful in diseases prevention in poultry (Shelef, 1983). Additionally, some plant extracts have demonstrated an activity against some chicken parasites, especially coccidia (*Eimeria spp*) (Giannenas *et al*., 2003, 2004; Christakis *et al*., 2004; Naidoo *et al*., 2008; Rczewska-Wlosek and Swiatkiewicz, 2012).

Betaine is a byproduct of the sugar beet industry; it has recently been a subject of several studies in the USA and Sweden. It seems to have a positive impact in fighting coccidiosis. In Sweden, Waldenstedt *et al*., (1999) showed that the addition of betaine in the poultry feed, reduced weight loss during coccidial infection by different *Eimeria* species in poultry. It protects against osmotic stress associated with dehydration and permits normal metabolic activity of cells. However, the protective effects of betaine on the intestinal cells are also exerted on parasitic cells.

Turmeric is a spice coming from the rhizome of *Curcuma longa*. It is used as a food coloring, but also for medicinal purposes. The active component is curcumin, a phenolic compound at concentrations of about 1 to 5%. It has antioxidant, anti-inflammatory and anti-tumoral activities. In infected chicken with *Eimeria maxima*, supplementation of feed with 1% turmeric spice improves weight gain, reduces intestinal lesions and oocyst excretion. Curcumin exerts its anticoccidial effect through its antioxidant action on the immune system (Allen *et al*., 1998). Soltan *et al*., (2008) found that the supplementation of poultry feed with anise grains, improved blood parameters and increased the phagocytic activity and lymphocyte counts. Cinnamon has also an immuno-stimulating effect that can be attributed to its anti-oxidant property.

In addition to all these antimicrobial implications, phytogenics improve the microbial carcass hygiene and the preservation quality, in relation with their antimicrobial and antioxidant properties (Botsoglu *et al*., 2002b; Ruberto *et al*., 2002; Aksit *et al*., 2006).

According to the European Food Safety Authority (EFSA), this alternative should be considered as one of the most effective ways to reduce the microbial contamination of food and to control the spread of foodborne diseases within the human population through the food chain. Addition of plants extracts in foods and / or systems used on carcass surfaces decreases the bacterial contamination of poultry products (Gülmez *et al*., 2006). In the improvement of microbial carcass hygiene, oils extracted from plants (such as oregano, rosemary, sage) have a positive effect (Young *et al*., 2003; Govaris *et al*., 2007). However, it is too early to conclude that these decontamination methods are entirely effective and reliable.

Effects of FPA on production performances

The effects of FPA on production performance have shown promising results. Cabuk *et al*., (2006) measured production parameters in chickens grown on feed supplemented with a mixture of essential oils of oregano, bay leaf, sage, anise and citrus. This mixture has significantly improved feed conversion resulting of high nutrients availability due to changes in the intestinal ecosystem.

Lippens *et al*., (2005) have attempted to assess the effectiveness of a mixture composed of cinnamon, oregano, thyme, cayenne pepper, citrus extracts and of another mixture of plant extracts and organic acids in comparison with the avilamicine in chicken feed. The supplemented with plant extracts group of animals reached a much larger body weight than the other groups. Apparently, the increase in body weight was due to the increase of feed intake. This was attested by a reduced feed conversion in animals of the plant extracts group (0.4% lower than avilamicine group and 2.9% lower than the organic acids group).

Fenugreek (*Trigonella foenum-graecum*), is an annual legume, cultivated all over the world, it is one of the herbs with multi-functional characteristics. It is a good source of dietary proteins for humans and animals. Fenugreek seeds supplementation improved significantly feed conversion ratio of broiler chickens which might be related to morphological changes in the gastrointestinal tissues (Srinivasan, 2006; Alloui *et al*., 2012; Mamoun *et al*., 2014).

The inclusion of anise seeds at a level of 0.5-0.75/kg corn-soybean-meal diet administered to broilers during 6 weeks, improved their body weight gain, performance index and relative growth rate. In contrast, a higher inclusion level of anise seeds (1.5 g/kg diet) reduced growth performance (Soltan *et al*., 2008).

Garlic (*Allium sativum*), thyme (*Thymus vulgarus*) and conflower (*Echinacea purpurea*) as feed supplements have recently been reported to exert a wide range of beneficial effects on the production performance (weight gain, feed conversion, egg production and quality) of broilers and laying hens (Aji *et al*., 2011; Rahimi *et al*., 2011; Khan *et al*., 2012).

Bolukbasi and Erhan, (2007) studied the effect of dietary supplementation with thyme on performance of laying hens and *E. coli* concentrations in their feces. Thyme addition to basal diet at the level of 0.1-0.5% have given an improvement in feed conversion and egg production associated to a decline of *E.coli* concentration in feces.

Effect of PFA on egg quality traits, such as yolk composition, shell thickness or Haugh Unit rating, were reported in a few studies only, whereas the majority of reports did not identify substantial effects (Nichol and Steiner, 2008; Singh, 2009; Navid *et al*., 2013).

CONCLUSION

PFAs are good alternatives to replace AGPs. They can be combined with other compounds such as prebiotics or probiotics to promote the performance of poultry production. Phytogenics have been used since a very long time, but empirically. General mechanisms of action were little known in humans and animals. Nowadays, much progress has been made to evaluate their effects on the poultry organism. For this, it is the responsibility of additive-manufacturers to promote and control these products taking into consideration all legislative requirements governing the production and marketing of these products. The identification, composition, effectiveness, toxicity and residues analysis, traceability and the risk of manipulation are the main factors to control during the manufacturing process. The industry of animal feeds and especially the poultry one must bring to market an effective, cheap diet of high quality.

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Original Article

Comparative Study on the Adaptation of Selected Herbaceous Bee Forages in Mid Rift Valley of Ethiopia

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ABSTRACT

The study was conducted in three districts of Ethiopian mid rift valley to evaluate germination date, blooming duration and number of bee visit of seven species of herbaceous bee forages. There was significant difference ($P<0.01$) in germination date, blooming duration and bee visit among different bee forages in each site. *Phacelia tanacetifolia, Bacium grandflorum, Trifolium pretense* and *Lenorus* had the shortest germination date than other plant species at Adami Tulu Research station. Whereas, *Lenorus, Bacium grandflorum* and *Trifolium pretense* had short germination date at Bura Borema site and *Lenorus* is the only plant species with short germination date at Lephis site. There was significant difference ($P<0.01$) in blooming duration between different species of plants tested in all sites. *Aschynomene uniflorum* and *Sinapis alba* had long blooming duration followed by *Phacelia tanacetifolia* at Adami Tulu Research station and Lephis, whereas, *Echuin vulgare* and *Bacium grandflorum* showed short blooming duration at this site. Similarly *Aschynomene uniflorum* and *Sinapis alba* showed long blooming duration at Bura Borema followed by *Phacelia tanacetifolia* and *Lenorus.* Bee visit was also significantly different ($P<0.01$) between all plant species. *Phacelia tanacetifolia* was highly visited by honey bees in all sites, while *Lenorus* was the least visited forage in all sites followed by *Sinapis alba*. It is recommended that further demonstration and scale up is required at farmers' apiary site particularly for *Phacelia tanacetifolia, Bacium grandflorum* and *Aschynomene uniflorum*.

Keywords: Adaptation, herbaceous, bee forage, mid rift valley, Ethiopia.

INTRODUCTION

Bee keeping is one of the important farming activities in Ethiopia since ancient times (Girma, 1998). Previous studies indicated that Ethiopia has longer tradition on beekeeping than any country in the world (Fitchl and Admasu, 1994; Ayalew, 2001; Gezahegn, 2007). Success in bee keeping depends upon many factors, among them availability of bee flora is the fundamental one. Bees obtain nectar, pollen, or both from flowers, which are the mainstay of honeybee's life (Crane, 1990). The value of flora in bee keeping has been observed in

many parts of the world. Ethiopia is a leading honey producer in Africa and one of the ten largest honey producing countries in the world. Despite the favorable agro-ecology for honey production and the number of bee colonies the country is endowed with, the level of honey production and productivity in the country is still low. The annual average honey production per hive is as low as 6-7 kg. One of the prominent factors for this low honey productivity is traditional hive and lack of improved beekeeping management techniques and expansion of cultivating land which leads to shortage of bee forages. As honeybees require large quantities of nectar and pollen at particular time, they utilize particular species of plants for a limited period of time. Rapid increase in population densities, continuous cultivation, cereal cropping and overgrazing in the mid rift valley areas of Ethiopia, have resulted to severe soil erosion and deforestation. Rate of deforestation in Ethiopia, which amounts to 163,000 - 200,000 ha yr-1, is one of the highest in tropical Africa (Reusing, 1998; Lemenih, 2004). Removal of trees will disrupt the cycle and this in turn leads to drier climate conditions (Collins, 2001). Other undesirable consequences are the undermining of sustainable socio-economic development and loss of biodiversity (Katrien, 2007).

These together with low inputs for production have resulted to shortage of bee forages and poor pastures. There is need therefore to explore other alternatives for improving forage productivity and enhance beekeeping activities in the area. Germination and emergence are the two most important stages in the life cycle of plants that determine the efficient use of the nutrients and water resources available to plants (Gan, 1996). Environmental factors such as temperature, light, pH, and soil moisture are known to affect seed germination (Rizzardi, 2009). On the other hand, temperature and other environmental factors affect the germination and the state of dormancy of the seeds and the seasonal changes of the dormancy state of the seeds of some species is directly related to the seasonal temperature changes (Pons, 1993). Hence this study was designed to evaluate the performance of annual bee forages in different agro-ecological zones of mid rift valley, Ethiopia.

MATERIALS AND METHODS

Location

The study was conducted in three districts of the Ethiopian mid rift valley namely: Adami Tulu Jido Kombolcha (ATJK), Arsi Negele and Shashamane Districts. The study area is located within a distance of 160 to 250km south of the capital Addis Ababa (Table 1). The rainfall is bimodal, the long rains occurs from June to September and the short rains are from March to April with peak in July and August, respectively. The study was conducted from June 2011 to January 2012.

Table1: Description of location, elevation, temperature, rainfall and soils for the 3 experimental sites, ATARC, Lephis and Bura Borema

Site	ATARC	Lephis	Bura Borema
Latitude	7^{o}9'N	7^{0}21'N	7^{0}13'19" N
Longitude	38^{o} 7'E	8^{0}42'E	38^{0}37'05" E
Altitude (masl)	1650	2500	1600
Mean temperature (^{o}C)	25 to 28	15.8 to 18.8	25-28
Mean annual rain fall (mm)	769	880	790
Soil type	Sandy	Loam	Clay

Source : ATARC(Adami Tulu Agricultural Research Center), Zeleke and Solomon, 2012, Adami Tulu Agricultural Research Center Metrology Team, unpublished paper

Seed sources

Seeds of all plant species were collected from Holeta Bee Research Center, Ethiopia.

Experimental plants and design

Seven species of annual bee forages were used for the study. They were planted at three locations representing wide agro-ecological zones. Each species were planted on 1m×1m plot in three replicate per each site.

Data collection

Data of germination and blooming of each plant species was collected on daily basis for the period of 45 and 120 days, respectively. Data of bee visit was collected twice/day during blooming time on 6:00 AM and 6:00 PM. In order to get the total number of bee visited a plant covering an area of 50×50cm was selected randomly and numbers of bees collecting pollen or nectar were counted per time.

Statistical analysis:

General Linear Model (GLM) procedure of SAS (2004) was used for analyzing data collected during monitoring. Mean comparison was done using the Least Significant Difference (LSD) for parameters with significant difference. Differences were considered statistically significant at 5% level of significant. The model used to analyze the effects of farm scale and parity classes on milk yield, reproductive traits and nutrient intake was:

$Yij = \mu + Ai + eij$
Where, Yij = response variables
μ = overall mean
Ai = fixed effect of i^{th} species (i= 1, 2, 3, 4, 5, 6, 7)
eij = residual effect.

RESULTS

In this study *Phacelia tanacetifolia, Sinapis alba, Echuin, Lenorus, Bacium grandflorum, Aschynomene uniflorum and Trifolium pretense* were planted in three different agro-ecological zones and mean values for the investigated traits were indicated in table 1, 2 and 3. For illustration of the performance of the forages, two season data from each of the three locations is also presented in Table 1, 2 and 3.

Germination Date

Values of germination date (GD) of the plant species are shown in table 1, 2 and 3. There was significant difference ($P< 0.01$) in germination date among different experimental plant species. *Phacelia tanacetifolia*, *Bacium grandflorum*, *Trifolium pretense* and *Lenorus* had the shortest germination date than other plant species at Adami Tulu Research station.

Whereas, *Lenorus*, *Bacium grandflorum* and sweet clover had short germination date at Bura Borema site. On the other hand, *Lenorus* is the only plant species with short germination date at Lephis site. In this study most plant species had long germination date at Lephis site which might be related to low temperature in this site (Table 1). Similar result was showed by Terenti (2004) that the best germination speed in *D. eriantha* occurred at 30 and 35°C.

Table 2: Performance of selected annual bee forages at Adami Tulu Research station

Species	Germination date(day)	Blooming duration (day)	NBV/minute	NBV/5minutes
Phacelia tanacetifolia	25.3 ± 2.6^{b}	94 ± 1.7^{b}	21.7 ± 1.7^{a}	38.7 ± 7.3^{a}
Sinapis alba	40 ± 2.9^{a}	107.3 ± 4.2^{a}	4 ± 0.6^{d}	4 ± 0.6^{c}
Echuin vulgare	32 ± 3.5^{ab}	54.3 ± 1.8^{d}	6.7 ± 1.2^{bd}	6 ± 0.6^{c}
Lenorus	22 ± 1.5^{b}	73.3 ± 0.9^{c}	1.7 ± 0.3^{d}	3.3 ± 1.2^{c}
Bacium grandflorum	25.3 ± 2.6^{b}	57.6 ± 4.6^{d}	12.3 ± 1.5^{b}	31.3 ± 1.8^{ab}
Aschynomene uniflorum	28.6 ± 4.0^{ab}	112.3 ± 1.5^{a}	10 ± 2.5^{bc}	18 ± 10.5^{abc}
Trifolium pretense	25 ± 2.3^{b}	62.3 ± 1.5^{cd}	7.3 ± 1.2^{bcd}	7.7 ± 2.2^{bc}

NBV= number of bee visit

Table 3: Performance of selected annual bee forages at Bura Borema station

Species	Germination date(day)	Blooming duration(day)	NBV/minute	NBV/5minutes
Phacelia tanacetifolia	42.7±1.7^{a}	98.7±2.8^{ab}	21±1.2^{a}	40.3±5^{a}
Sinapis alba	45±2.3^{a}	101.6±5.2^{a}	4.7±1.4^{ed}	3±1.0^{b}
Echuin vulgare	29.7±1.2^{bc}	59.7±5.6^{dc}	5.3±0.9^{cde}	7.7±0.9^{b}
Lenorus	22.3±1.7^{c}	77±6.4^{bc}	2.7±0.9^{e}	2.4±0.9^{b}
Bacium grandflorum	23.7±1.5^{c}	54.4±1.5^{d}	13.7±1.8^{b}	46±1.5^{a}
Aschynomene uniflorum	34±1.2^{b}	110±5.2^{a}	8.7±0.9^{bcd}	7±0.6^{b}
Trifolium pretense	23±2.3^{c}	57±1.5^{dc}	10.6±0.9^{bc}	6.3±1.5^{b}

NBV= number of bee visit

Blooming duration

There was significant difference (P<0.01) in blooming duration between different species of plants tested in each site. *Aschynomene uniflorum* and *Sinapis alba* had long blooming duration followed by *Phacelia tanacetifolia* at Adami Tulu Research station and Lephis, whereas, *Echuin* and *Bacium grandflorum* showed short blooming duration at this site. Similarly *Aschynomene uniflorum* and *Sinapis alba* showed long blooming duration at Bura Borema followed by *Phacelia tanacetifolia* and *Lenorus.*

Table 4: Performance of selected annual bee forages at Lephis station

Species	Germination duration(day)	Blooming duration (day)	NBV/minute	NBV/5minutes
Phacelia tanacetifolia	36±2.5^{ab}	91.7±1.7^{ab}	26.3±1.7^{a}	35±4.6^{a}
Sinapis alba	41.7±1.8^{a}	97.3±0.3^{a}	4±0.6^{de}	3±0.6^{b}
Echuin vulgare	29±2.5^{bc}	56.7±5.5^{c}	8.7±0.3^{bcd}	6.7±2.2^{b}
Lenorus	16.7±0.9^{d}	75.3±5.2^{b}	2.4±0.9^{e}	2.7±0.3^{b}
Bacium grandflorum	21.7±1.5^{dc}	48.7±1.7^{c}	13±1.8^{b}	45±7.6^{a}
Aschynomene uniflorum	36±0.6^{ab}	103.4±3^{a}	5.7±1.2^{cde}	10±0.6^{b}
Trifolium pretense	23.3±1.7^{cd}	57±3^{c}	10±1^{bc}	6±0.6^{b}

NBV= number of bee visit

Bee visit

There was significant difference (P<0.01) in bee visit between each plant species at all study sites (Table 1, 2 and 3). *Phacelia tanacetifolia* was highly visited by honey bees in all sites followed by *Bacium grandflorum* at Bura Borema site. *Bacium grandflorum* and *Aschynomene uniflorum;* Bacium *grandflorum and Echuin*; *Sweet clover* and *Aschynomene* were visited moderately at Adami Tulu Research station, Lephis and Bura Borema sites, respectively. *Lenorus* was the least visited forage in all sites followed by *Sinapis alba*.

DISCUSSIONS

The study demonstrated considerable variation in performance of different species in different sites. Generally the species *Phacelia tanacetifolia, Aschynomene* and *Bacium grandflorum* had high performance with more adaptation than the other species in all the experiments. Lower performance of other species could be possibly due to poor adaptation to the environment. Graves *et al*. (2010) indicated that environmental conditions may delay reproduction of *Echuin vulgare* until the plant is three to four years old. Wondwossen (2009) also indicated that different species of plants have variability of performance in lower and higher slopes classes.

CONCLUSION

From this study, good ranges of well adapted bee forage have been identified and could have a high potential for use as bee forage. A good number of species especially the species

Phacelia tanacetifolia, Aschynomene-uniflorum and *Bacium grandflorum* showed a wide environmental adaptability and did well in all sites. Other main important species which include the *Trifolium pretense* had a considerable potential at Bura Borema while *Echuin vulgare* performed exceptionally well at Lephis. However there is need to evaluate these species further to determine their adaptation under irrigation conditions and identify where they could fit and the specific benefits they can contribute in the irrigated systems within mid rift valley region of Ethiopia.

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Original Article

Seasonal Variation in One Humped-Camel (*Camelus dromedarius*) Foetal Wastage at Sokoto Abattoir, Sokoto State, Nigeria

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ABSTRACT

The slaughter of camels at the Sokoto abattoir was evaluated over one year period from May 2009 to April 2010 with the aim of determining foetal wastage due to slaughter of pregnant camels. The total number of camels slaughtered during the period of study at the Sokoto abattoir was 3366 out of which 1625 were females and 113(7%) of these number were pregnant. In the study the highest wastage was observed in the month of April, followed by March and the least wastage was observed in the month of September and November. In relation to season it was observed that more female camels were slaughtered in the late dry season followed by early rainy season. However, the highest percentage of foetal wastage was in the early rainy season and least in the early dry season. It was observed that of the 113 foetuses, 35 (30.97%) were in the first trimester, 52 (46.02%) were in the second trimester while 26 (23.01%) were in the third trimester. Estimated financial losses over a ten year period through annual slaughter of 113 pregnant camels at Sokoto abattoir was eleven million two hundred thousand naira (N11,200,000). It was concluded that Government intervention in camel marketing remain essential particularly in the enforcement of policies relating to sales of pregnant camel for slaughter. Adequate ante-mortem inspection be intensified, literacy campaigns amongst butchers and farmers on the implication on slaughtering pregnant animals be intensified as effort to improve camel production in Nigeria.

Keywords: Seasonal variation, Foetal wastage, Camel, Abattoir.

INTRODUCTION

The dromedary camels are pad-footed artidactyl domestic mammals belonging to the species Camelus dromedaries (Lawal *et al*., 2007). They are important livestock species that adapted to hot and arid environments (Elzubeir *et al*., 2006, Al-Dobaib, 2009). They are used for a variety of purposes(Ghazi *et al*., 2008).Camels are traditionally used for transport and supplementing animal protein for human in terms of its milk and meat (Abubakar *et al*., 2008). Camel milk is a very important source of nutrient for human(Ahmed *et al*., 2010) and

used for curing some diseases (Hassan e*t al*., 2007; Alikhan and Alzohairi, 2011) Camels are increasingly gaining popularity in Africa and indeed Nigeria where they are used as a source of meat (Falope, 1991) and for transportation. Mohammed and Hoffmann (2006) estimated the population of camels in northern Nigeria as 74,360. About 60% of the 74,360 camels' were in the former Sokoto state. Foetal Wastage through the slaughter of pregnant females is probably one of the most destructive practices man has ever used against his own production endeavours (Abassa, 1995). Even though slaughter of pregnant animals is forbidden by law in nearly all countries of the world (ECA, 1988) the practice is still continued. A lot has been written on foetal wastages by different workers in Nigeria, with respect to camel (Ribadu, 1988; Ataja and Uko, 1994; Bello *et al*., 2008), cattle (Oyekunle *et al*., 1992; Ogundipe and Olaifa, 2000; Abdulkadir *et al*., 2008), small ruminants (Ogwuegbu *et al*., 1987). A huge financial loss is incurred annually as a result of result of destruction of thousands of foetuses at the abattoirs. ECA (1988) estimated the economic losses from slaughtering of 17000 pregnant cows in a single year in Nigeria over a ten year period to be about fourteen million US dollars (US $14 million). Ribadu (1988) estimated a financial loss of six million, seventy five thousand (N6,075,000) over a ten year period from destruction of 4,500 camel foetuses annually at Kano abattoir. Umaru (1997) reported an estimated annual loss of eight hundred and twenty eight thousand naira (N828,000) from Sokoto abattoir. Similar projection was made by Bello *et al*. (2008) of about ten million naira (N10,000,000) for destruction of 341 foetuses in a year in the same abattoir. Even though a lot had been written on foetal wastage still the problem is persisting. Therefore this work was carried out to quantify the magnitude of wastages of camel foetus at Sokoto abattoir across different seasons.

MATERIALS AND METHODS

Sample Collection and Analysis

From May 2009 to April 2010 a total of 113 camel foetuses were collected on a daily visit from slaughtered pregnant camel dams at Sokoto abattoir for this study. The foetuses were collected immediately after slaughter from the uteri of the slaughtered dams. They were properly identified as male or female foetuses by physical examination of their genitalia and data were compiled and analyzed using proportional (percentage). Economic loss was estimated as described by Ribadu (1988).

Foetal Age Estimation

The age of the foetuses were estimated using a formula (GA = (CVR +23.99)/0.366) as described by Elwishy *et al*. (1981).

RESULTS

Number of camels slaughtered

A total of 3366 camels were slaughtered between May 2009 to April 2010 in the Sokoto abattoir out of which 1741(51.72%) were males and 1625 (48.25%) were females (Table 1).

Number of pregnancy

Of the 1625 female camels examined 113 (13.42%) were pregnant when slaughtered (Table 1).

Foetuses recovered and their sexes

Out of the 113 foetuses recovered 120 (55.05%) were males, 85 (38.99%) were females, while 13 (5.96%) their sexes were not recognized (Table 2).

Table 1: Number of Camels slaughtered at Sokoto metropolitan abattoir between May 2009 to April 2010

Month	Number of Camels slaughtered		
	Male	Female	Total
May	119	131	250
June	135	131	266
July	124	98	222
August	147	111	258
September	148	111	259
October	178	103	281
November	186	94	280
December	141	130	271
January	158	163	321
February	133	153	286
March	133	204	337
April	139	196	335
Total	1741 (51.72%)	1625 (48.25%)	3366 (100%)

Table 2: Total number of foetuses recovered from pregnant female camels slaughtered at Sokoto abattoir between May 2009 and April 2010

Month	Male	Female	Sex not determined	Total
May	4	6	1	11
June	5	4	0	9
July	6	5	0	11
August	3	2	0	5
September	2	3	1	6
October	5	2	1	8
November	2	4	0	6
December	4	2	0	6
January	5	3	1	9
February	4	3	1	8
March	7	8	1	16
April	13	5	0	18
Total	60(53.05%)	47(41.70%)	6 (5.3%)	113(100%)

Stages of pregnancy

It was observed that out the 113 foetuses recovered 35(30.97%) were in first trimester, 52(46.02%) were in second trimester and 26(23.01%) were in third trimester (Table 3).

Table 3: First, second and third trimester fetuses recovered from female camels slaughtered at Sokoto abattoir between May 2009 and April 2010

Trimester	Number of fetuses Recovered	Percentage (%)
First	35	30.97
Second	52	46.02
Third	26	23.01
Total	113	100

Wastage across seasons

In the late dry season (January-March) 510 females were slaughtered out of which 65 (12.75%) were pregnant. In the early rainy season (April-June) 458 females were slaughtered and 71 (15.50%) were pregnant. In the late rainy season (July-September) 320 females were

slaughtered out of which 46 (14.50%) were pregnant. In the early dry season (October-December) 327 females were slaughtered out of which 36 (11.01%) were pregnant (Table 4).

Table 4: Foetal wastage across seasons among female camels slaughtered between May 2009 and April 2010

Season	Number of females	Number pregnant(%)
Late dry(January-March)	520	33 (6.30)
Early rainy(April-June)	458	38 (8.30)
Late rainy(July-September)	320	22(6.6)
Early dry(October-December)	327	20 (6.1)

DISCUSSION

The magnitude of the problem of pregnancy wastage in camel in Sokoto can be extrapolated from this study. The total number of camels slaughtered annually at the Sokoto abattoir was 3366 out of which 1625 were females and 7% of this number was pregnant. This number may not be that big but if you multiply it by the expected number from other abattoirs in the country especially Kano and Maiduguri where the slaughter is almost twice that of Sokoto (personal communication), the economic loss may be enormous. The number of pregnancy wastages in camel in this study is low compared to the previous reports of 49.64% in Kano abattoir (Ribadu, 1988), 23.99% (Bello *et al*., 2008) in Sokoto abattoir and 34.2% in Maiduguri abattoir (Abubakar *et al*., 2010). However, camel foetal wastages in this study were low compared to previous reports in other animal species: 50.9 % of cattle in Zaria (Ojo *et al*., 1978), 22.1% of cattle in Cameroun (Ndi *et al*., 1993). But the finding was higher than reported for cattle, 5.55% (Ogundipe and Olaifa, 2000), 3.9% (Abdulkadir *et al*., 2008) and 5.01% (Cadmus and Adesokan, 2010). The most likely reason for lower number of wastages in the present study compared to some previous reports may be the increase in awareness that might have been enhanced by veterinary services and also awareness on the part of farmers. Lower number of wastage reported previously, compared to the present study, may be due to the fact that little or no camels were considered for meat in the past. With the current increase in the contribution of camel meat to the daily animal protein requirement (Agaie *et al*., 1997), which could be responsible for slaughter of more camels, this figure has the tendency to increase as envisaged previously (Bello *et al*., 2008). That the proportion of male camels slaughtered was found to be higher (P>0.05), than females. This finding is similar to that of Garba *et al*. (1992), Ndi *et al*. (1993) in cattle in Sokoto and Cameroun. The present study differed from the findings of Bello *et al*. (2008) in camel in Sokoto in which more females were found to be slaughtered than males. It was suggested to be due to higher demand of males for use in traction which translated into higher cost; such that butchers go for cheaper females in order to maximize profits.

In relation to season, it was observed that more females were slaughtered in the late dry season followed by early rainy season. However, the highest percentage of foetal wastage was in the early rainy season and least in the early dry season. The trend of females slaughtered in the late dry season was similar to the findings of Boeckm *et al*. (1974), Germen (1975), and Abdulkadir *et al*. (2008) in cattle. This trend was attributed to the fact that the periods were characterized by drought and hunger which exposed animals to poor nutrition and diseases. To forestall losses due such disasters, farmers sell their animals. Also cost of treatment against helminthes during early rainy season may be some of the reasons of selling their animals. Higher foetal wastage during early rainy season, followed by late rainy season was similar to the findings of Ojo *et al*. (1978) in cattle.

It was observed in the present study that there were more male foetuses recovered than female foetuses, although the difference was not statistically significant (P>0.05) .The average sex ratio (male to female) of recovered foetuses in this study was 53.05% to 47.70%.

This varied from the observations of Shalash (1965), Ribadu (1988), Umaru (1997) and Bello *et al*. (2008) who obtained 47.48% to 52.52%, 47.2% to 52.8%, 47.48% to 52.52% and 47.76% to 52.24% male to female ratio, respectively. In this study, it was observed that of the 113 foetuses recovered, 30.97% were in the first trimester, 46.02% in the second trimester while 23.01% were in the third trimester. These suggested that most of the farmers were aware of the pregnancy of their animals before slaughter because 69.03% of the animals were in advanced stages of pregnancy (second and third trimesters), as such the pregnancy could easily be diagnosed without much difficulty.

In the present study, the results obtained showed an estimated financial loss over a ten year period by the slaughter of 113 pregnant camels at Sokoto abattoir in a year to be as high as eleven million two hundred thousand naira (N11,200,000). These estimate was lower than what was reported by Bello *et al*. (2008) which was N24,960,000, but higher than what Umaru (1997) reported which was N 828,000 in the slaughter of pregnant camels from the same abattoir. Similar projection of about N6,000,000 was made by Ribadu (1988) from the wastage of 4,500 camel foetuses in Kano abattoir. Furthermore, ECA (1988) estimated the economic losses from the slaughtering of 17,000 pregnant cows in a single year in Nigeria over a ten year period to be about fourteen million dollars ($14,000,000).

CONCLUSION

The financial loss due to slaughter of pregnant camels nationwide is worrisome and this may likely continue so long as consumption of camel meat is on the increase. The Government intervention in camel marketing remains essential particularly in the enforcement of policies relating to sales of pregnant camel for slaughter. Adequate ante-mortem inspection be intensified, literacy campaigns amongst butchers and farmers on the implication on slaughtering pregnant animals also intensified as efforts towards improvement of camel production in Nigeria.

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Original Article

Development of GIS-based Ecological Carrying Capacity Assessment System

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ABSTRACT

Earth ecosystems cover about 28% of our planet, but only 25% of these ecosystems are green, while the remainders are characterized by sparse vegetation cover that shows the color of the soil beneath. Much of the sparse vegetation is found in arid and semiarid deserts. Using the GIS-based approach, Ecological Carrying Capacity Model of Nutrition Resources (ECCNR) is based on grazing energy intake. This study focused on the identification and analysis of the components of the ECCNR during three years in the Bakkan distinct, located in Southern Iran. The objectives of the study were to identify and describe the current components of the highland range, crop production system, the grazing ruminant production system and their interactions. Based on the study objectives, an approach system was determined to be the best way of recognizing the effects of, and the relationships between the components and modeling and simulating them is the most effective way to study and assess this complex system. Surveys were used as a technique to gather data, from interviews with nomads and the heads of their groups over a period of three years. The observations validate the generalized structure of the ECCNR under the different feeding and production systems, and this model can be coupled with the appropriate models of feeds and feeding systems in rangeland, cropland, and hand feeding systems.

Keywords: Ecological carrying capacity, ecological modelling, grazing energy intake, nutrition resources, southern Iran.

INTRODUCTION

Many studies have recommended that environmental issues be absorbed into project planning and design and to fully incorporate environmental issues in the planning stage itself (Mc Donald and Brown, 1995). Incorporating environmental knowledge into planning contributes significantly to sustainable planning (Leitao *et al.*, 2002). Environmental planning (EP) occurs early in the planning process and can be incorporated into land use planning to address environmental issues. By addressing environmental concerns early in the project development cycle, environmental planning helps to mitigate environmental impacts. Site

development suitability analysis is based on an environmental sensitivity assessment and considers constraining factors for certain developments in the site, for example a wetland of ecological importance or land having high slope. “Suitability levels” are first tested based on individual factors which are later overlaid to indicate overall development suitability. This approach considers existing natural resources at the site and aims to protect environmentally and ecologically sensitive areas. A GIS-based site suitability analysis on the environmental evaluation for urban land-use planning is illustrated for the urban area of Lanzhou City and its vicinity in Northwest China (Dai *et al*., 2001). GIS analysis helps in evaluating large data at landscape and regional level easily and helps decision makers to visually understand the environmental consequences of the project (Badjian, 2005). Environment planning and ecological planning can be incorporated into both large and small scale development projects and will help in choosing the best available land that helps to reduce environmental impacts and preserve biodiversity. Landscape ecological planning can provide a conceptual framework for the assessment of consequences of long-term development processes like urbanization and industrialization on biodiversity components and helps in evaluating and visualizing the impacts of alternative planning scenarios. In recent decades, GIS-based ecological and environmental planning has contributed immensely to sustainable development. GIS based environmental planning is being practiced in many developing nations now like Mauritius (Johnson, 2010) with developed nations already in advanced stages of using GIS in sustainable land use planning. In India, there have been many studies on land use planning for cities (Sudhira *et al*., 2003; 2004), townships, industrial areas, districts (Bobade *et al*., 2010) and watersheds (Chowdary *et al*., 2009).

The GIS- based Ecological Carrying Capacity Model of Nutrition Resources (ECCNR-GIS) software is a new approach based on rangeland assessment and the estimated energy content of forage. This software is derived from following studies on the ecological capacity model of livestock feed resources in Bakkan plain area, Southern Iran (Badjian, 2013). ECCNR-GIS software is designed to calculate the regional ecological carrying capacity based on available forage resources and considers the energy metabolism (ME) requirements in relation to livestock management to estimate the animal needs. ECCNR-GIS software is written in Visual Basic, as a set of mathematical equations that represent a system of relations between production subsystems. The software is based on conceptual models and measurements taken from rangeland, agricultural fields and animal herds of Joobkhale region in Southern Iran. These subsystems include rangeland production as the main forage resource of the region together with farm byproducts that also play a significant role in the area. The current status of the rangelands does not meet the needs of the animal and hence the need to incorporate agricultural crops and residues. The model estimates the amount of energy produced from agricultural residues to determine overall nutritional supplies and carrying capacity (Badjian *et al*., 2003; 2004).

MATERIALS AND METHODS

The production data from rangelands used in ECCNR-GIS software was estimated from plant species derived from digital plots and maps of slope, soil, pasture, palatability class status and trends at a plot level, with digital point location using GPS. Digital plots showed distribution of species in vegetation types. These were used as input information in the GIS environment. After weighing the dried samples, the amount of energy based on dry matter digestibility (DMD) was determined. Available forage AF, ME, DMD and the production rate (P) of species were also estimated. A mathematical relationship between the amount of DMD and ADF (Acid Detergent Fiber) in ECCNR-GIS was established.

In the laboratory, samples were dried and ground and ADF value was measured to estimate the amount o f DMD (Badjian *et al*., 2008).

The software estimated the total energy produced compared with the amount of energy needed for the livestock subsystem in the area. Hand feeding systems of the animals was taken into account for by including rangeland and farm by-products through the calculation of the amount of energy. The software consists of all the relationships of herd type and composition of the herd as well as the relationship between grazing and rangeland, ranging from topography, class, slope class, soil rating palatability of the status (Badjian *et al*., 2004; 2005). The trends in the pasture with the loss of energy are also given in the mathematical equation.

DISCUSSION AND RESULTS

Properly managed grazing is ecologically sustain-able. But because long-term sustainability is linked closely to social values, the greatest challenges to the development and implementation of fully sustainable rangeland agriculture systems are social rather than ecological. As such, rangeland agriculture in the United States and other economically developed countries will continue to be threatened if rangeland agriculturalists do not respond to changing social values in a positive, proactive, and understanding manner. This is in contrast to those regions of the world where economic development is severely limited and current human population is at or in excess of ecological carrying capacity. In those situations, we suggest that it's folly to attempt to develop sustainable agriculture systems, including rangeland agriculture systems, before addressing and rectifying the ecological and social challenges arising from unsustainable human populations.

Introduction of ECCNR-GIS features and its abilities can be described in following outputs:

I- Vegetation layer accompanied with ecological rangeland assessment is based on evaluated digital plots including the type of plant species in each vegetation type, slope, soil, pasture conditions, trends, range and class of palatability. Clearly the greater the number of digital points, is the more accurate the result in a model.

II- Measuring the vegetation-types area is based on the species canopy in plots. A digital vegetation-type area layer is produced in GIS.

III- Based on topography of the region, soil classes can be determined. Compliance with the layer level of the digital environment, GIS, soil surface of each class can be obtained. The digital domain not only shows the location and condition of species on soil, but also in other parts of the region. In other words, the user can determine the state of the soil in the region.

IV- Based on topography of the region, steep class types can be determined. These levels are defined in terms of the classification model. As before, the user can recognize the entire class gradient in the study area that would assist in planning.

V- Domain combination of rangeland condition and trend in digital is defined in ECCNR-GIS. This combination would be compared in determination of the PUF (Proper Use Factor) coefficient. This factor helps the user to determine the combination level of grazing management in the region.

VI - Palatability as a factor in determining the amount of reducing multiple PUF is defined in the placement of digital surface in ECCNR-GIS. This map would help the user to make the necessary decisions for grazing management in the region.

VII - Range of plant-level production based on the different types of digital harvested forage production levels is defined in ECCNR-GIS. Certainly, compared to the levels obtained in the previous steps, this factor would be an important rangeland grazing management decision-making factor.

VIII – Rangeland trending and condition, vegetation class, steep, slope and soil classes are factors that affect palatability and animal preference or PUF in ECCNR-GIS. Domain

information would help the user for the aforementioned factors and optimal management to apply.

IX – Available forage (AF) of the rangeland related to PUF can be obtained in ECCNR-GIS. AF level helps the user to generate an optimal utilization (a maximum of 50% forage production).

X - Determination of metabolic energy (ME) of digitally located species in vegetation types that is based on DMD.

XI - Determination of DMD layout and levels in ECCNR-GIS can be estimated by the ME.

XII - The final ECCNR-GIS output am ME level in digital vegetation map of the region. This map shows the ecological factors that impinge on sustainable ME production with consideration of the region's livestock. This map shows the ecological balance between livestock and rangeland.

CONCLUSION

Work with ECCNR-GIS software is easy and with a little education, most experts familiar with GIS can benefit from it. Changing the input data to the ECCNR-GIS, it can predict, on the basis of a herd of productive resources, provision of productive resources based on vegetation change in circumstances such as drought and subsequent ecological capacity of livestock feed resources in different conditions.

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Original Article

Potentialities of Dairy Production of Local Cattle Raised In Rural Environment In Northern Ivory Coast

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ABSTRACT

Despite significant investment made by Ivorian authorities to develop livestock production since the independence, the local production is dependant to the external production. This study aims to underline the real dairy performances of local cattle breeds (N'Dama, Méré and Métis) raised in rural conditions. The designation ''Métis'' has been given to animals recognized as crossbred, but of unknown parents. Three parameters (Milk production, Duration of lactation and Calving interval) was studied in six rural localities of the northern region of Ivory Coast. The results showed that milk quantity produced by Métis cattle, 262±77 kg were significantly higher than those of the two other cattle. Méré cattle with 223.3±64 of milk, was significantly different from N'Dama breed (193.53±46.76 kg). Quantity of milk produced and duration of lactation were significantly influenced by genetic type (N'Dama, Méré, Métis), age, calving season. But it was not the same case for calving interval. Inadequate natural and technical environment affect the genetic potential of local breeds expression. Adequate management conditions could substantially enhance the dairy performances of local cattle.
Keywords: Local cattle, milk, productivity, breeds expression.

INTRODUCTION

The Ivorian dairy products market is inadequately supplied by domestic production. Ivory Coast is dependent on imports for milk, up to 83 %. In effect, country produces only 17% of its consumption (MPARH, 2012).

Despite significant investment made by Ivorian authorities to develop livestock production since the independence, the local production is dependant to the external production (Atsé and Gbodjo, 1998). In the perspective of self-sufficiency in this field, important efforts have to be made.

Despite their low-use in the dairy system, local cattle breeds presents several advantages, including local cattle breeds which are adapted to the environment (trypanotolerant cattle

breeds), abundant food resources (large areas of natural pastures, forage crops with high yields, abundant agro-industrial products) (Rege *et al*., 1994).

However, a meticulous observation of this sector shows a set of climatic, parasitological and technical disadvantage in animal production (Agyemang *et al*., 1987). Knowing the starting performance, one can easily appreciate the genetic progress that will result from improved local breed animals.

This study underlines the potentialities of local cattle breeding in rural area. Milk production and associated parameters were studied according environmental factors (calving season, cow age, and animal illness)

MATERIAL AND METHODS

Sampling

This study was achieved in some localities of Boundiali, region in the north of Ivory Coast. A river called Bagoue crosses the region from south to north and the accompanying gallery forest represents the main tsetse habitat.

A survey was conducted to identify farming areas where there were tsetse flies. Then, farmers who were selected were sensitized to their participation and collaboration in the achievement of this study.

Thus, animals included in this study are N'Dama, Méré and Métis raised in six (06) rural localities (Nondara, Sissedougou, Ponondougou, Landiougou, Kouto and Kantara). The most common farming system in this region is the traditional sedentary system.

Méré cattle is a crossbreed between local trypanotolerant taurine breeds (Baoulé breed mainly) and zebu breeds mainly originated from Burkina Faso and Mali (Sokouri *et al*., 2007).

The designation ‘‘Métis’’ has been given to animals recognized as crossbred, but their parents are unknown.

The main sampling criterion of a cow was based on the regularly treatment of animals by the herdsman. In total, seven (08) herds distributed in the six localities cited above, were selected. There were two herds of N’Dama cattle in Nondara and one herd in Sissédougou. For Méré Cattle, there were four (04) herds distributed in Kouto, Landiougou, Nondara and Ponondoougou. Métis cattle were only found in Kantara.

All animals monitored under this study were identified by a number marked on both a metal plate to one of the ears and to a plastic plate to the other ear. This precaution was taken to avoid losses which overcome in the different places of grazing.

Data collection

Parasitological data

Hematology

Blood was collected using a capillary tube. A drop is used to make a smear. The capillary tube is then centrifuged for 5 minutes on site. Centrifugation allowed separation of plasma and blood elements. The tube is cut with a diamond pen 1 mm below the BUFFY COAT (plasma interface and red blood cells) to include the red cells. This levy is observed under microscope and can see trypanosomes and microfilariae. The smear is fixed with methanol and stained with Giemsa in laboratory. It serves to determine trypanosome species, Theileria, Babesia and of anaplasma. Observations are done under microscope with an immersion objective.

Coprology

The stool examination was also done in laboratory. Two methods were used; sedimentation method and Mc Master Technique.

Sedimentation method

It consists in searching heavy fluke eggs. A mixture of 3 mg of fecal material in 30 ml of water is made. Then this mixture is mechanically disintegrated. The homogenate is filtered through a sieve opening of 80 microns. The filtrate is centrifuged for 5 minutes, then the supernatant is removed, the pellet is suspended again in a 10 ml conical tube. At each stage the glass and the sieve are washed. The used water is added to the sample. A second centrifugation occurs, and the supernatant removed. Pellet in a drop of methylene blue was added to 1%. The eggs of the liver fluke yellow are visible on the blue background (Troncy *et al*., 1991).

Mc Master Technique

It quantifies eggs of strongyles, Strongyloides, coccidia and tapeworms. The first three steps are the same as sedimentation method. At the fourth step 10 ml of saturated sodium chloride solution must be added to deposit, and then the solution must be homogenized. The Mc Master numbering cell is quickly filled by using a Pasteur pipette. Then you have to let it sit for 5 minutes and count the eggs in two bedrooms (Troncy *et al*., 1991).

Milk production

Each 15 days, very early in the morning (around 06:00), milk was extracted by the herdsman in each herd.

Milk quantity per lactation was estimated by averaging the two monthly milking which was multiplied by the number of days of each month; this gave the monthly quantity of milk. The sum of different monthly quantity of milk over the duration of lactation yields an estimate of the quantity of milk per lactation extracted for human consumption.

All operations performed on animals in the absence of the investigator were recorded on a notebook. Indeed, health treatments, births, deaths and their causes, sales of animals and weaning dates were recorded.

Records concern 43 lactations in Sissédougou and 53 lactations in Nondara for N'Dama cattle. For Méré cattle 75 lactations were recorded in Nondara, 38 lactations in Landioudougou, 30 lactations in Ponondougou and 45 lactations in Sissédougou. There were 127 lactations for Métis cattle collected in Kantara locality.

Calving interval

This parameter is the period between two successive calving. For N'Dama cattle, the sample size was about 98 calving intervals distributed as follow: 45 observations in Nondara and 60 observations in Sissédougou. For Méré cattle, there were 362 records; 144 in Nondara, 73 in Landiougou, 58 in Ponondougou and 86 in Sissédougou. There were 202 calving intervals for Métis cattle.

Duration of lactation

Lactation length is the time elapsed from the beginning to the end of this lactation. This parameter was calculated in 80 cases in N'Dama breed, 190 in Méré cattle and 127 in Métis cattle.

Analysis of data

Data sheets were drawn on the basis of the regularity of their records, and then entered on coded data records before being stored on a database program.

Data verification was performed to find and fix or remove outliers, referring to the field sheets. These steps followed the calculations of different parameters.

Missing data were estimated by taking the value for the month in which the data was missed, the average of milk quantity of the two months that frame this missing data. This estimation does not take into account the lactations with missing data located at the beginning

or end of lactation. Lactations with more than two missing data were not considered in our analysis.

The effects of genetic type, calving season, age, disease, on quantity of milk, and duration of lactation were investigated.

Age was used instead of number of lactation that was not possible to specify, because of the lack of information at this level. Age was divided into three levels: cows under 6 years, from 6 to 8 years, and those over 8 years.

Four (4) calving seasons were identified. (i) The beginning of dry season (from October to December); (ii) the middle and the end of dry season (from January to March); (iii) the beginning of rainy season (April-June); (iv) the middle and the end of the rainy season (from July to September).

Analysis of variance (ANOVA) was used. The effect of disease on milk production and duration of lactation was evaluated with Student test.

Analyzes were performed using SAS (Statistical Analysis System) software, 9.2 versions.

RESULTS

Prevalence of some diseases in the study area

Blood diseases

The overall prevalence of trypanosomiasis was 5.22 %. Three types of trypanosomes were met in the study area; *Trypanosoma congolense* (32.02 %), *Trypanosoma vivax* (47.14 %) and *Tryapanosoma brucei* (20.84%). The season influenced significantly (P <0.05) the prevalence of trypanosomiasis. Indeed, the dry season had the highest prevalence (5.92 %). The effect of locality was also significant (P <0.05) on the prevalence of this disease (Table 1).

Table 1: distribution of prevalence of blood diseases according to locality and season

Variable	Trypanosomiasis	Microfilariosis	Theileriosis
Locality	P = 0.007	P = 0.005	P = 0.223
Kantara	2.45^{bc}	6.96^{c}	30.59^{a}
Kouto	2.45^{bc}	14.14^{b}	34.71^{a}
Landiougou	1.24^{c}	14.34^{b}	36.78^{a}
Ponondougou	9.94^{a}	25.63^{a}	36.85^{a}
Nondara	5.62^{b}	13.83^{b}	34.82^{a}
Sissédougou	4.59^{bc}	10.99^{b}	35.28^{a}
Season	P = 0.031	P = 0.018	P = 0.042
Dry season	5.92^{a}	13.14^{b}	35.9^{a}
Rainy season	4.54^{b}	15.26^{a}	32.89^{b}

In each column the means with the same letter are not signicantly different at α=0.05

The prevalence of microfilariosis was significantly different (P <0.05) from a locality to another. The season also had a significant effect (P <0.05) on the prevalence of this disease. The rainy season is very favorable to this disease. However, for theileriosis, it is the dry season which is very favorable to the disease (Table 1).

Babesiosis and anaplasmosis are very rare diseases in the region. Indeed, over the period of this study, there were only two cases of animals carrying *Babesia spp*. and not of animals hosting *Anaplasma spp*.

Gastrointestinal diseases

The rainy season is very crucial for gastrointestinal diseases, especially for strongylosis, coccidiosis and fascioliasis (P <0.05). However, the effect of season on Strongyloidiasis was not significant (P <0.05). The effect of locality is highly significant (P <0.001) for ascariasis and significant for fascioliasis (P <0.05) (Table 2).

Table 2: Distribution of prevalence of gastrointestinal diseases according to locality and season

Variable	Strongylosis	Strongyloidiasis	Ascariasis	Coccidiosis	Fascioliasis
Locality	P = 0. 304	P = 0.102	P = 0.004	P = 0.218	P = 0.036
Kantara	43.14[a]	13.77[a]	32.38[a]	32.38[a]	10.13[a]
Kouto	49.27[a]	5.70[a]	1.91[b]	32.57[a]	5.29[b]
Landiougou	44.15[a]	9.04[a]	2.09[b]	39.19[a]	1.81[b]
Ponondougou	41.90[a]	3.04[a]	29.12[a]	29.12[a]	14.36[a]
Nondara	44.49[a]	4.78[a]	0.78[b]	34.04[a]	10.37[a]
Sissédougou	35.69[a]	5.19[a]	30.95[a]	30.95[a]	3.72[b]
Season	P = 0.004	P = 0.315	P = 0.006	P = 0.004	P = 0.027
Dry season	36.29[b]	4.90[a]	11.95[b]	27.10[b]	6.92[b]
Rainy season	48.82[a]	7.14[a]	20.11[a]	37.14[a]	11.56[a]

In each column the means with the same letter are not signicantly different at α=0.05

Milk production

The effect of breed on milk production was significant. Indeed, milk quantity produced by Métis cattle, 262±77 kg was significantly higher than those of the two other cattle. On another hand, Méré cattle with 223.3±64 kg of milk, was significantly different from N'Dama breed (193.53±46.76 kg). The analysis of the evolution of milk production within a monthly lactation showed that daily milk quantity of Métis cattle was significantly higher than quantities of milk produced daily by Méré cattle and N'Dama breed (Figure 1).

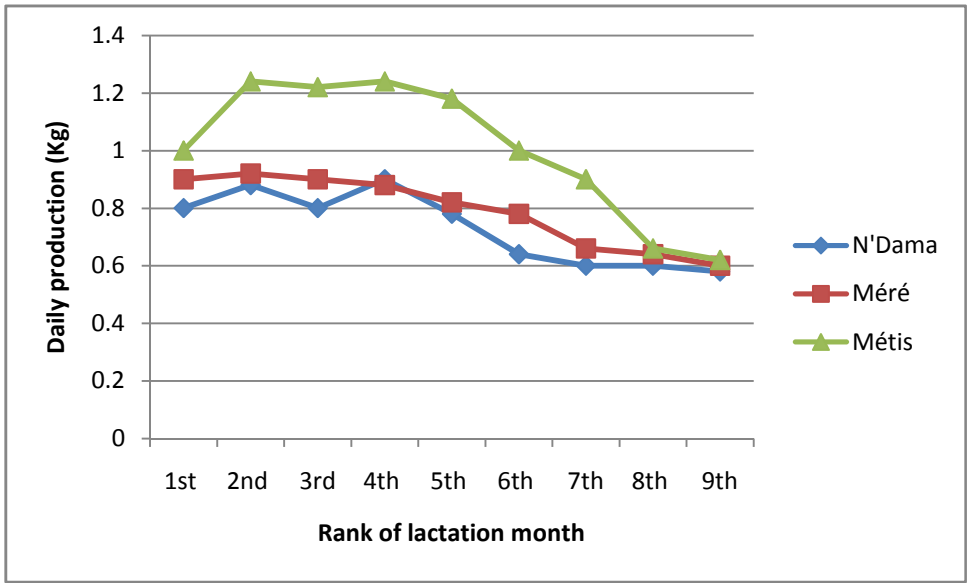

Figure1: Evolution of daily milk production according to genetic type

The effect of age on milk production was not significant in Méré and Métis cattle. However, age had a significant effect in N'Dama. The milk quantity produced by cows aged from 6 to 8 years, was significantly the highest; 211.3±72 kg.

They were followed by animals aged from 2 to 6 years with 184.7±53 kg of milk produced. The last group was composed of animals of age greater than 8 years (161.9 ±47 kg). Beyond 8 years, the quantity of milk declined.

The effect of calving season was significant in Metis cattle. But it was not significant in N'Dama breed and Méré cattle. In Métis cattle, calving beginning in the rainy season (from April to June), corresponded to the highest lactations (Figure 2).

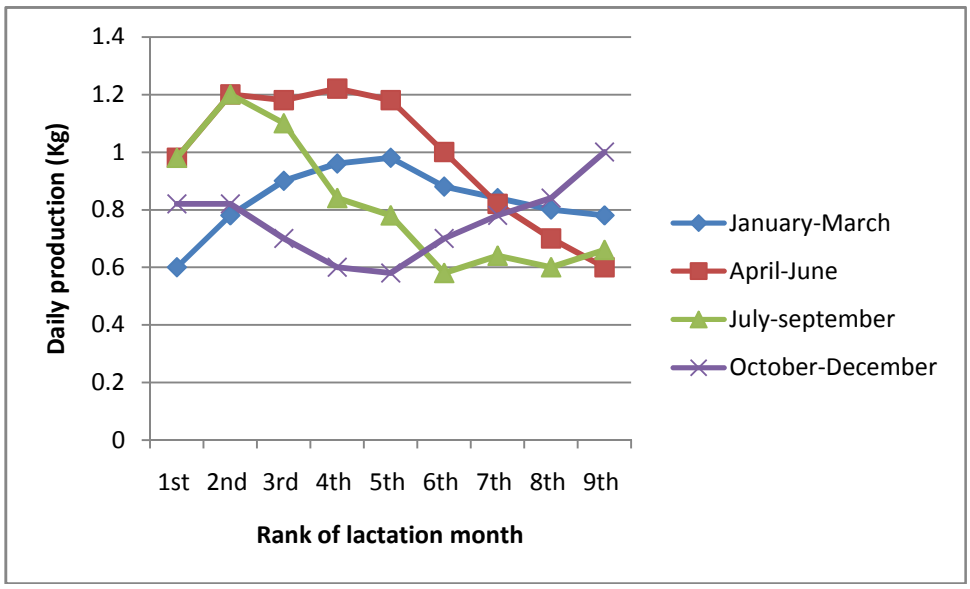

Figure 2 : Evolution of daily milk production according to calving season

The available data showed that theileriosis and microfilariosis had no significant effect on the total quantity of milk per lactation. Indeed, milk production from animals of which the test for these diseases were positive, was not significantly different from the quantity of milk from the other animals (Table 3).

Table 3: Effect of disisease (microfilariosis and theileriosis) on total lactaion

Breed	Healthy animals		Diseased animals		t observed	t excepted
	Lactation (kg)	Nbr	Lactation (kg)	Nbr		
N'Dama	138.79±17.74	2	210.19±48.03	9	1.873 ns	2.262
Méré	217.84±22.54	3	240.35±56.44	9	0.614 ns	2.228
Métis	258.86±22.87	7	257±68.88	11	0.0725 ns	2.179

Lactation: quantity of milk; Nbr: Number of animals; ns: Not significant; t: Student test; α=5%

Duration of lactation

Métis cattle had lactation length (310±53 days) significantly more important than duration of lactation from Méré catlle and N'Dama breed. In addition the lactation of Méré (290±38 days) cattle was significantly longer than the N'Dama one (277±28 days).

The effect of cow age on lactation length was not significant. There was nevertheless an observed trend. It showed that the duration of lactation decreased with age (Table 4).

Table 4: Effects of calving season and age on lactation length (days) in each genetic type

Calving season	N'Dama	Méré	Métis	Age (year)	N'Dama	Méré	Métis
Jan-March	272.5±48	285±48	296±35[b]	< 6	268±36	287±41	309± 42
April-June	280±42	293±47	322±39[a]	6<Age<8	266±23	280±38	296±36
July-Sept	273±45	289±52	310±46[a]	> 8	270±40	289±45	287±32
Oct-Dec	271.5±36	288±50	285±33[c]	-	-	-	-

In each column the means with the same letter are not signicantly different at α=0.05

The calving season had no significant effect on the duration of lactation in Méré cattle and N'Dama breed. However, its effect was significant in Métis cattle. The calving occurring between April and June recorded the longest lactation (314±39 days), followed by the period from July to September (311±46 days). The dry season recorded shorter lactations (Table 4).

As for milk, effect of disease was not significant over the period of lactation (Table 5).

Table 5: Effect of disisease (microfilariosis and theileriosis) on duration of lactaion

Breed	Healthy animals		Diseased animals		t observed	T excepted (5%)
	DL (day)	Nbr	DL (day)	Nbr		
N'Dama	259±22	2	271±24	9	1.620 ns	2.262
Méré	294±15	3	268±23	9	1.665 ns	2.228
Métis	312.5±15	7	307.5±36	11	1.719 ns	2.179

DL: Duration of lactation; Nbr: Number of animals; ns: Not significant; t: Student test; α=5%

Calving interval

The effect of Genetic type on this parameter was not significant. Calving intervals from N'Dama breed (495±132 days), Méré cattle (482±136 days) and Métis cattle (495±135 days) were not significantly different.

The cow age had no significant effect on calving interval. However in each the three genetic types studied, there was a trend showing that intervals were reduced with advancing age (Table 6).

Table 6: Effect of age on calving interval (days) in each genetic type

Age (year)	N'Dama	Méré	Métis
< 6	503±134	487.5±128	497±140
6<Age<8	489±159	475±120	486.5±126
>8	473±125	462±143.5	470±119.5

DISCUSSION

Méré cattle are better than N'Dama breed in perspective of milk production. This clearly shows the contribution of the cross on the genetic potential of animals (Gbodjo *et al*., 2013). Indeed, it has already been shown that dairy performances of N'Dama breed are better than those of Baoulé breed (Coulomb, 1977). However, with input from crossing, the trend is reversed because Méré cattle (crossbreed from zebu and Baoulé) benefit from genetic potential provided by zebu to outperform the N'Dama breed. Therefore, the superiority of Métis cattle suggests that they are from crossing between zebu and N'Dama breed. In effect, in local breeds, for milk production N'Dama breed is superior to Baoulé one. Moreover, milk production of zebu breeds is significantly than those of these local breeds (Sokouri, 2008). Indeed milk production of Métis cattle was significantly higher than the N'Dama and Méré's ones. But this dairy performance is very lower than those of crossbred from N'Damance and N'Dama, 1024.4±468 kg (Gbodjo *et al*., 2013).

The increase lactation with age before 8 years demonstrates a progressive establishment of milk production process. On the other hand, reducing lactation beyond 8 years reveals the negative impact of aging on dairy performance.

The calving season had a significant effect on milk production as indicated by Laoudi *et al*. (2011). The beginning of the rainy season was a favorable period of parturition for good milk production. In fact, cows that calve during this period have an abundant and lush pasture due to the rains return. The period from July to September is the second good season. At this level the right time are short (the end of rainy season). Animals will approach the dry season in difficult supply conditions. This food stress causes a decrease in milk production (Choisis *et al*., 1990; Mouffok and Madani, 2005; Laoudi *et al*. 2011). This result demonstrates that food and water availability are fundamental in milk production. At a few months from calving, energetic needs of cows increase, so they expend a lot of energy in this period of their gestation (Biggadike *et al*., 2001; Enjalbert, 2003; Faverdin *et al*., 2007).

Our data suggest the lack of significant effect of theileriosis and microfilariosis on total lactation. This could be explained by the limited data collected on disease parameter during our study. Indeed, several provisions were lacking during the data collection. First, there were very few sick cows that end their lactation, due to the fact that the herdsman stopped milking sick animals for three reasons: (i) to avoid depleting the cows, (ii) devote all milk to the calves, (iii) finally by health concern. This approach is certainly reasonable, but it skewed the results. In addition, when animal was positive for a disease it was automatically kept; that neutralized the action of the disease we wanted to highlight. Also, animals subjected to analysis generally had a benign pathology, so there was a small share of diseases. Milk remains an important source of income for the herdsman. Therefore cows are generally treated in case of illness.

In addition, the prevalence of trypanosomiasis in animals followed in this study was low, which showed that animals were treated. This result is not an isolated case. Analyses by CIPEA (1992) in Gambia in similar conditions showed that the effect of trypanosomiasis is low on milk production (non-significant effect of the disease on the total lactation). The fact that the PVC does not have an effect on lactation is certainly due to the same reasons.

Local breeds are recognized to be low milk producers. In the government ranch of Nioronigué in Ivory Coast, N'Damance cattle (crossbreed from Montbéliarde and N'Dama) produced an average of 5.5 kg/day of milk. The milk production of N'Dama breed was only 2.25 kg/day (Coulomb, 1977). For technical constraints, the results showed that a cow produces average 0.698 kg /day of milk in N'Dama breed.

The improvement of the mode of management (adequate veterinary care, nutritional supplementation, etc.) can significantly contribute to the improvement of milk production. Indeed, it has been shown that there is an interaction between genetic potential and production system (Kolver *et al*., 2002; Buckley *et al*.; 2005; Horan *et al*., 2005; Mc Carthy *et al*., 2007).

The duration of lactation obtained in this study for N'Dama breed (277±28 days) is much shorter than that obtained in Gambia during 411 days (Agyemang, 1987). This difference might be attributable to the herdsmen. In this study they stopped milking around 9 and 10 months to allow sufficient rest to the cows before their next parturition. This short duration of lactation is offset by a shorter calving interval.

In addition, Métis and Méré cattle have generally duration of lactation longer than N'Dama cattle. This advantage could be explained by the contribution of the cross breeds on the genetic potential of local breeds.

The rainy season records longer lactations because the abundance of grazing at this time helps maintain lactation for a longer time (Mc Carthy, 2007).

Regards to the total milk production, the effect of diseases on the duration of lactation was not significant. Similar conclusion was led by Agyemang (1987) in Gambia, who showed that trypanosomiasis had no significant effect on either the duration of lactation or on the total lactation.

There was a correlation between milk production and calving interval. In fact, animals that achieve high lactation had a longer calving interval. It might be that the herdsmen watching a long rest after heavy productions. Similar results were found in Gambia (Agyemang, 1987).

The average calving interval obtained in the present study in N'Dama breed is lower than that obtained in Gambia (604±160 days) by Agyemang *et al*., (1987). However this average is higher than that obtained in research station in Bouaké, Côte d'Ivoire (Sokouri *et al*. 2010) and in Congo (428 days), (Akouango *et al*. 2010).

CONCLUSION

The results of this study showed that dairy performances of livestock in rural areas are low. The reasons are to be found at the genetic and technical constraints. So the genetic potential expression of local breeds is low due to inadequate natural and technical environment. We

believe that in creating improved management conditions, the performance of local breeds could be enounced. So, herd owners should not consider livestock as a marginal activity but rather as a real business. Nutritional and mineral supplementation must be promoted, and hay must be stored to prevent food shortages during the dry season.

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Short Communication

Evaluation of the Physical and Chemical Properties of Some Agricultural Wastes as Poultry Litter Material

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ABSTRACT

The physical and chemical properties of some agricultural wastes included wheat straw, sugarcane bagasse, sugarcane peat; rice hulls as well as wood sheaving and sawdust as the control were examined for determine their potential as poultry bedding materials. Sugarcane bagasse and peat compared to other materials had greater initial moisture content ($P<0.05$) and there were no significant difference between other materials. The highest and lowest water holding capacity (WHC) was related to sugarcane peat (548.14%) and rice hulls (116.70%), respectively ($P<0.05$). Water releasing capacity (WRC) was significantly affected only in two hours after socking the materials in water so that the highest and lowest WRC were related to rice hulls (6.03%) and peat (1.75%), respectively ($P<0.05$). The highest and lowest pH values were related to peat (7.26%) and sawdust (4.60%), respectively ($P<0.05$). The highest and lowest bulk density were related to sawdust (182.51 kg/m^3) and bagasse (46.28 kg/m^3), respectively ($P<0.05$). The highest and lowest nitrogen (N) percentage values were also related to wheat straw (0.39%) and sawdust (0.01%), respectively ($P<0.05$). In conclusion, rice hulls due to its favorable properties could be successfully used as alternative poultry litter material. Peat was not a satisfactory material for applying as poultry bedding. In contrast to peat, bagasse due to similar properties to straw seems to have good potential for using as poultry litter material.

Keywords: Agricultural waste, physical and chemical properties, litter, poultry.

INTRODUCTION

Although rearing the meat poultry in cage systems has recently attracted a lot of attention, however, some of the meat poultry stocks particularly broiler chicken still grow up on the floor of the poultry houses with a substrate known as litter material as poultry bedding. The recent trend in poultry industry has increased the demand for litter materials. Litter serves a number of important functions, such as absorbing moisture of excreta, reducing contact

between birds and manure, insulates chicks from the cooling effects of the ground and provide a warm and sponge like bedding for instinctual and well-being needs such as soil scratching, dust bathing and search for food and normal behaviors (Grimes *et al*., 2002; Lacy, 2002). Litter management is one of the important management practices would be consider by poultry growers to overcome some problems associated with litter such as wet litter, ammonia and odors emissions, incidence of carcass lesions, etc. In this regard, the selection of litter material type, quantity and qualityand availability of that have an important role in controlling environment within poultry house and bird performance (Lacy, 2002; Garcês *et al*., 2013).

Research in identifying potential sources of materials for application in poultry litter is necessary because of their direct impacts on poultry welfare, health and performance. In addition, it's easy availability and costs of the material finally is the main determinant of choice and their application as poultry litter (Grimes *et al*., 2002). Effects of different litter materials on poultry are related to its chemical and physical properties. For efficient use of the material as bedding, materials must be dry, dust and pathogen free, fragile, appropriate particle size, high capacity to absorbing and releasing moisture, non-toxic, etc. (Brake *et al*., 1992; Grimes *et al*., 2002).

In general, each material with properties listed above can be satisfactorily used as litter material, but approximately we can’t find a material that meets all of the above characteristics.

Furthermore, it must be compatible as a fertilizer or animal feed after it has served its purpose in the poultry house (Lacy, 2002). Therefore, litter quality, bird performance and carcass quality is considerably influenced by these materials (Malone *et al*., 1982). Wood shaving is the most common and effective litter material used by the poultry industry for many decades in the entire the world (Brake *et al*., 1992; Grimes *et al*., 2002). Appropriate properties such as particle size, absence of dust, bulk density, thermal conductivity, quick drying rate, and compressibility make wood shavings an ideal litter material for poultry.

Nevertheless, both softwood and hardwood shavings have become increasingly expensive and difficult to obtain and they are unavailable in most poultry production areas in the entire world, encouraging researchers to evaluate other litter sources such as agricultural wastes (Grimes *et al*., 2002; Garcês *et al*., 2013). Several alternative materials have been studiedas bedding material (Grimes *et al*., 2002; Khosravinia, 2006; Garcês *et al*., 2013).The fairly inexpensive agricultural wastes such as rice hulls (Hester *et al*., 1985), grains straw (Malone, 1992), leaves (Khosravinia, 2006),sugarcane bagasse (Davasgaium and Boodoo, 1997; Watkins, 2001), citrus pulps (Harms *et al*., 1968) and tea refused (Ataputta and Wickramasinghe, 2007) were found to have substantial potential as local and seasonal alternative poultry litter material. For example, corn cobs may be suggested as a litter material source in areas with large quantity of corn cultivation (Smith, 1956; Khosravinia, 2006). The easy availability and relatively low cost of these materials are the important criteria which determine their suitability for applicationin the poultry litter in addition to having the properties listed above.Therefore, in the current laboratory study an attempt was made to compare the physical and chemical properties of some agricultural wastesfor examine their potential as poultry bedding material.

MATERIALS AND METHODS

Sampling

In the current study, four samples from different agricultural waste types included wheat straw, sugarcane bagasse, sugarcane peat, rice hulls as well as wood sheaving and sawdust (Figure 1) were collected from different regions of Khuzestan province, Iran. Wood sheaving was imported from outside the Khuzestan province. Sawdust was obtained from local woodworkoperations. Sugarcane bagasse and peat were received by Karoon Agro-industry Company at Khuzestan province. Wheat straw and rice hulls were obtained from a one of the main areas (Baghmalek city, Khuzestan province) of wheat and rice cultivation.

Figure 1. Materials used in the experiment.

To ensuring the collected material being fresh, an attempt was made to collect materials from the latest cultivation of the crops as far as possible.

Laboratory procedure

A total of 3 subsamples of each collected samples of different materials were examined to evaluate physical and chemical properties included initial moisture content, water holding capacity (WHC),water releasing capacity (WRC), pH, bulk density and N. Because of high moisture content of sugarcane bagasse and peat as received, after determining initial moisture content, were dried for 24 h at room temperature and all of the examinations were performed on dried samples.

Moisture content of the materials was measured using 10 g of sample at 105ºC for 24 h (AOAC, 1994). For determine water holding capacity (WHC), first each sample material was dried and 20 g of sample placed in plastic pans at a depth of approximately 4 cm. Then, the pans filled with water and left them to stand at room temperature (22–24°C) for 60 min. After draining excess water for 3 min, the samples were weighed to determine the percentage of water absorbed on a dry matter basis. To determine water releasing capacity (WRC), in 2 and

24 h intervals after draining the excess water, the samples weighed again and amount of moisture losses in each time period was calculated based on the percentage of moisture released on a dry matter basis.

For pH measurement, 1:10 sample per distillated water was prepared. After 30 min, pH values of each sample were recorded by pH meter (Model 691 Metrohm, USA)until constant values were obtained. The bulk density was determined by the method described by Brake *et al*., (1992). Briefly,a large amount of each material was placed into a measured plastic container and then was shaken until the container was full and packed firmly. Container plus material were weighed and bulk density was calculated for each sample as kg/m^3. N percentage of each material type was determined by Kjeldal procedure according to AOAC (1994).

Statistical Analysis

Data were analyzed according to the ANOVA procedure of SAS software, version 6.12as a completely randomized design. Significant differences among treatments were determined at a 5% probability by Duncan's multiple range tests.

RESULTS AND DISCUSSION

The results of comparing the physical and chemical properties of examined materials are presented in Table 1. Sugarcane bagasse and peat in comparison with other tested materials had greater initial moisture content (P<0.05) and there were no significant difference between other tested materials. One of the important properties of suitable material for litter is that having a least amount of moisture, because high moisture increases the risk of pathogen growth and ammonia production in the litter (Carlile, 1984). According to Al-Homidan *et al*. (2003) litter moisture have a substantial impact on ammonia volatilization compared to other factors such as the type of litter material. Because of high moisture content (>50%) in the sugarcane bagasse and peat, their moisture content should be reduced before using as litter material.

Table 1. Comparison of physical and chemical properties of different materials as poultry litter material

Item	Wheat straw	Sugarcane bagasse	Sugarcane peat	Rice hulls	Wood sheaving	Sawdust	SEM	P-value
Initial moisture (%)	5.02^{c}	41.07^{b}	57.67^{a}	4.98^{c}	7.03^{c}	7.44^{c}	5.20	0.0215
WHC1 (%)	290.24^{b}	348.15^{b}	548.14^{a}	116.70^{c}	141.30^{c}	283.35^{c}	35.66	0.0001
WRC2, after 2 h (%)	3.96^{c}	3.34^{c}	1.75^{d}	6.03^{a}	4.97^{b}	2.30^{d}	0.37	<0.0001
WRC2, after 24 h (%)	48.42	42.38	23.22	47.28	54.46	55.20	2.46	0.093
pH value	6.17^{ab}	6.93^{ab}	7.26^{a}	6.20^{ab}	5.63^{bc}	4.60^{c}	0.25	0.0125
Bulk density (kg/m3)	55.19^{ed}	46.28^{e}	63.48^{b}	108.39^{c}	94.58^{c}	182.51^{a}	11.23	<0.0001
Nitrogen (%)	0.39^{a}	0.27^{c}	0.34^{b}	0.18^{d}	0.07^{e}	0.01^{f}	0.033	<0.0001

WHC: Water Holding Capacity
WRC: Water Releasing Capacity
^{a,f} Columns with different letters are significantly different (P < 0.05).

Water releasing capacity (WRC) was significantly affected only in two hours after socking the sample materials in water so that the highest and lowest WRC were related to rice hulls (6.03%) and peat (1.75%), respectively (P<0.05). Davasgaium and Boodoo (1997) reported that different litter materials have a varying capacity in absorbing and holding the moisture.In the present study, the highest and lowest water holding capacity (WHC) was observed in

sugarcane peat (548.14%) and rice hulls (116.70%), respectively (P<0.05). Sugarcane bagasse and peat have absorbed 3 and 5 times to their initial weights, respectively, while, absorbed moisture for rice hulls was 1 times to its initial weight.

Malone *et al*. (1982) found that moisture absorbing capacity of materials was an important factor in evaluating litter materials, whereas, Ruszler and Carson (1974) reported that moisture releasing capacity is a more important factor than moisture absorbing capacity. Particle size of litter material affects moisture releasing capacity of litter. Litter materials with smaller particle size have a little tendency to absorb and maintain the moisture (Ruszler and Carson, 1974). Adhesion of the particles of litter material to each other influenced by physical form and amount of absorbed moisture of different materials which finally affects amount of releasing moisture capacity (Brake *et al*., 1992).

WHC and WRC values of wheat straw and bagasse were relatively satisfying. Although wood sheaving is a good material with appropriate water absorbing capacity, in comparison to other tested materials except rice hulls, had lower WHC, but like rice hulls was better than other materials in WRC. Garcês *et al*. (2013) with evaluating some agricultural and ground materials found that the WHC of both sand and coconut hulls was lower and that of grass was higher than wood sheaving. Sawdust in spite of appropriate WHC properties was not suitable inWRC which was in contrast to results of Ruszler and Carson (1974). However, it is necessary to note that not only particle size, but also other factors might have an influence on WHC (Ataputta and Wickramasinghe, 2007). Differences in WRC between sawdust and peat which had similar particle size, probably was due to other physical properties of these materials.

The highest and lowest pH values were related to peat (7.26%) and sawdust (4.60%), respectively (P<0.05). It is reported that the low pH level of litter material has an advantage because in acidic pH of litter, the conversion of uric acid to ammonia will be reduced (Moore *et al*., 1996). Typical wood sheaving and sawdust have a pH ranged from 5 to 5.6 whereas, the pH of rice hulls is around 7.03 (Coufal *et al*., 2006).The highest and lowest bulk density values were related to sawdust (182.51 kg/m^3) and bagasse (46.28 kg/m^3), respectively (P<0.05).

Amount of needed litter material for poultry rearing is usually calculated based on depth and height (for example 5 or 10 cm) of litter. Hence, based on difference in bulk density of litter materials, there is need to use a various amounts of litter materials. Obviously, whatever the bulk density of a material is greater; much more of that material will is needed. The lower bulk density of a material shows high porosity in these materials and moisture absorbing capacity, air circulating and moisture releasing capacity will be better (Ataputta and Wickramasinghe, 2007). The highest and lowest N percentage values were related to wheat straw (0.39%) and sawdust (0.01%), respectively (P<0.05). Zifei *et al*., (2007) reported a relationship between N content of litter material and higher ammonia production from litter. While in another study reported that, having higher N content in litter material, the value of poultry litter as an organic fertilizer and ruminant feed may be higher. Although it does not appear that the nitrogen content of the bedding material has a major effect on the ammonia production, whereas, physical form and differences in the absorption and releasing of moisture had a substantial effect on the ammonia emissions (Ataputta and Wickramasinghe, 2007).

CONCLUSION

According to the results obtained from the current study, it is concluded that among the examined materials, rice hulls due to its favorable properties could be successfully used as poultry bedding. Peat was not a satisfactory material for bedding and it seems that other usages such as ruminant feeding would be considered. In contrast to peat, bagasse due to similar properties to straw seems to have good potential for using as a litter material. Watkins (2001) reported that growth performance of broiler chickens reread on bagasse litter were similar to those reread on wood sheaving litter. However, because of low cost and availability of this material in the countries with extensive cultivation of sugarcane as well as study of its direct impacts on birds and environment within poultry houses more research is needed.

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Original Article

Effect of Feeding Roselle Seeds (*Hibiscus sabdariffa* L.) on Some Reproductive Traits of Desert Sheep

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ABSTRACT

Roselle (*Hibiscus Sabdariffa* L.) is a medicinal plant known in Sudan as Karkadeh, which grows successfully in the tropics and sub-tropics, mainly for the production of calyces and epicalyces. This experiment was conducted to evaluate the influence of feeding Roselle seeds on rams' semen characteristics and level of blood estrogen compared with groundnut cake feeding. Nine males of Sudanese desert sheep were allocated to (3) treatments (control group (A), test group (B) and castrated group (C). While the (12) ewes were divided into two groups (control group and test group). Each ram of group A and group B mated with 3 ewes of the experimental females. Group A and C fed with groundnut cake, while group B fed with Roselle seeds .The results showed significant differences ($P<0.05$), in daily feed intake (DFI), average daily gain (ADG) and Feed conversion ratio (FCR) among the experimental groups for rams fed on crushed Roselle. The study showed significant differences ($P<0.05$) among the treatments in semen characteristics (semen volume, motility, sperm morphology and concentration). The study showed significant difference ($P<0.05$) among the treatments in serum estrogen levels. According to the results, Karkadeh (*Hibiscus sabdariffa* L.) seeds had an adverse effect on semen characteristics that might be due to the presence of estrogen in the (*Hibiscus sabdariffa* L.).Based on the current study it is not recommended to use Roselle seeds as an alternative source of protein for reproductive male animals. Roselle seeds could be used for the purpose of fattening of animals.

Keywords: sheep, Roselle seed, reproductive traits, castration.

INTRODUCTION

Sudan is a large country, covering an area of more than 1.850 million square kilometers. The livestock sub-sector in Sudan provides a livelihood for about 14% to 20% of the population; it is concentrated in the Western Sudan States, which have about 39% of the

countries. Livestock in the Sudan satisfies the internal demand and leaves substantial excess for export, which represents about 22% of the country's total exports. Livestock industry has great importance to Sudan economy as it is one of the main sources of food, employment and foreign currency (M.A.R.F., 2008). In recent years, Sudanese sheep namely Sudan desert ecotype, has received great interest as an export commodity to the Arab countries. In the year of 2000 – 2001 for example, sheep exports has contributed with 261.34 million dollars to the national exchange earning at an annual off take rate of 21778 head (M.A.R., 2002).

Sudan Desert sheep tend to breed at certain periods of the year in such a way that lambs are dropped when range fodder is at its best. A few ewes may miss the traditional breeding season and breed in the rainy season to lamb in winter. Some ewes occasionally divert their breeding time to the late of September and October. If allowed to remain in the flock they would lamb during the period of feed and water shortage which lasts from February to May. The off-season ewes are usually identified in early pregnancy and sold for slaughter. To avoid these occurrences, mating is obstructed with the use of a device called a "Kunan". This is a double-looped string fixed around the neck of the scrotum and the neck of the ram's sheath to prevent-the penis from emerging. *Hibiscus Sabdariffa* is a herb belonging to the *malvaceae* family and it is cultivated for leaf, fleshy calyx and seed (Dalziel, 1973)**.** Hibiscus anthocyanin, a group of phenolic natural pigment, present in the dried flower of *Hibiscus sabdariffa* and *Hibiscus rosasinensis*, have been found to have cardio protective hypocholesterolemic, anti-oxidative and hepatoprotective effects in animals, genital tract (Olaleye, 2007)**.** Gaya *et al*., (2009) reported that a preliminary phytochemical screening of the ethanolic seed extract of *Hibiscus sabdariffa* revealed the presence of alkaloids, saponins, tannins, anthraquinones, steroids, cardiac glycosides, flavonoids and phlobatanins. They reported that the lactogenic effect of ethanolic seed extract of *Hibiscus sabdariffa* was investigated by administering extract and metoclopramide in albino rats. Okasha *et al*., (2008) reported phytochemical alkaloids, cardiac glycoside, deoxy sugar, flavonoids, steroidal ring and tannin concentration were moderate, moderately low, high and low respectively when they studied the effect of aqueous *Hibiscus sabdariffa* seed extract on serum prolactin level of lactating female albino rats.

Hibiscus sabdariffa locally known as karkadeh grows successfully as a cash-crop in western Sudan appears to have a great food value and pharmaceutical potential not fully exploited (Karamall's personal communications). Sudan is known to be the world's major supplier of Karkadeh. The Roselle seeds, which are the subject matter of interest in this study, are just a by-product of the crop and its total production is increasing steadily, as a result of increased international demand.

The Roselle seeds have a good potentiality as a new source of vegetable oil and protein (AL–Wandawi *et al.,* 1984). The objective of this study to evaluate the influence of feeding Roselle seeds compared with groundnut cake on sheep's semen characteristic and level of blood estrogen.

MATERIALS AND METHODS

Management of experimental animals

Nine rams of Sudan Desert sheep (ecotype Shugur) at age of 7-8 months, with average body weight of 41.9 kg , and Twelve ewes of Sudan Desert sheep, ecotype Shugur, within age range of 2-3 years with average body weight of 30.13 kg were purchased from Maatoug area, Gezira State – central Sudan. Animals were vaccinated against anthrax and hemorrhagic septicemia, injected with antibiotic as prophylactic measures, dipping in Gamatox solution against external parasite and drenched with broad-spectrum antihelmntic against internal parasite. All animals were allowed to have adaptation period for two weeks, during which they were fed complementary feed (60% concentrate and 40% roughages).The experimental 9 male animals of Sudanese desert sheep were divided into (3) groups each was allocated to one

of the treatments (control group, test group and castrated group), while the (12) ewes, were divided into two groups (control group and test group).

Housing

The experimental sheep were lodged in a semi opened house 7×9 meters enclosed with corrugated zinc set over a half – meter brick wall. The roof was made of corrugated metal sheets, sloping from the middle (3m height) to the sides (2.5m) and supported with metal pipes.The floor was made of concrete with reasonable inclination for drainage. House was partitioned internally to 10 pens (1.5×2 m.). Each pen had a separate door and adequately equipped with watering and feeding facilities.

Experimental diets

Two experimental rations were formulated as complete formula feed, utilizing Roselle crushed whole seed and groundnut meal as a protein sources (Table 1). The experimental diets were labeled A (control) and B (contained Roselle seeds). Ingredients used to formulate the rations were based on sorghum grain, wheat bran, groundnut hulls, molasses and urea. Mixing of the experimental rations was done manually after weighing the recipe. The experimental diets were formulated iso-energetic and iso-nitrogenous to meet or exceed the nutritional requirements of sheeps. The dry small quantity ingredients were mixed first then finally with the molasses with urea. Table 2 shows the chemical composition of the experimental diets. The experimental feeding extended for 10 months.

Table 1- Experimental rations composition (% fresh basis)

Ingredients%	Rations	
	A	B
Roselle seed meal	00.00	30.00
Groundnut meal	20.00	00.00
Dura grain	40.00	30.00
Wheat bran	15.00	10.00
Molasses	10.00	15.00
Groundnut hulls	10.67	10.20
Urea	00.33	00.80
Oyster shell	02.00	02.00
Nacl	02.00	02.00

Table 2- Chemical composition (% dry matter basis) of experimental rations

Item	Rations	
	A	B
Dry matter	91.24	92.52
Crude protein	23.26	22.33
Crude fiber	20.74	22.88
Ether extract	5.68	7.30
Nitrogen-free extract	20.44	16.77
Ash	10.32	12.50
Energy (MJ/Kg DM)	10.80	10.74

Data collection

Performance

Feed intake (kg/group) was recorded on daily basis by difference between feed offers and residues. Weekly body weights of individual animals were recorded to the nearest 0.5 kg once weekly at 8:00 a.m. before feeding. Feed conversion ratio was calculated weekly as: feed intake/weight gain.

Blood serum

Blood samples were collected from each animal. For male blood, samples were collected biweekly for two months at four occasions and for female, samples were collected at 14 days interval for 6 months (period 1, period 2 and period 3). The blood samples were collected via jugular vein using sterilized 5ml syringes into heparinized tubes for serum separation.

Estrogen determination

Estrogen level of experimental animal serum was determined by using estrogen kit according to Abraham (1975). One ml of reagent with 100 pg/ml four assays were set up simultaneously and incubated for varying periods at 37ºC and then reading the level of estrogen in the tubes.

Semen characteristics

Three rams were selected and fed till reached the age of maturity and trained for semen collection. The volume of the ejaculate was read directly from a graduated collection tube. Individual forward motility was estimated by examining one drop of semen, diluted in 3.8% sodium citrate solution, under a microscope (10×40).

The number of spermatozoa per cubic millimeter was counted using a haemocytometer. A 0.05 ml of semen was drawn into the pipette. A small bubble of air was drawn into the tube. The tube was filled with 3% normal saline to reach 1.01 ml. Then, the dilution pipette was agitated gently for one minute. A haemocytometer was prepared by placing cover slip on ruled filed and a drop of diluted semen was allowed to run under the glass cover and sperm cells were left to settle. The counting was made under (40x) magnification.

Five large squares each one containing sixteen smaller squares was counted (corner and middle chamber). Dead spermatozoa was determined by examining 200 spermatozoa in an eosin nigrosine smear and categorizing them into coloured (dead) and non-coloured (alive) cells under a microscope at high magnification (10×100). The proportion of morphologically abnormal spermatozoa was also determined by examining 200 spermatozoa in an eosin-nigrosine smear under the same magnification.

Testes and scrotum morphometric

Testicular measurements (scrotal circumference, testicular diameter, and testicular weight) were measured as described in the companion paper (Toe *et al*., 2000).

Chemical analysis

The experimental rations were chemically analyzed according to A.O.A.C (1984). Extracted Roselle seed oil was analyzed to assess phytoestrogen, while the blood serum for level estrogen was determined by using estrogen kit according to Abraham (1975).

Statistical analysis

The data were statistically analyzed analyses of variance by using MSTAT program. T-test has been used for semen characteristics for the two dietary treatments. Also, Duncan multiple range tests was used to detect difference between means (Steel and Torrie, 1980)

RESULTS AND DISCUSSION

Feedlot performance of rams

The feedlot performance results of the experimental rams were shown in (Tables 3**).** The Initial body weight and final body weight showed no significant differences (P>0.05) among the treatment groups (A control, B Roselle seed 30% and C castrated). Group B had the

highest value of daily weight gain and group A and C had the lowest values (P>0.05). The high nutritive value of Roselle seed meal may be due to estrogenic compounds or factors are found generally in malvacaes (*Hibiscus Sabdariffa*). Beshir (1996), Hassan (2005) and Darran (2007) reported a similar trend that agreed with the present results, as they found that the rate of weight gain increased with increased level of the Roselle seed meal, which made subordination of Roselle seed content of estrogenic compounds. The plane of nutrition and the nutritive value of ingredients are the major factors affecting the daily feed intake. The ruminants eat until they reach satisfy, while monogastrics eat to satisfy their energy requirements. Thus as the energy content of the ration increased, the amount required to satisfy a certain nutritional requirements decreased. In the experiment the daily feed intake showed a significant difference (P≤0.05) among the treatments. In this study, Lambs fed ration B (Roselle seed) had the less value of daily feed intake.

These results agreed with Mohammed and Idris (1991), who revealed that the feed consumption in poultry decreased as the level of Roselle seed meal increased, and they attributed that to the acid taste, and to high fat content of Roselle seed meal, while disagree with Salihand Abdelwhab (1990) and Bakheit (1993), who reported that the feed intake in poultry increased as the level of Roselle seed meal increased.Feed conversion ratio (FCR) is an important factor reflecting the nutritive value of the feed and the efficiency of utilization of the feed.

The feed conversion ratio in this study showed no significant differences (P>0.05) among the different treatment groups. The best recordof (FCR) was reported with group B (9.24). Roselle seed as protein source for feeding ruminants showed a similar trend of FCR that increased as the level of Roselle seed meal increased (Beshir, 1996; Suliman, 2004; Hassan, 2005; Darran, 2007).

Table 3- The effect of castration treatment and inclusion of Roselle seed meal replacing partially the dietary groundnut meal on feedlot performance of the rams

Items	Groups			±S.E	Treatment effect
	A Control	B (R.S)30 %	C Castrated		
Initial body weight (kg)	42.65	41.35	42.00	0.40	N.S
Final body weight (kg)	53.81	54.07	52.47	0.40	N.S
Total weight gain (kg)	11.22[b]	13.11[a]	10.81[b]	0.32	*
Daily weight gain (kg)/day	0.19[b]	0.22[a]	00.19[b]	0.0001	*
Daily feed intake (kg)/head/day	02.13[a]	02.02[b]	02.14 [a]	0.01	*
Feed conversion ratio	11.20	09.24	11.21	0.33	N.S

[a, b]Means in a row with differing letters differ significantly (P < 0.05); N.S. not significant. * = P < 0.05.

Testicles and scrotum measurements of experimental rams

Testicles measurements include scrotum circumference, length and weight are shown in (Table 4)**.**The study showed significant differences (P>0.05) among the treatments for final scrotum circumference and testicular final length and weight. Rams fed ration A had the highest values, while the other treatments had the lowest values.

There were no significant differences (P>0.05) between rams fed Roselle seed meal in their diet and castrated rams group. The lower values of testicles measurements of group B might be attributed to the phytoestrogenic factors of Roselle seed. Kurzer and Xu (1997) reported that phytoestrogens had estrogenic compounds found in plants which affect the central nervous system, inducing estrus and stimulating the growth of the genital tract of animals.

Adams, (1995) reported that in Australia and New Zealand sheep grazing on estrogenic clover pasture showed symptoms of (clover disease) a fertility disorder due to changes in the genital tract. However, animals in treatment C had testicle atrophy as a result of castration.

Table 4- The effect of castration treatment and inclusion of Roselle seed meal replacing partially the dietary groundnut meal on scrutum and testicular measurements

Items	Groups			Treatment effect
	A Control	B (R.S)30 %	C Castrated	
Scrotum circumference (cm)	29.33±0.67[a]	26.33±0.33[b]	20.0±0.00[b]	*
Testicular final length (cm)	14.67±0.33[a]	11.78±0.39[b]	9.06±0.05[b]	*
Testicular weight (g)	350±28.87[a]	216±16.67[b]	166±16.67[b]	*

[a, b]Means in a row with differing letters differ significantly (P < 0.05); N.S. not significant. * = P < 0.05.

Semen evaluation

Semen characteristics of the experimental animals were shown in (Table 5)**.** According to Bearden *et al.*, (2004) semen characteristics of the normal spermatozoa are composed of a head and a tail that is divided into mid-piece, main-piece and end piece**.** The study showed highly significant differences (P≤0.01) among the dietary treatments for semen volume, mass motility, abnormal morphology and semen concentration. Treatment A rams had the best values of the good semen characteristics, whereas treatment B rams had the lowest values of the good semen characteristics.

Table 5- the effect of inclusion of dietary Roselle seed meal replacing the groundnut meal on semen of rams

Items	Groups		Treatment effect
	A Control	B (R.S)30 %	
Semen volume (ml)	1.5±0.0[a]	0.89±0.05[b]	**
Mass motility score	4.33±0.33[a]	3.0±0.00[b]	**
Individual motility score	3.67±0.33[a]	3.0 ±0.00[b]	**
Normal morphology (%)	87.0±1.73[a]	72.0 ±1.45[b]	**
Abnormal morphology (%)	13.33±1.76[b]	27.33±1.45[a]	**
Dead sperm (%)	12.33±1.45[b]	21.67±0.88[a]	**
Concentration/ml×10^9	4.06±0.18[a]	3.28±0.9[b]	**

[a, b]Means in a row with differing letters differ significantly (P < 0.01);
N.S: not significant. * *= P < 0.01.

These results recorded may be due to feeding the rams with Roselle seeds meal which contain estrogenic compounds. The average volume of ram semen ejaculate when collected by artificial vagina was about 1.0 ml depending on age and condition of the animals, frequency of collection and skill of operator. Accurate determination of semen concentration is very important for the determination of the dilution rate (Evans and Maxwell, 1987)**.**These results agreed with Darran (2007) who studied the effect of feeding Roselle seed meal on semen characteristic of Sudanese desert rams and Orisakwe *et al.*, (2004) who studied the effect of sub chronic administration of aqueous extract of *Hibiscus Sabdariffa* calyx on rat testes activity.

Estrogen levels in experimental ram's serum

Table 6 showed the estrogen levels in experimental animals**.** The study showed significant differences (P≤0.05) among the treatments for estrogen level in experimental rams serum. The study showed that the level of estrogen concentration increased for those rams of fed Roselle seed meal. The present study findings are in line with the results reported by (Kurzer and Xu, 1997; Adams, 1995; Darran, 2007). They reported that Roselle seed had estrogenic effect when fed to the small ruminants (rams). On the other hand, the study showed no significant differences (P>0.05) among castrated rams and the others fed the control diet.

Table 6- The effect of castration treatment and inclusion of Roselle seed meal replacing partially the dietary groundnut meal on estrogen level in ram blood serum

Items	Groups			Treatment effect
	A Control	B (R.S)30 %	C Castrated	
Level of estrogen with an initial weight.(pg/ml)[1]	12.24±0.13	12.51±0.20	12.09±0.16	N.S
Level of estrogen after two weeks .(pg/ml)	14.22±0.56[b]	17.83±0.91[a]	11.00±0.68[b]	*
Level of estrogen after four weeks.(pg/ml)	17.04±1.73[b]	26.72±1.56[a]	18.13±1.28[b]	*
Level of estrogen after six weeks .(pg/ml)	19.27±0.64[b]	28.77±0.44[a]	17.42±0.53[b]	*

[1]Pg/ml: Pico mol gram/ml[a, b],Means in a row with differing letters differ significantly (P < 0.05); N.S. not significant. *= P < 0.05.

CONCLUSION

Feeding males on Roselle seeds affected the secretion of semen volume and concentration and consequently decreased semen ejaculation. However, males fed on groundnut cake gave good volume, concentration and mass motility (the good semen characteristics) .Therefore, Roselle seed meal is very convenient for feeding castrated males for fatting because it contains high percentage of factors could enhance estrogen which promotes the weight gain and it could be good alternative protein source in sheep diet.

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Review Article

A Review on Dromedary Camel Milk Products and Their Uses

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ABSTRACT

This paper reviewed researches on dromedary camel milk products and their uses. Milk from the lactating camel must provide nourishment for her young calf as well as for human, not a great deal will be left for milk products. Moreover, the composition of camel milk does not allow for making some of the accepted products that are made from cow, sheep and goat milk. Nevertheless, milk products are made from camel milk, and the milk itself is used for purposes other than simply nutrition. Camel products have various names in various parts of the world. In the Caucasus it is called kefir; in Armenia, matzoon; in India, dahdi; in Sardinia, gioddu; in Bulgaria, yoghurt; in Ethiopia, Dhanaan and in Syria, Israel and Egypt, lehben. Some authors describe butter being made from camel milk. While others categorically state that butter cannot be made from camel milk. The preparation of butter from camel milk is not as easy as from milk of other animals owing to its unique milk-fat properties. Soft cheese can be made from camel milk. Camel milk and their product are used therapeutically against dropsy, Jaundice, problems of the spleen, tuberculosis, asthma, anaemia, and piles. In Ethiopia camel milk is considered as having aphrodisiac powers. In Somalia, among the pastoral tribes, it is believed that milk drunk on the night when the camels first drink water, following a long period of thirst, has magical powers**.** We suggest that consumption of camel milk and their products may have remedial effects for many different life-style related diseases.

Keywords: Aphrodisiac power, dhanaan, dromedary, remedial effect.

INTRODUCTION

Milk from the lactating camel must provide nourishment for her young calf as well as for human, not a great deal will be left for milk products. Moreover, the composition of camel milk does not allow for making some of the accepted products that are made from cow, sheep and goat milk. Nevertheless, milk products are made from camel milk, and the milk itself is used for purposes other than simply nutrition. In most pastoral communities, where milk for human consumption is obtained from more than one domesticated species of animal, milk products are made after milk of various animals in mixed. It is often unclear therefore if some

of the products can be made from camel milk alone (Dhal and Hjort, 1976). This is often the case when camel milk is mixed with fresh or churned goat milk (Gast *et al*., 1969). This mixture is made with certain quantities of camel milk added until the required taste is obtained.

Not all communities use camel milk for making products. The milk of the Afar camels in Ethiopia, for instance, is not allowed to be processed (Dhal and Hjort, 1979). On the other hand the milk of the Somali camels in Ethiopia is allowed to be processed into different dairy products for instance butter made from camel milk alone and blending it with goat milk (Asresie *et al.,* 2013). When camel milk is not consumed fresh it must be processed as soon as possible both because its keeping quality seems to be poor and as it is further adversely affected by the climate it soon goes bad if not treated. Many superstitions and beliefs have evolved around camel milk and milking only specific members of the family can graze the animals and the milk is considered as having medicinal as well as mystical properties (Hartley, 1979). Therefore, this manuscript Endeavour's to present a detailed discussion on dromedary camel milk products and their uses.

CAMEL MILK PRODUCTS

Fermented milk products

Under warm conditions raw milk does not keep for long and actually its fermentation appears to be a means to preserve it not only for a limited period of time. Fermented products have various names in various parts of the world (Aggarwala and Sharma, 1961). In the Caucasus it is called kefir; in Armenia, matzoon; in India, dahdi; in Sardinia, gioddu; in Bulgaria, yoghurt; in Ethiopia, Dhanaan and in Syria, Israel and Egypt, lehben. The method of preparation of fermented milk consists in heating the milk to the boiling point (Aggarwala and Sharma, 1961) so as to kill bacteria.

The milk is well stirred and kept overnight at ambient temperature. By next morning it has curdled. At that stage it has acquired a sour taste and the typical flavour of fermented milk has developed. Pathogenic bacteria were killed when the milk was boiled and conditions have developed which will make it difficult for them to develop, assuring that a re-infection took place at a later stage. Therefore, fermented milk products are edible for some time. The method for commercial manufacture of kefir from camels' milk: milk is flashing pasteurized at 85^0C, getting rid by this means of pathogenic bacteria. The milk is then cooled to 26–30^0C and then inoculated with a 3 to 6 percent of kefir culture. It is then bottled. After incubation at 20–26^0C for 8 to 12 hours, a soft coagulum is formed and its acidity reaches 60–70^0T. The product is then allowed to ripen for 24–28 hours at 6 to 8^0C. The end product has a refreshing flavour and a thick creamy consistency. It is white and without gas. The acidity of one-day old kefir is in the region of 95^0T and its alcohol content is about 4 percent (Kheraskov, 1964).

"Chal" or "shubat", is a white sparkling beverage that has a sour flavour (Lakosa and Shokir, 1964). The "Chal" is prepared by first souring it in a skin bag or ceramic jar, normally with a capacity of 30kg. Previously soured milk is added to the fresh milk. It is well mixed and each day, for 3 to 4 days, fresh milk is added to the mixture. Eventually the end product must have 3 to 5 times the original volume of "Chal" that was initially added. This is the best ratio for the "Chal". It was found that camel milk does not sour at temperatures below 10^0C and this for up to 72 hours. At 30^0C the milk sours in approximately 8 hours, compared with cow's milk, which sours within 3 hours at a temperature of 30^0C. The comparison between the composition of camel milk and camel "Chal" is as follows (Grigor'yants, 1954): The "Chal" contains Lactobacilli lactic; streptococci and yeast (Kieselev, 1956). "Chal" was successfully prepared by using cultures of Lactobacillus casei, Streptococcus thermophilus and lactose fermenting yeasts and incubating inoculated milk for 8 hours at 25^0C and subsequently for 16 hours at 20^0C. Holder pasteurization did not affect the quality of the milk, but pasteurization at 85^0C for 5 minutes caused the milk to have a bad flavour. "Chal" made

from pure cultures of Lactobacillus casei, Streptococcus thermophilus and species of Torula had markedly less no-fat solids and lactose than the milk from which it was made (Kuliev, 1959).

In Mongolia "Tarag" is a cultured milk product similar to yoghurt, while "Unda" is a product produced by lactic and alcohol fermentation of camel and other animals' milk (Accolas *et al.,* 1975). In the Ahaggar region of the Sahara milk is fermented in a manner similar to that mentioned above (Gast *et al*., 1969). The animals are milked into special jars, made of Tamari wood, which can hold 2 to 3 litres of milk. The milk is mixed in the jars, and if not immediately drunk, it is stored in containers made of animal skin. In these skin containers the milk sours. The milk of the previous day is mixed with fresh milk until sour. There are great changes in the fat percentages of the milk products. As it is a practice to water the animals only once every 4 to 5 days, and as the lack of drinking water can cause a decrease in fat percentage (Yagil and Etzion, 1980) the fluctuating fat content is understandable. A lehben is also made by sweetening fresh milk (Gast *et al*., 1969). If water is added to this mixture a longer storage time is achieved. This lehben can be kept for 5–6 days in the summer, and up to 10 days in the winter.

Khoa and other non-fermented whole milk products

"Khoa" is made by evaporating small amounts of milk over a hot, steady fire. (Aggarwala and Sharma, 1961). The milk is continuously stirred to prevent scorching. At first the mass left over has a buttery consistency, but after cooling, it turns into semi-solid dough with a sweet taste. "Khoa" can be kept for about 200 days. If sugar is added it keeps for longer periods. "Rabbri" is also made by heating milk in a shallow iron pan over a hot fire. The difference with "Khoa" is that the solids are removed successively from the thin layer of coagulated milk on the surface. Then the product is allowed to cool. When the milk reaches a fifth to an eighth of the original volume, it is removed from the fire. The mass is now gently mixed, without damaging the flakes that have formed. Sugar is added and it is then allowed to cool.

Butter and derived products

Some authors describe butter being made from camel milk (Asresie *et al*., 2013; Shalash, 1979) while others categorically state that butter cannot be made from camel milk (Dickson, 1951). The preparation of butter from camel milk is not as easy as from milk of other animals owing to its unique milk-fat properties. The fat is distributed as small micelle-like globules in the milk (Dong-Wei, 1981); Yagil and Etzion, 1980). In addition, the fat is apparently bound to protein and there is a great difference in fatty acid composition. (Gast *et al*., 1969). Samples of camel butter are characteristically rich in polyunsaturated fatty acids. There are only traces of fatty acids with chains shorter than C-12 lauric acid. The butter does contain normal amounts of C-16 palmitic acid, and has very high content of the polyunsaturated C-18 oleic and linoleic acids, when compared with butter obtained from milk of other animals (Gast *et al*., 1969). Knoess observed that butter can be obtained after 15 to 20 minutes churning, whereas according to (Shalash, 1979) it can take up to about four hours. Butter can be made by churning fresh camel milk at 24–25^{0}C in a special blender (Lakosa and Rakin, 1964). At lower temperatures the cream of the camel milk will not churn. Water content of butter was found to be about 13 percent and its acidity 3.3^{0}T. Specific gravity was 0.923 and it melted at 44.5^{0}C. This butter is used for cooking and is not eaten as butter. It is sometimes used by women as a cosmetic (Gast *et al*., 1969).

In the Sahara, butter is made by placing camel milk into a thin, hairless, goat-skin for 12 hours. This skin is never washed with water. Inside the temperature rises to 28^{0}C, a temperature very similar to that used in the blender (Lakosa and Rakin, 1964). In winter the goat-skin is often placed into the ground near a warm fire to obtain the optimum temperature before making butter. This aids in the fermentation. Churning is done when the container is

half filled with sour milk. Air is blown into the container and the top is tied off. It is hung on a tent pole and rapidly swung to and fro. This is done in the early morning and the amount of butter obtained is determined by the skill of the man doing the churning. No churning is done during the day as solar heat apparently impedes proper separation. Some cold water is added into the goat-skin before the end of churning. This aids in solidifying the butter. It is then placed in a wooden bowl or kettle.

Fresh butter is not eaten, but is often used as a base for medicines. The fresh butter is difficult to preserve. It is not limpid and becomes rancid rapidly. Most of the butter is thus melted down to make Shmen or "Semma". The butter is melted at 100–120^{0}C for 30 minutes. A clarifying agent is added to hot butter and it is stirred with a wooden spoon.

This agent can be crushed dates or a grated, roasted piece of ram horn, or leaves of certain plants or seeds. Heating destroys the bacteria and the clarification agent collects the dirt and floats to the top, where it can be skimmed off. If dates are used as clarifying agent it is then given to children. If not, it is thrown away. The leaves give the specific colouring and aroma to the butter. The Bedouin in the Sinai Peninsula place the camel milk that is left over in a big clay jar, were it allowed to partially ferment. Then they place the milk into a leather container and shake it for about 4 hours and subsequently extract butter. Milk from quite a few camels is normally required to obtain enough butter for the requirements of the herder families. Camel butter has a harder consistency than the butter of sheep milk. The butter has a greasy appearance and taste, so only little is eaten and it is used mainly for cooking.

Cheeses

Soft cheese can be made from camel milk. The fat is bound to the milk proteins and the casein is also different from that of other animals (Ottogalli and Resmini, 1976). The alpha and beta caseins were found to react much more slowly on electrophoresis. Nevertheless, several plants that make rennet coagulated cheese from camel milk exist (Dilanyan, 1959; Mares, 1954). The Tourag nomads on the other hand say that cheeses cannot be made from camel milk, as it does not curdle, and so discussion on cheese making in the Sahara is restricted to cheeses made from milk of other animals (Gast *et al*., 1969). However, cheeses can also be made by mixing camel milk with milk of other animals (Kheraskov, 1965.; Rao *et al*., 1970). The cheeses made are often spiced cheeses or made without salt or sugar. The difficulty in making cheeses in the Sahara most probably refers to the technique which is being used. This is apparent as the addition of the peptic enzyme that is collected from rabbit stomach, or from the abomasums of young goats, to camel milk causes the formation of a coagulatum. This coagulated mass is soft like cotton wool (Gast *et al*., 1969).

As previously mentioned, in summer the lack of proper amenities in many countries to keep milk at low temperature does not allow for storing milk. The left-over camel milk is thus curdled and soured. Casein can be prepared from this milk and the product is known as "industrial casein" (Pant and Chandra, 1980), because the product is considered unfit for human consumption. It is used for making glue and gums. Whereas industrial casein and its fractions made from cow milk were found to be rich in crude proteins, the industrial casein and its fractions when made from camel milk are poor in crude proteins. Simple and effective methods were standardized for obtaining proteins from milk whey. The proteins of camel milk whey have a relatively higher percentage of nitrogen than those obtained from the whey of cow milk (Pant and Chandra, 1980). The high percentage of proteins and the amino acid composition of camel milk industrial casein suggest that it could make a satisfactory dietary supplement to the human diet. The unpleasant odour and taste however, make it unsuitable for consumption by man or animals. It is thought that it would be possible to purify the camel industrial casein and so make it fit for human consumption. The Bedouin of the Sinai Peninsula and the Tourag nomads (Gast *et al*., 1969) make a dry cheese called "Afig". These are balls of cheese that are made from butter milk, after the butter has been made, as mentioned previously. The Afig cheese balls are placed on the sides of the tents to dry out. No

other kinds of cheeses are made. The reason for this is said to be that the camel spoke to the Prophet Mohammed and it was agreed that no cheeses would be made from her milk and that her wool would not be dyed.

MISCELLANEOUS USES OF CAMEL MILK

Medicinal properties

In India camel milk is used therapeutically against dropsy, Jaundice, problems of the spleen, tuberculosis, asthma, anaemia, and piles (Rao *et al*., 1970). The "Chal" and other lung ailments (Gast *et al*., 1969.) have proven beneficial in the treatment of tuberculosis (Akundov *et al*., 1972). A clinic has been established in which milk is used for treatment (Urazakov and Bainazarov, 1974). Patients with chronic hepatitis had improved liver function after being treated with camel milk (Sharmanov *et al*., 1978). In fact, camel milk was as effective as ass milk and superior to treatment with only medication or a diet consisting of cow milk proteins. The camel milk works as a laxative on people unaccustomed to drinking this milk (Rao *et al*., 1970). Apparently stomach upsets only occur when the milk is drunk while still warm. When it is cool, no ill effects have been noted (Gast *et al*., 1969). The milk also apparently has slimming properties (Yasin and Wahid, 1957).

Camel milk is given to the sick, the elderly and the very young because of the belief that it is not only healthier, but works especially well in bone formation (Gast *et al*., 1969). The belief among the Bedouin of the Sinai Peninsula is that any internal disease can be cured by drinking camel milk. The milk is said to be of such strength, and to have such health-giving properties, that all the bacteria are driven from the body. This said to be true only for camels that eat certain shrubs and bushes. The shrubs and bushes are, themselves, used in the preparation of medicines. However, camels which eat straw are said to lose this ability.

Mystical properties

In Ethiopia camel milk is considered as having aphrodisiac powers (Rao *et al*., 1970). In Somalia, among the pastoral tribes, it is believed that milk drunk on the night when the camels first drink water, following a long period of thirst, has magical powers (Mares, 1954). "He who drinks milk on this night from a thirst-quenched camel will lose the thorns that have penetrated his feet, even from childhood". In the Sahara there is a superstition that when camel milk is given to a certain guest, only the milk of one particular camel is given to him. (Gast *et al*., 1969). Therefore, if the guest casts an evil eye on the herd, only the camel, whose milk he has drunk, will be affected and will stop lactating.

CONCLUSIONS

The consumption of camel milk and their product not considered as a cultural value in the world except in pastoral community as well as in Muslim religious follower country people compared to the consumption of milk and derived products from cow, goat, buffalo and Sheep. As for the camels, it seems that this requirements less fulfilled than for other animals with some negative hypothesis remains, which must be overcome gradually. The authors of this article are engaged to positively review and to further propagandize nutritional and therapeutic value of camel milk and their products. We suggest that camel milk and their products may have remedial effects for many different life-style related diseases, including, hypertension and cardiovascular diseases.

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Original Article

Temporal and Spatial Analysis of Fish Diversity and Community Structure in Lihu Lake, China

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ABSTRACT

From May 2010 to April 2011, 10 sampling sites were set to analyze fish diversity, community structure and dominant species. The results showed that 3720 fish of 710.860 kg were collected by using cage net and gill net, total of 45 fish species belonged to 7 orders and 12 families, which is less than 18 fish species than that of 63 fish species in 1960s, a decrease of 28.57%. The IRI index of Erythrocu1ter *dabryi dabryi* and *Coilia ectenes taihuensis* were more than 2000, and the above 2 fish were dominant species. Shannon-Wiener diversity index ranged between 1.759 with 3.011, and Pielou's evenness index ranged between 0.609 with 0.939, which showed the current state of fish diversity and community was good. The temporal and spatial variation of fish diversity and community structure in Lihu Lake were analyzed, and ecological effect of endogenous treatment was studied, which could provide references to the further treatment of exogenous pollution in Lihu Lake.

Keywords: Lihu Lake, fish diversity, fish community, temporal analysis, spatial analysis.

INTRODUCTION

Since the 1960s, disorderly production and development such as sewage directly into the lake, large area of reclamation from lake and enclosure culture and others, which caused the destruction of the ecological and fishery environment of Lihu Lake (Yin *et al*.,1994). The comprehensive evaluation of water quality standard in Lihu Lake was inferior class V, and Lihu Lake was the hyper-eutrophication lake, which gradually led to the decline of fishery'sresources (Fan *et al*., 2012). From 2002, the integrated measures of ecological restoration and water environment treatment were taken to reconstruct the healthy aquatic ecosystem of Lihu Lake, including the sewage interception, ecological dredging, restoration from paddy fields to fishing, dynamic water exchange, lakeshore remediation and

construction shelter belt around the lake, etc., and to achieve the goals of water self-purification capacity enhancement, water quality improvement, landscape optimization and biodiversity restoration, etc (Courrat *et al*., 2009; Zhang and Tang, 2003).

Fish researches of Lihu Lake have been reported a lot. Wu Xianwen analyzed the composition of fish fauna, and reported there were 63 fish species that belonged to 18 families, among them 48 species belonged to 37 genera of Cyprinidae (Wu, 1962). Li Wenchao analyzed the fish evolution of Lihu Lake during the eutrophication process, and reported that fisheries resources of Lihu Lake were relatively abundant, ferocious carnivore fish were dominant in 63 fish species and had more benthic fish (Li, 1996). Duan Jinrong *et al*. used diversity index to analyze fish community structure of Lihu Lake, and preliminary evaluation the effect of fisheries resources releasing and enhancement and fishery management taken to the Lihu Lake (Duan *et al*., 2009).

To evaluate the implementation of endogenous treatment impact on fisheries resources, 10 sampling sites were chosen to investigate the fish during 12:00 AM on the 15th day of each month to 12:00 AM on the next day, from May 2010 to April 2011. Based on the data of sampling fish, the temporal and spatial variation of fish diversity and community structure in Lihu Lake were analyzed, and ecological effect of endogenous treatment was studied, which could provide references to the further treatment of exogenous pollution in Lihu Lake.

MATERIAL AND METHODS

Study area

Lihu Lake, is also named Wulihu Lake, the tributary lake of Taihu Lake and the inner lake of Wuxi, Jiangsu province, and locates in the southwest of Wuxi, and is a shallow lake with an average depth of about 3m and between 119°13′12″-119°17′11″E and 31°29′54″-31°32′50″N (Duan *et al*., 2009). Lihu Lake looks like gourd-shape, and is about 6000m from the east to the west, between 300 to 1800m from the north to the south and an area of about 9.5 km2 (Fan *et al*., 2012). 10 sampling sites were set in the Lihu Lake based on the coverage situation of the lake, and the book named Chinese inland water fisheries resources (Figure 1) (Zhang and He, 1991).

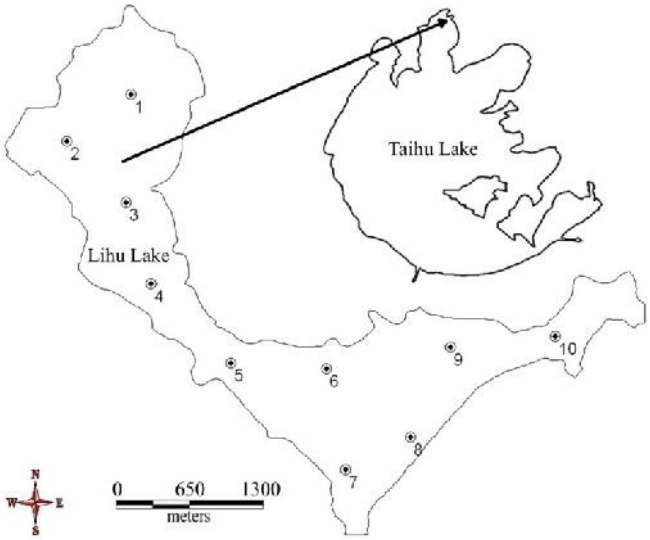

Fig-1 Map of the study area with sites indicated

Sampling procedure

Cage net (cross section 500mm×500mm, length 5m) and gill net (2a=50mm, height 1.5m, length 16m) were set at each sampling site. The operation period was 24 hours from 12:00 AM on the 15th day of each month to 12:00 AM on the next day. Fish from each sampling site were identified, counted and weighed, and biological parameters such as body length and body weight were measured at the same time, and all the above data were stored to the constructed database and used for the temporal and spatial analysis of fish diversity and community structure.

Data analysis

The species diversity was expressed by using Shannon diversity index (H′) and Pielou's evenness index (J):

$$H' = -\sum_{i=1}^{s} (Pi)(\log_2 Pi) \text{ and } J = \frac{H'}{\log_2 s}$$

Where Pi is the proportion of individuals in a community, which are members of the ith species, s is the total number of fish species (Pielou, 1975; Shannon and Weaver, 1949).

The dominant species and important species were classified by the calculation result of the index of relative importance (IRI):

IRI=（P_i+W_i）F_i

Where P_i is the ratio of the ith fish species individuals and total number of fish species, W_i is the ratio of the ith fish species weight and total weight of fish species, and F_i is the ratio of the frequency of the ith fish species and total sampling times (Micheli and Halpern, 2005; Przybylski *et al*., 1991) .

Similarity between sampling sites and species was calculated by using the Marczewski and Steinhaus(1958) equation:

q=c/(a+b-c)

where q is the similarity of 2 sampling sites, c is the total of the lower number of specimens of each pair of species common for 2 given analyzed sampling sites, a is the total number of specimens of a species at the sampling site A, and b is the total number of specimens of a species at the sampling site B. When q is between 0 and 0.25 and means no similarity, q is between 0.25 and 0.5 and means medium no similarity, q is between 0.5 and 0.75 and means medium similarity, q is between 0.75 to 1 and means very similarity (Marczewski and Steinhaus, 1958).

One-way ANOVA was conducted to examine the variations in Shannon'sShannondiversity index and Pielou's evenness index of two surveys, when a significant difference was found, Tukey's test was performed ($P<0.05$). All the statistical analysis was run in SPSS 16 and isoline of diversity index was expressed by surfer 8.0 (Shan *et al*., 2011).

RESULTS

Composition of fish community

During study period, 3720 fish of 710.860kg were collected by using cage net and gill net, total of 45 fish species belonged to 7 orders and 12 families (Figure 2), which is 18 fish species less than that of 63 fish species in 1960s, a decrease of 28.57%, among them 31 fish species belonged to 24 genera of Cyprinidae and accounted for 68.89% of total fish species, which is less than 17 fish species than 48 fish species belonged to 37 genera of Cyprinidae in 1960s, a decrease of 7.30% (Wu,1962).

In addition, there were 3 fish species belonged to Gobiidae, 2 fish species belonged to

Salangidae and 1 fish species belonged to the other'sfamilies.

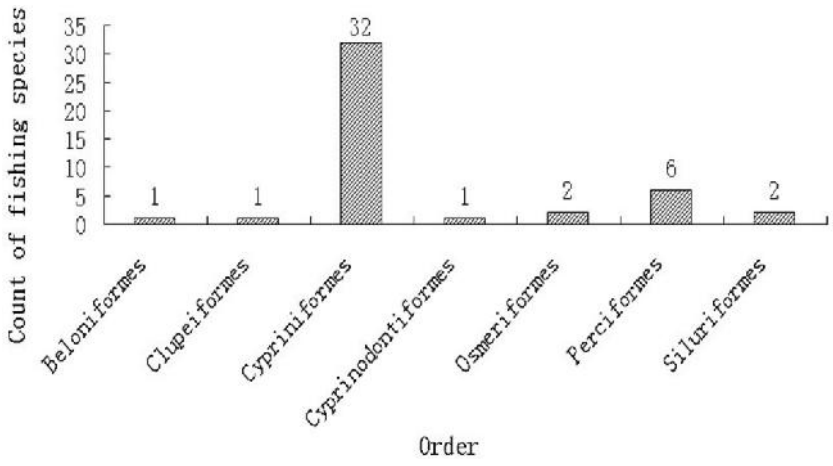

Fig2- The general classification of fishing species of Lihu Lake

Dominant species and its biologic characteristics

The index of relative importance (IRI) is used to express the community ecological dominance and is calculated by fishing volume, biomass and frequency of various species of the fish community. In general, the IRI index of fish is more than 1000 as an important species. Once, the IRI index of fish is greater than 2000 as a dominant species (Pianka, 1971). The IRI index of *Hypophthalmichthys molitrix* and *Carassius auratus* were more than 1000, and that of *Erythrocu1ter dabryi dabryi* and *Coilia ectenes taihuensis* were more than 2000 (Table 1).

Table 1- Important relative index of major species of fish community in Lihu Lake

Species	Body length/mm	Body weight/g	Quantity percentage (%)	Weight percentage (%)	Frequency rate/%	IRI
Erythrocu1ter dabryi dabryi	127.30±31.90	28.20±5.60	28.83	3.88	100.00	3271.00
Coilia ectenes taihuensi	178.70±44.30	23.40±14.50	22.77	2.36	91.65	2303.16
Hypophthalmichthys molitrix	342.30±64.90	878.90±233.60	2.28	16.89	83.45	1599.73
Carassius auratus	182.90±22.80	189.20±23.80	3.47	13.46	83.54	1414.33

Body length and body weight were used to fit the power function, and that of *Erythrocu1ter dabryi dabryi*, *Coilia ectenes taihuensis*, *Hypophthalmichthys molitrix* and *Carassius auratus* were:

$W = 0.0016 \times L^{2.9205}$ ($R^2 = 0.9252$, $P = 0.018 < 0.05$)
$W = 0.0011 \times L^{2.7704}$ ($R^2 = 0.9462$, $P = 0.014 < 0.05$)
$W = 0.0021 \times L^{2.9783}$ ($R^2 = 0.0.8779$, $p = 0.022 < 0.05$ and
$W = 0.0004 \times L^{2.4761}$ ($R^2 = .8111$, $P = 0.027 < 0.05$) respectively.

Similarity of fish community

The similarity degrees of different sampling sites were determined by the common amount of species, and the common amount of fish from 10 sampling sites in Lihu Lake was from 19 to 31. According to the similarity coefficient formula, the statistical results ranged from 0.5000 to 0.7692 and showed in Table 2.

Table-2 Similarity coefficient of all sampling sites

Sampling site	1	2	3	4	5	6	7	8	9	10
1	1									
2	0.6785	1								
3	0.6400	0.6428	1							
4	0.7307	0.6666	0.6923	1						
5	0.7307	0.6666	0.6923	0.6000	1					
6	0.7600	0.6896	0.7200	0.6206	0.6785	1				
7	0.6551	0.6562	0.6206	0.6451	0.5454	0.6666	1			
8	0.6923	0.5312	0.7200	0.6206	0.6206	0.7692	0.5625	1		
9	0.6363	0.5769	0.5909	0.5600	0.5600	0.6521	0.6666	0.5833	1	
10	0.7500	0.5666	0.6400	0.6071	0.5517	0.6296	0.6000	0.6923	0.5652	1

Based on the assessment criteria of the similarity, the fish community of each sampling site in Lihu Lake was in medium similar, namely the spatial distribution of fish in Lihu Lake was relatively even (Przybylski and Zalewski, 1991; Zalewski *et al*., 1990).

Variety of diversity index

According to the formula of Shannon's diversity index and Pielou's evenness index, the calculation results of each sapling site were listed in Tab1. Shannon-Wiener diversity index ranged between 1.759 with 3.011, and Pielou's evenness index ranged between 0.609 with 0.939, which showed the current state of fish diversity and community was good (Table 3).

Table 3- Shannon diversity index and Pielou's evenness index of all sampling sites

Sampling sites	Item	Season			
		Summer May-Jul	Autumn Aug-Oct	Winter Nov-Jan	Spring Feb-Apr
1	H′	2.649	2.493	2.542	2.099
	J	0.833	0.774	0.848	0.911
2	H′	2.393	2.817	2.679	2.779
	J	0.786	0.828	0.867	0.899
3	H′	2.520	2.701	2.578	2.493
	J	0.815	0.839	0.860	0.899
4	H′	2.835	3.011	2.423	2.642
	J	0.851	0.924	0.823	0.897
5	H′	2.669	2.822	2.602	2.562
	J	0.851	0.877	0.918	0.855
6	H′	2.599	2.955	2.563	2.486
	J	0.818	0.896	0.887	0.897
7	H′	2.224	2.405	2.502	1.759
	J	0.867	0.707	0.835	0.609
8	H′	2.362	2.735	2.466	2.672
	J	0.817	0.850	0.837	0.907
9	H′	1.793	2.479	2.814	2.462
	J	0.721	0.894	0.939	0.909
10	H′	2.228	2.710	2.493	2.418
	J	0.803	0.832	0.806	0.916

According to a logarithmic relationship between Shannon-Wiener diversity index and Pielou's evenness index based the scatter distribution diagram to fit equation of

$H' = 2.8653 + 1.9547 \text{ Ln } (J)$ ($R^2 = 0.8814$, $P = 0.037 < 0.05$).

The analysis result of ANOVA showed that Shannon's diversity index differences of No.1 site and No.2 sites as well as that of No.1 site and No.4 site were significant ($P<0.05$), Shannon diversity index differences of others sites were not significant ($P> 0.05$). Pielou's evenness index differences of 10 sites were not significant ($P> 0.05$). Shannon diversity index differences of summer and autumn as well as that of spring and autumn were significant ($P<0.05$). Pielou's evenness index differences of 4 seasons were not significant ($P> 0.05$). To calculate the average Shannon's diversity index and Pielou's evenness index of each sampling site of 4 seasons, and use surfer8.0 to complete the spatial distribution of isoline about the average Shannon diversity index and Pielou's evenness index (Figure 3 and Figure 4) (Belliard *et al*., 1997; Galacatos *et al*., 2004).

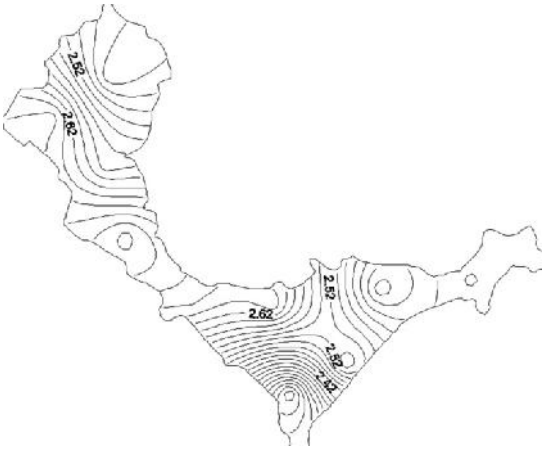

Fig 3- Isoline of Shannon diversity index

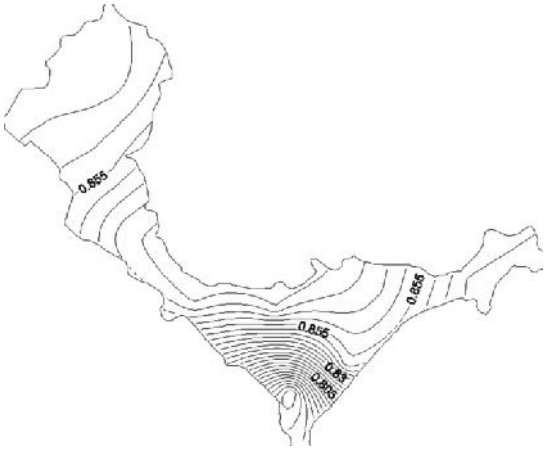

Fig 4- Isoline of Pielou's evenness index

DISCUSSION

Before 2002, Lihu Lake belonged to cultured lake and the releasing fingerling in spring, and fishing adult fish in winter were taken as general management method. The implementation of endogenous treatment for Lihu Lake began in 2002, and the function of Lihu Lake transferred cultured lake to natural Lake, and the dominant position of four major Chinese carps such as black carp, grass carp, silver carp and bighead carp gradually weakened (Lowe-McConnell, 1987). This result showed that small carnivorous fish of *Erythrocu1ter dabryi dabryi(Bleeker)* and *Coilia ectenes taihuensis* in every sampling site were the dominant species and belonged to top three in fishing volume, which may lead to the change of a food chain, thus increase the ratio of filter-feeding fish such as silver carp and bighead carp of fishery releasing and enhancement in order to maintain the relatively stable status of fish diversity in Lihu Lake (Duan *et al*., 2009).

The Shannon diversity index and Pielou's evenness index of the whole Lihu Lake could be calculated based the summary data of the whole study period and those were 2.689 and 0.886 respectively, which showed that the status of fish diversity in Lihu Lake was stable. After the implementation of endogenous treatment of Lihu Lake, the fishing volume of each sampling site increased over 50% than that of 1990s, but the species number decreased 18 than that of 1990s by preliminary statistic analysis (Li, 1996). The method of fishery releasing and enhancement increased the fishing volume of four major Chinese carps, and indigenous fish significant increased by their own reproduction owing the improvement environment, and the virtuous cumulative effect had achieved, but there was a long way to reach the level of fish

diversity and community structure in 1960s.

According to the report of local media, 2 kinds of exotic fish were found in Lihu Lake. The origin of *Lophiuslitulon* is South America. *Lophiuslitulon* is also known as scavenger, and it feeds mainly on detritus, and it harms the indigenous fish by eating their eggs (Chen *et al*., 2010). The origin of *lepisosteus oculatus* is North America, and it is a ferocious fish with sharp teeth and attacks all fish that it meets (Chen *et al*., 2010). The above 2 exotic fish were not collected during the study period, but in order to prevent the invasion of exotic species, fishery management departments should strengthen the propaganda of fishery law and rule, and enhance the environment protection awareness of nearby residents, and spread the knowledge of the ecological hazard of any release of exotic species to Lihu Lake. On the other hand, the fry and fingerling from Taihu Lake basin should be taken as the first choice to release to Lihu Lake and to avoid mixing of exotic species, to maintain the purification of germplasm resources.

To maintain and promote the status of fish diversity in Lihu Lake, the following recommendations and management measures were proposed.

1) To continue to fishery releasing and enhancement, and deepen the study of reasonable ratio of releasing variety and number.

2) To enhance the propaganda of knowledge of ecological balance of natural water body and to prevent any releasing of exotic fish to Lihu Lake.

3) To implement the policy on transferring fishermen's jobs and to prevent the fishermen to re-enter Lihu Lake for fishing operations and destruct the fish community.

4) To set up breeding ground for indigenous fish and provide good ecological environment for the fisherie'sresources restoration.

CONCLUSIONS

During study period, 3720 fish of 710.860 kg were collected by using cage net and gill net, total of 45 fish species belonged to 7 orders and 12 families. Among them, 31 fish species that belonged to 24 genera of Cyprinidae and accounted for 68.89% of total fish species. The IRI index of *Hypophthalmichthys molitrix* and *Carassius auratus* were more than 1000 and the above 2 fish were important species, and that of *Erythrocu1ter dabryi dabryi* and *Coilia ectenes taihuensis* were more than 2000 and the above 2 fish were dominant species. The spatial distribution of fish in Lihu Lake was relatively even.

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