



COMPARISON OF INTENSIVE AND EXTENSIVE SYSTEM OF MANAGEMENT IN FEEDLOTING OF INDIGENOUS BULLS

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ABSTRACT

The study compared intensive and extensive systems of management in feedlotting of indigenous bulls at Dairy Research and Development Centre ATBU, Bauchi. Haematological examination, serum biochemical and parasitological tests of blood samples were analysed. All measurements were taken early in the morning prior to feeding. There was significant difference ($P < 0.05$) in haematological values, with intensive system having the superior mean corpuscular haemoglobin ($MCH = 23.93 \pm 0.64$), mean corpuscular haemoglobin concentration ($MCHC = 39.65 \pm 0.74$), Platelet ($PLT = 294.17 \pm 27.26$) and neutrophils ($NEUT = 46.62 \pm 4.13$) while Red blood cell ($RBC = 5.74 \pm 0.36$), haemoglobin ($Hb = 11.23 \pm 0.47$) were lower in intensive but higher among animals raised under extensive system. Glucose concentration ($GC = 3.77 \pm 0.11$) was significantly higher ($P < 0.05$) among intensively raised bulls. Extensive system showed significantly higher ($P < 0.05$) prevalence of blood and faecal parasites except for *Cooperia pectinata* which was higher in intensive system. Bulls raised under extensive system (42.36%) showed higher return on investment than bulls raised under intensive system. Bulls managed under intensive feedlot demonstrated higher significant values of MCH, MCHC, PLT, NEUT & GC except RBC & Hb which were high in extensive system. Extensive system showed significantly higher parameters of blood and faecal parasites except for *Cooperia pectinata* which was higher in intensive system. Parasite can cause low haematological values leading to poor physiological status of animals hence, low productivity. It is recommended that in the absence of facilities and other resources for intensive feedlotting, farmers should adopt partial extensive system and, parasitic control should be paramount to whatever system adopted.

Keywords: Haematology, Biochemistry, Parasitology, Intensive and Extensive.

INTRODUCTION

Beef is a high-quality source of protein that also can provide highly desirable eating experiences, and demand is increasing globally. Extensive beef production systems typically include pasture-based cow-calf and stocker backgrounding or grow-out systems, and pasture or feedlot finishing. Intensive systems can maintain more control over nutrition and the environment and are more typically used for beef and veal from dairy breeds, crosses between beef and dairy breeds, and during finishing of beef cattle to assure product quality and specifications (Paul, 2021). The management of bulls in feedlot systems is a multifaceted issue, involving considerations of growth performance, animal welfare, environmental impact, and meat quality (Mormede *et al.*, 2014). Several factors affect livestock productivity, but the most important environmental factor that determines livestock productivity is feed. However, the nutritive value of feeds can be known from the performance of the animals as well as through blood profiling of the animals. (Shittu *et al.*, 2020) observed that blood is an important index of physiological and pathological changes in an organism. Isaac *et al.* (2013) also reported that cattle with good haematological composition are likely to exhibit better performance and productivity.

Bulls raised in feedlots are often subject to stressful conditions, which can have significant implications for their health and welfare. The confinement, high stocking densities, and limited natural behaviours can lead to increased incidence of diseases such as respiratory infections, lameness, and digestive disorders (Bradford *et al.*, 2014). Moreover, the intensive nature of feedlot systems may result in physical discomfort for bulls due to limited space and access to pasture (Mormede *et al.*,



2014). Prevalence rates of parasitic infestations in feedlots can vary depending on geographic location, management practices, and environmental conditions. Studies report that gastrointestinal nematodes are highly prevalent in feedlots globally, with prevalence rates ranging from 30% to 80% in various regions (Tom *et al.*, 2023; Sirikanda *et al.*, 2021). Feedlot operations are capital-intensive, with costs primarily driven by feed (60-70% of total costs), followed by labour, health management, and infrastructure (Gallaway & Martin, 2019). The goal of feedlot operation is to identify strategies that optimize cattle performance while minimizing costs and maximizing returns on investment (Kamilaris, *et al.*, 2020). The objective of the study is to evaluate the haematological variables and cost benefit analysis of bulls managed under intensive and extensive system of management.

MATERIALS AND METHODS

Study Area

The experiment was conducted at the Dairy Research and Development Centre, Gubi Campus ATBU, Bauchi State. Gubi Campus ATBU is located 25 Kilometre away from Bauchi metropolis, it is sited in Gubi village of Ganjuwa local Government of Bauchi state Nigeria, it has a total land area of 48 km², Gubi Campus is within Savanna zone at latitude 10° 45'N and longitude 9° 82'E with an annual average rainfall of 250mm occurring mainly during the month of June to September, August is the wettest month with 335mm of rainfall (Dauda *et al.*, 2013).

Experimental Diet

Animals used in the extensive system grazed on crops residues with no concentrate supplementation. A concentrate feeds was formulated for intensive bulls with the following ingredient; maize 15%, wheat offal 61.7%, cotton seed cake 20.3%, bone meal 2%, salt 1%, and premix 0.1%. The bulls were fed 3kg/head/day for the period of the treatment. Rice straw hay and water were provided *ad libitum*.

Experimental Design and Management of Animals

A total number of 48 Bunaji bulls were used for the experiment. The liveweight of the experimental bulls ranges from 150 to 200 kg. Twenty-four (24) bulls were managed under intensive system while the other twenty-four (24) bulls were under extensive system management. The animals were purchased from neighbouring cattle market of Mararraba, Takanda, Soro and Gadan Maiwa of Bauchi and Jigawa State. On arrival, the bulls were treated with antibiotic (Oxytetracycline L-A), antiprotozoan (Diminazine aceturate) and dewormed with antihelmintic (Nitrozinil) against endo-parasites and sprayed with acaricide (Amitraz 20% EC) solution to control ecto-parasites. Proper sanitary condition was observed throughout the experimental period and animals were allowed for two weeks to adapt with the diet and environment before the start of the experiment while the duration of the actual experiment was seventy (70) days.

Data Collection

The blood and faecal sample of each bull were collected for haematology, biochemical and parasitological parameters. Blood sample was collected from all the experimental animals, using a 5mls needles and syringes via the jugular vein. The blood was put in two sets of sample bottles. The first set of bottles contained EDTA (ethylene diamine tetra acetic acid), which was to prevent the clotting of blood so that the haematological parameters could be evaluated. The second set of bottles were free of EDTA; this was to allow for the harvest of the serum in order to analyse the serum biochemical constituents. Faecal sample was collected from rectum by lubricated gloved hand and put into sample bottles. Haematological constituents measured include; haemoglobin (g/dL), red blood cell ($\times 10^6/\mu\text{L}$), white blood cell ($\times 10^3/\mu\text{L}$), haematocrit (%), platelet ($\times 10^3/\mu\text{L}$), lymphocyte (%) and neutrophils (%) were determined using standard procedures (Whitbread, 2015). Mean corpuscular volume (fL), mean corpuscular haemoglobin (pg) and mean corpuscular haemoglobin concentration (g/dL) were calculated as described by Whitbread (2015) while serum biochemical indices measured include: Total Protein Concentration (g/dl) and Glucose Concentration (mmol/l). Standard procedures for the biochemical analysis were followed (Whitbread, 2015). Blood and faecal parasites were determined as described by Charles (2015). All samples were taken early in the morning prior to feeding.



Data Analysis

Statistical analysis was carried out using Statistical Package for Social Science (SPSS) version 26. Data obtained from haematology and serum biochemistry were analysed using independent t-test. Data obtained from parasitology and economic evaluation were analysed using descriptive statistics.

RESULTS AND DISCUSSION

Haematology and Serum Biochemical Indices

Table 1 and 2, revealed the haematological and serum biochemical indices of bulls at first (1st) and ten (10th) weeks of the experiment. Extensive system had the higher significant difference ($p < 0.05$) in WBC (11.80 ± 0.49), RBC (6.64 ± 0.18 & 5.74 ± 0.36), HGB (10.83 ± 0.27 & 11.23 ± 0.47) and HCT (33.43 ± 0.80) which were within the reference range. This was as a result of stress, dehydration and parasitic infestation associated with extensive environment. These findings align with observations by Brown *et al.* (2016), who found that exposure to environmental stressors in grazing systems stimulates physiological adaptations, including enhanced immune responses. Similarly, higher HGB and RBC values were reported by Nseabasi (2014) for grazing cattle due to their need for efficient oxygen transport under active foraging conditions. The higher significant difference ($P < 0.05$) observed in MCH (23.93 ± 0.64), MCHC (39.65 ± 0.74), PLT (294.17 ± 27.26), NEUT (46.62 ± 4.13) for intensively reared bulls at the tenth weeks were higher than the reference range due to confined-stress in one place. Glucose (4.02 ± 0.19) and Total protein concentration (7.60 ± 0.16) were significantly difference ($P < 0.05$) in extensively reared animals. Because the animals were malnourished at the first week of the experiment. But at the tenth weeks of the experiment glucose concentration (3.77 ± 0.11) were highly significant ($P < 0.05$) in intensive system and this is in consistent with a study by McAllister *et al.* (2014), where intensive systems led to higher glucose levels due to high-concentrate diets, while extensive systems exhibited stable glucose levels from forage-based nutrition. The increased platelets (PLT) and glucose concentrations in the intensive system also reflect findings by Habibu *et al.* (2018), who noted stress-induced haematological changes in confined cattle.

Prevalence of Blood Parasites

Prevalence of blood parasite in feedlot bulls for both intensive and extensive system is presented in Table 3. The higher prevalence of *Anaplasma marginale* (20.69%) and *Babesia bigemina* (17.24%) in extensively managed bulls aligns with research by Gabriella *et al.* (2022), who highlighted tick-borne diseases as common in grazing systems with minimal vector control. Research finding of fewer parasite infections in the intensive system corresponds with studies such as those by Dembelo *et al.* (2018), who emphasized that feedlot environments reduce exposure to ticks and other vectors. Interestingly, the presence of *Babesia bovis* in both systems supports reports by Hassen *et al.* (2021), who found that vector control in feedlots can be less effective for certain pathogens under high-density conditions.

Table 1: Haematology and Serum Biochemical Parameters of Bulls Reared under Intensive and Extensive Management Systems at the First (1st) week of the Experiment

Parameters	Production System		LOS
	Intensive	Extensive	
WBC ($\times 10^3/\mu\text{L}$)	8.31 \pm 0.56	11.80 \pm 0.49	*
RBC ($\times 10^6/\mu\text{L}$)	5.40 \pm 0.29	6.64 \pm 0.18	*
HGB (g/dL)	9.37 \pm 0.47	10.83 \pm 0.27	*
HCT (%)	27.67 \pm 1.48	33.43 \pm 0.80	*
MCV (fL)	49.72 \pm 2.32	50.59 \pm 0.82	NS
MCH (pg)	16.80 \pm 0.79	16.38 \pm 0.36	NS
MCHC (g/dL)	32.44 \pm 1.44	32.52 \pm 0.31	NS
PLT ($\times 10^3/\mu\text{L}$)	260.92 \pm 39.37	214.00 \pm 33.71	NS
LYM (%)	44.51 \pm 3.36	33.63 \pm 5.92	NS
NEUT (%)	45.11 \pm 3.54	----	*
Serum Biochemistry			
Glucose Concentration (mmol/l)	3.37 \pm 0.21	4.02 \pm 0.19	*
Total Protein Concentration (g/dl)	6.58 \pm 0.31	7.60 \pm 0.16	*

Haemoglobin (**Hb**), red blood cell (**RBC**), white blood cell (**WBC**), mean corpuscular volume (**MCV**), mean corpuscular haemoglobin (**MCH**), mean corpuscular haemoglobin concentration (**MCHC**), platelets (**PLT**), total protein concentration (**TPC**), glucose concentration (**GC**), lymphocyte (**LYM**), neutrophils (**NEUT**), haematocrit (**HCT**), level of significance (**LOS**), Not Significant (**NS**), * Significant ($P < 0.05$).

Table 2: Haematology and Serum Biochemical Parameters of Selected Bulls Reared under Intensive and Extensive Management Systems at the Tenth (10th) of the Experiment

Parameters	Production System		LOS
	Intensive	Extensive	
WBC ($\times 10^3/\mu\text{L}$)	8.12 \pm 0.17	8.84 \pm 1.02	NS
RBC ($\times 10^6/\mu\text{L}$)	4.02 \pm 0.12	5.74 \pm 0.36	*
HGB (g/dL)	9.62 \pm 0.19	11.23 \pm 0.47	*
HCT (%)	31.30 \pm 6.94	31.69 \pm 1.38	NS
MCV (fL)	53.58 \pm 5.58	56.24 \pm 3.77	NS
MCH (pg)	23.93 \pm 0.64	19.94 \pm 1.30	*
MCHC (g/dL)	39.65 \pm 0.74	35.44 \pm 0.27	*
PLT ($\times 10^3/\mu\text{L}$)	294.17 \pm 27.26	183.00 \pm 42.53	*
LYM (%)	53.48 \pm 3.94	51.70 \pm 3.10	NS
NEUT (%)	46.62 \pm 4.13	35.6 \pm 0.04	*
Serum Biochemistry			
Glucose Concentration (mmol/l)	3.77 \pm 0.11	3.03 \pm 0.08	*
Total Protein Concentration (g/dl)	7.00 \pm 0.11	7.20 \pm 0.13	NS

Haemoglobin (**Hb**), red blood cell (**RBC**), white blood cell (**WBC**), mean corpuscular volume (**MCV**), mean corpuscular haemoglobin (**MCH**), mean corpuscular haemoglobin concentration (**MCHC**), platelets (**PLT**), total protein concentration (**TPC**), glucose concentration (**GC**), lymphocyte (**LYM**), neutrophils (**NEUT**), haematocrit (**HCT**), level of significance (**LOS**), Not Significant (**NS**), * Significant ($P < 0.05$).

Table 3: Prevalence of Blood Parasites in Feedlot Bulls Raised under Intensive and Extensive Management Systems

Organisms	Intensive System		Extensive System	
	No. of cattle Infected	Prevalence (%)	No. of cattle Infected	Prevalence (%)
<i>Anaplasma marginale</i>	3	11.54	6	20.69
<i>Anaplasma centrale</i>	1	3.85	2	6.90
<i>Babesia bigemina</i>	4	15.38	5	17.24
<i>Babesia bovis</i>	1	3.85	2	6.90
No Parasite Found	16	61.53	14	48.28
Mortality	1	3.85	0	0
Total	26	100	29	100

Number of Observation (N), Percentage (%).

Table 4: Prevalence of Faecal Parasite in Feedlot Bulls Raised under Intensive and Extensive Management Systems

Organisms	Intensive System		Extensive System	
	No. of cattle Infected	Prevalence (%)	No. of infected cattle	Prevalence (%)
<i>Fasciola</i> Spp	12	36.37	20	42.55
<i>Fascioloides magna</i>	2	6.06	7	14.89
<i>Oesophagostomum radiatum</i>	2	6.06	3	6.38
<i>Cooperia pectinata</i>	4	12.12	1	2.13
<i>Balantidium coli</i>	5	15.15	9	19.15
<i>Dicrocoelium dendriticum</i>	1	3.03	2	4.26
<i>Bunostomum phlebotomum</i>	2	6.06	-	-
<i>Schistosoma bovis</i>	-	-	2	4.26
No Parasite Found	4	12.12	3	6.38
Mortality	1	3.03	0	0
Total	33	100	47	100

Number of Observation (N), Percentage (%).

Prevalence of Faecal Parasites

Table 4 revealed the Higher prevalence rates of *Fasciola spp.* (42.55%) in the extensive system are consistent with findings by Isah (2019), who attributed this to contaminated water sources and grazing in poorly drained areas. Conversely, the higher prevalence of *Cooperia pectinata* (12.12%) in the intensive system supports results by Asem-Hiablie *et al.* (2017), who noted that confined systems often foster localized parasite transmission due to repeated exposure in shared feeding and watering areas. The lower prevalence of faecal parasites overall in the intensive system confirms the role of controlled environments in reducing parasite loads, as observed by Hassan *et al.* (2019). However, the presence of certain parasites like *Balantidium coli* in both systems highlights the need for integrated parasite management, regardless of the production system.

Economic Evaluation

Economic evaluation of intensive and extensively managed bulls is presented in Table 5. Extensively managed bulls had the higher return on the total capital invested (ROI 42.36%) than intensive system. The higher ROI of 42.36% in the extensive system mirrors results from a study by Nwigwe *et al.* (2016), which demonstrated that grazing systems significantly reduce feed costs, thereby enhancing profitability. Similarly, Andrea *et al.* (2022) noted that despite lower weight gains, extensive systems often yield better net margins due to reduced input costs. In contrast, the low ROI



of 3.37% in the intensive system aligns with findings by Smith *et al.* (2015), where feed costs were identified as the primary factor reducing profitability. However, a contrasting perspective is provided by Patel *et al.* (2020), who argued that intensive systems can achieve competitive ROIs in premium markets for grain-fed beef or where grazing land is scarce. Research findings confirm that profitability in intensive systems is highly sensitive to feed cost management (Patel *et al.*, 2020).

Table 5: Economic Evaluation of Bulls Raised under Intensive and Extensive Management Systems

Items	Intensive System (N=24)	Extensive System (N=24)
Purchase Price (₦)	219,364	300,000
Sale Price (₦)	307,727	429,167
Cost of Feeds (₦)	149,134	-
Cost of Labour (₦)	1,875	1,458
Total Cost (₦)	370,373	301,458
Profit/Loss (₦)	-62,645	127,709
Return on Investment (%)	0.0337 (3.37%)	0.4236 (42.36%)

Number of Observation (N).

CONCLUSION AND RECOMMENDATION

Parasite can cause low haematological values leading to poor physiological status of animals hence, low productivity. It is recommended that in the absence of facilities and other resources for intensive feedlotting, farmers should adopt partial extensive system as it is cost effective and, parasitic control should be paramount to whatever system adopted. Further research is recommended to explore hybrid systems that integrate the benefits of both management approaches while minimizing their limitations.

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