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Nutrition-non Ruminants, Applied particles of Nanosilver in poultry production, Additives, Immune system, Nutrient digestibility
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Murtada Babiker Mohamed Elemam
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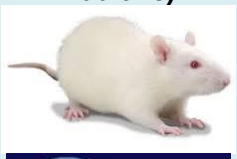
Table of Contents, 25 Sep, 2013

Research Title / Graphical Abstract	Article Information / Abstract	Download
Forage species availability, preference and grazing behaviour of Muturu and Zebu cattle in Asaba, Delta State, Nigeria  Muturu  Zebu	**Original Research, C39** pii: S222877011300039-3 **Udeh I, Isikwenu JO and Obika GC.** ***Online J. Anim. Feed Res.*, 3(5): 197-201, 2013.** **ABSTRACT:** *The objectives of this study were to identify the forage species available, species preference and to compare the grazing behaviour of Muturu and Zebu cattle under semi intensive system of management in Delta State University, Asaba Campus, Asaba Nigeria. Eleven cattle made up of one bull and ten cows each of Muturu and zebu were used for the study. There were five grazing areas. The total number of plant species, their population density and the most significant forage species preferred by the cattle were noted by the use of the quadrat method. Seventeen forage species were classified comprising twelve grasses, two legumes, two shrubs and one tree, which formed most of their food. Among the forage species identified, panicum maximum, grass specie was the most preferred and incidentally the widest spread forage in the area. Zebu significantly (P<0.05) bites more than muturu on ellusine indica, axonopus compressus, imperata cylindrica cynodon polystachus, centrosema pubescen and aspilla Africana. Muturu cattle showed significantly (P<0.05) greater preference for sida acuta and tridax procumbens than zebu. Zebu cattle spent significantly (P<0.05) more time on resting, courtship behaviour, brushing of the body and digging of soil than Muturu. Muturu cattle spent significantly (P<0.05) more time on playing and bullying than zebu. The finding in this study will be useful in the establishment of pastures and grazing management of muturu and zebu cattle in this ecological zone of the country.* **Key words:** *Cattle, Plant Species, Population Density, Preference, Time Spent*	PDF Watch Online
Effect of within herd environmental factors on milk, fat and protein yields in red Dane cattle in Zimbabwe 	**Original Research, C40** pii: S222877011300040-3 **Nyamushamba G. B, Halimani T. E, Imbayarwo-Chikosi V.E, Tavirimirwa B and Zishiri O.T.** ***Online J. Anim. Feed Res.*, 3(5): 202-204, 2013.** **ABSTRACT:** *A study was carried out to establish within herd environmental factors affecting milk yield, butterfat and protein in Zimbabwean Red Dane cattle. 305-day lactation records were obtained from the Livestock Identification Trust (LIT) containing herds with cows that calved from 2004 to 2009. A General Linear Model (GLM) procedure of the Statistical Analysis System version 9.1.3 was used to determine the effect environmental factors on milk yield and composition. Age at calving fitted as covariates, the effect of calving interval and herd-year-season were analysed. Milk yield, fat and protein content obtained increased with an increase in calving interval. It is thus important to pre-adjust data for these environmental factors when carrying out genetic evaluations of production traits in dairy cattle.* **Key words:** *Environmental Factors, Herd-Year-Season, Calving Interval, Age at Calving*	PDF Watch Online
Responses of albino rats to high rice bran diets: effects of type of rice bran and level of X-Zyme™ (An Exogenous Enzymes + Probiotics Feed Additive)  	**Original Research, C41** pii: S222877011300041-3 **Okai D. B., Boateng M., Armah W. N. L. and Frimpong Y. O.** ***Online J. Anim. Feed Res.*, 3(5): 205-209, 2013.** **ABSTRACT:** *The experiment was conducted to determine the effects of high (60%) rice bran-based diets with rice brans of different qualities (Type A-poor and Type B-good) and 2 levels of X-zyme™ (an exogenous enzymes+probiotics feed additive) on the growth performance and carcass characteristics of albino rats. Thirty albino rats were randomly allotted to five dietary treatments, T1 (maize-based, Control), and four other diets containing rice bran with differing quality (A and B) plus X-zyme™ at two levels (250 and 500mg/kg) labeled: T2 (Type A RB+250mg X-zyme™per Kg feed), T3 (Type A RB+500mg X-zyme™ per Kg feed), T4 (Type B RB+250mg X-zyme™ per Kg feed) and T5 (Type B RB+500mg X-zyme™ per Kg feed). There were 6 rats on each treatment, housed individually in plastic cages and each rat served as a replicate. Feed and water were provided ad libitum and their growth performance monitored for 28 days after which the rats were euthanized for carcass measurements. Data collected showed significant (P<0.05) differences in weight gain, feed intake, feed efficiency and the feed cost per 100g gain with better growth performance trends for treatments T1 (Control), T4 and T5 (Type B rice bran). Also, there were significant differences in the weights of kidneys, liver, lungs, heart and the empty stomach. It was concluded that, the composition of agro industrial by-products such as rice bran may have an effect on how efficiently they are utilized by monogastric farm animals even when some nutrient releasing and growth promoting feed additives have been added.* **Key words:** *Exogenous Enzymes, High Levels, Probiotics, Quality, Rice Bran.*	PDF Watch Online
Nutritional evaluation of processed mango *(Mangifera indica* - Kent) seed kernel meal as replacement for maize in the diet of growing crossbred rabbits	**Original Research, C42** pii: S222877011300042-3 **Shittu M. D., Olabanji R.O., Ojebiyi O.O., Amao O.A. and Ademola S.G.** ***Online J. Anim. Feed Res.*, 3(5): 210-215, 2013.** **ABSTRACT:** *A study was conducted to investigate the effect of different inclusion levels of sun-dried and parboiled mango seed kernel meal in diets of growing rabbits. Thirty crossbred male rabbits of between 6-8 weeks old with average initial weight of between 630.70g-646.36g were used. Five diets were formulated to contain 0 (control) 10 and*	

20% sun-dried mango seed kernel meal (SMSKM) and 10 and 20% parboiled mango seed kernel meal (PMSKM) substituted for maize of the control diet. The rabbits were randomly divided in to five groups of six rabbits each with each rabbit serving as replicate in a complete randomized block design experiment. Feed and water were offered ad libitum. The response criteria shows that the average daily feed intake ranged from 63.51 to 71.57g for all the five diets. Effects of dietary treatments on weight gain and feed conversion ratio were not significant (P>0.05). The relative weights of the organs examined (liver, spleen, heart, testis, lung, kidney) were not significantly (P>0.05) different across dietary treatments. The feed cost/ kg reduced significantly (P<0.05) as the levels of inclusion of MSKM increased. It was concluded that SMSKM and PMSKM can be included up to 20% level in growing rabbit rations without adverse effect on growth performance and carcass characteristics of growing rabbits. Mango seed kernel used in this study is of no direct value for man hence its utilization as a feed ingredient will lower feed cost and encourage increased production of meat and by implication availability of more animal protein to the populace.
Key words: *Mango Seed Kernel Meal, Parboiled, Crossbred Rabbits, Performance, Carcass Characteristics*

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FORAGE SPECIES AVAILABILITY, PREFERENCE AND GRAZING BEHAVIOUR OF MUTURU AND ZEBU CATTLE IN ASABA, DELTA STATE, NIGERIA

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ABSTRACT: *The objectives of this study were to identify the forage species available, species preference and to compare the grazing behaviour of Muturu and Zebu cattle under semi intensive system of management in Delta State University, Asaba Campus, Asaba Nigeria. Eleven cattle made up of one bull and ten cows each of Muturu and zebu were used for the study. There were five grazing areas. The total number of plant species, their population density and the most significant forage species preferred by the cattle were noted by the use of the quadrat method. Seventeen forage species were classified comprising twelve grasses, two legumes, two shrubs and one tree, which formed most of their food. Among the forage species identified, panicum maximum, grass specie was the most preferred and incidentally the widest spread forage in the area. Zebu significantly (P<0.05) bites more than muturu on ellusine indica, axonopus compressus, imperata cylindrica cynodon polystachus, centrosema pubescen and aspilla Africana. Muturu cattle showed significantly (P<0.05) greater preference for sida acuta and tridax procumbens than zebu. Zebu cattle spent significantly (P<0.05) more time on resting, courtship behaviour, brushing of the body and digging of soil than Muturu. Muturu cattle spent significantly (P<0.05) more time on playing and bullying than zebu. The finding in this study will be useful in the establishment of pastures and grazing management of muturu and zebu cattle in this ecological zone of the country.*

Key words: *Cattle, Plant Species, Population Density, Preference, Time Spent*

ORIGINAL ARTICLE

INTRODUCTION

Forages are source of food for ruminants. The ruminant digestive system is designed to utilize non starch polysaccharides (NSPS) for the majority of the energy need of the animal. The availability of forage species vary from one place to another. This difference in forage species availability underscores the need to identify the various forage species available in an area which could be useful in pasture establishment. Cattle vary substantially in their ability to harvest and digest forages (Launchbaugh and Hunt, 2001). Making efficient use of existing forage resources can therefore be done by selecting the species and breed of animal that has the natural ability to eat the available forage (Launchbaugh and Hunt, 2001). Forage acceptability by animals on pasture or zero grazing conditions is a function of forage palatability and forage morphology (Komwihangilo et al., 2007). Palatability reflects the animal's preference of one forage specie to another based on the ability of the forage to satisfy the animal's nutritional needs. Forage preference involves proportional choice of one plant specie from among two or more species and is commonly behavioral. Herbivoures vary in their choice or preference of one forage specie to another. It is also believed that feeding behaviour patterns varies according to breed within each specie of animal (Paggot, 1992). Muturu are short horned cattle distributed all over the rainforest zone of Africa (Nweze, 2006). The cattle are indigenous to south eastern states of Nigeria. It is the smallest cattle breed known with height at withers of 95cm for the male and 88cm for the female (Maule, 1990). In south eastern Nigeria the muturu is usually black or black and white. The breed is reported to be trypanotolerant and has significant cultural values (Adeneji, 1983). The zebu cattle are believed to have originated from south west Asia and are found in northern ecological zone of Nigeria. They are usually red or grey in colour, have loose skin, large ears and humps above their shoulders. They have large horns and are highly heat tolerant. They are believed to be less trypanotolerant compared to the muturu. Understanding the forage species available and the grazing behaviour of these two traditional breeds of cattle will help in establishing pastures for these animals. The specific objectives of this research were as follows.

1. To identify the forage species available in the grazing area and their population density.
2. To determine the forage preference of zebu and muturu.
3. To compare their grazing behaviour.

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MATERIALS AND METHODS

Experimental site

The study was conducted at Delta State University farm, Asaba Campus. The study area lies between latitude 4 ^{0}N 10 ^{0}N and longitude 6 ^{0}N 8 ^{0}N in Oshimili south local government area of Delta State. Annual rainfall was 1505-1849mm, mean annual temperature 28.6 ^{0}C, relative humidity 69-80% and monthly sunshine of about 4.8bars (NIMET, 2006).

Experimental animals

The experimental animals comprised 10 cows and 1 bull each of muturu and zebu reared under semi-intensive system of management at Delta State University farm, Asaba Campus in the southern guinea savannah ecological zone of Nigeria. The age of the animal as ascertained from dentition ranged 2-3 years. The animals were allowed to graze on available pasture from 8am-2pm daily, after which they returned to their pen and supplementary feed provided for them.

Experimental procedures

The grazing activities of the animals were monitored daily from the hours of 8am-2pm from August 2011 to October 2011. Grazing observation involves following and monitoring the animals during grazing. The observations include plant species chosen by the cattle and their grazing behaviour.

Forage specie availability

The different forage species available were determined by the use of quadrat method, where the different grazing area located at different areas were measured (Odo et al., 2001). The size of the first grazing area was 4000m^2 and the second measured 3000m^2, the third 5000m^2, fourth 9000m^2 and the fifth 9000m^2. Each of the measured area was further divided into five equal parts. All the plant species intercepted by the tape were identified. A wooden quadrat of 1m^2 was thrown randomly from any standing point at any direction. Ten throwing were made at different sides of each measured area and the different plant species occurring in each throw were identified, enumerated and recorded. Trees, grasses, legumes and shrub occurring within the quadrat were identified, counted and recorded. The total plant species were calculated. The method used to calculate the population density for each plant species was described by Odo et al. (2001) as follows:

Population density of specie A= Number of times specie A occurred divided by the area.

Number of bites and time spent on individual specie

The method used to observe forage preference involved close observation of randomly selected focal animal (one at a time) as they grazed with others (Osolo et al., 1994). A bite was taken as the act of breaking or picking up a piece of forage (Osolo et al., 1994; Odo et al., 2001). The time spent by the animal feeding on one species of plant without walking one full step was estimated in seconds and recorded (Osolo *et al*, 1994).The animals were grazed in different areas and a different individual was randomly selected for observation one at a time.

Statistical Analysis

The data collected on the number of bites, the time spent for each forage specie and the grazing behaviour of the two breeds of cattle were subjected to t-test (SPSS, 2007).

RESULTS

The numbers of forage species available in the study area as well as their relative density expressed as number of plants per 3000m2 are shown in Table 1. Seventeen plant species were identified comprising 12 grasses, 2 legumes, 2 shrubs and one tree. The five most wide spread forage species in the study area were *panicum maximum*, *axonopus compressus, ellusine indica, amaranthus spinosus and commelina nudiflora*. The least noticeable forage specie in the area was *chromoleana odurata*. Table 2 presents the mean ± se of number of bites per second while table 3 shows the mean time spent on each forage specie by zebu and muturu cattle. Table 2 shows that *panicum maximum* was the most preferred forage specie by zebu and muturu followed by *ellusine indica, axonopus compressus, penisetum purpurem* and *imperata cylindrica* in that order. Incidentally, the most preferred forage was the most abundant in the grazing area. Significant ($P<0.05$) differences were observed between muturu and zebu in the number of bites and the time spent on each forage specie. Zebu cattle bite significantly ($P<0.05$) more than muturu on *ellusine indica, axonopus compressus, imperata cylindrica, cynoden polystachus, aspilla Africana* and *ageratum conizoides*. Muturu cattle showed significantly ($P<0.05$) greater preference for *sida acute* and *tridax procumbens* than zebu. *Pueria phasioloide*, *chromolaene odurata* and *talinum trangulare* were not eaten by the animals. Both breeds of cattle graze a minimum of five hours daily and grazed thoroughly for the first one hour before carrying out some of the grazing behaviours shown in table 4. There were significant ($P<0.05$) differences in time spent by zebu and muturu cattle in carrying out all the observed grazing behaviours. Zebu spent significantly ($P<0.05$) more time in resting, brushing of the body, digging of soil and courtship behaviour than muturu. On the other hand, muturu spent significantly ($P<0.05$) more time on playing and bullying than zebu.

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Table 1 - Average plant population density (plants/ 3000m²) of forage species

Forage species	Total frequency	Plants/ 3000m²
Grass species		
Panicum maximum	1737 ± 34.74	0.579
Axonopus compressus	817 ± 16.34	0.273
Ellusine indica	629 ± 12.58	0.209
Amaranthus spinosus	524 ± 10.48	0.175
Commelina nudiflora	300 ± 6.00	0.100
Pennisetum purpureum	140 ± 2.80	0.047
Aspilla Africana	131 ± 2.63	0.045
Tridax procumbens	127 ± 2.54	0.042
Cynodon polystachus	89 ± 1.73	0.029
Ageratum conizoides	67 ± 1.34	0.022
Imperata cylindrica	13 ± 0.26	0.004
Talinum triangualre	3 ± 0.06	0.001
Legume species		
Centrosema pubescens	184 ± 3.60	0.061
Pueria phasioloide	21 ± 0.42	0.007
Shrub species		
Sida acuta	143 ± 2.86	0.048
Chromolaena odurata	2 ± 0.04	0.001
Tree species		
Gmelina arborea	21 ± 0.42	0.007

Table 2 - Mean ± S. E of number of bite per second on the various forage species for zebu and Muturu cattle

Forage species	Zebu	Muturu
Panicum maximum	9.17 ± 7.56	8.50 ± 0.75
Ellusine indica	7.40 ± 0.66^{a}	5.44 ± 0.53^{b}
Axonopus compressus	6.56 ± 0.74^{a}	5.06 ± 0.67^{b}
Penisetum purpureum	6.06 ± 0.86	6.56 ± 0.80
Imperata cylindrical	5.94 ± 0.93^{a}	4.00 ± 0.68^{b}
Amaranthus spinosus	5.89 ± 0.72	6.28 ± 0.85
Gmelina arborea	5.50 ± 0.79	5.11 ± 0.49
Commelina nudiflora	4.44 ± 0.96	4.28 ± 1.09
Cynodon polystachus	4.44 ± 0.62^{a}	1.56 ± 0.53^{b}
Centrosema pubescen	3.39 ± 0.62^{a}	2.61 ± 0.81^{b}
Aspilla Africana	2.39 ± 0.62^{a}	1.33 ±0.38^{b}
Ageratum conizoides	0.89 ± 0.30^{a}	0.06 ± 0.06^{b}
Sida acuta	0.83 ± 0.43^{b}	3.89 ± 1.36^{a}
Tridax procumbens	0.61 ± 0.23^{b}	4.00 ± 0.68^{a}
Pueria phasioloide	0	0
Chromolaena odurata	0	0
Talinum trangulare	0	0

a, b means with different superscripts are significantly (P<0.05) different

Table 3 - Mean ± S.E for time spent on each forage specie by Zebu and Muturu cattle (in seconds)

Forage species	Zebu	Muturu
Panicum maximum	10.72 ± 0.96	10.17 ± 0.80
Ellusine indica	9.56 ± 1.05^{a}	7.99 ± 0.67^{b}
Axonopus compressus	7.33 ± 0.94^{a}	6.28 ± 0.76^{b}
Pennisetum purpureum	7.72 ± 1.14	7.50 ± 0.99
Imperata cylindrica	6.61 ± 1.09^{a}	4.44 ± 0.87^{b}
Amaranthus spinosus	8.44 ± 1.21^{a}	6.61 ± 1.08^{b}
Gmelina arborea	7.94 ± 0.93	7.17 ± 0.87
Commelina nudiflora	6.50 ± 1.39	5.67 ± 1.10
Cynodon polystachus	4.28 ± 0.92^{a}	1.44 ± 0.49^{b}
Aspilla Africana	2.50 ± 0.65^{a}	1.28 ± 0.38^{b}
Ageratum conizoides	0.89 ± 0.40^{a}	0.67 ± 0.46^{b}
Sida acuta	1.00 ± 0.72^{b}	4.56 ± 1.72^{a}
Tridax procumbens	0.33 ± 0.20^{b}	0.72 ± 0.29^{a}
Centrosema pubescens	2.60 ± 0.89^{a}	1.45 ± 0.20^{b}
Pueria phasioloides	0	0
Chromolaene odurata	0	0
Talinum triangulare	0	0

For each forage specie, b< a (P<0.05)

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Table 4 - Mean time in minutes ± S.E spent by Zebu and Muturu cattle in carrying out some grazing behaviours

Observed activity	Zebu	Muturu
Resting with or without rumination		
Playing and bullying	10.83 ± 2.51[a]	9.00 ± 1.54[b]
Courtship behaviour	0.72 ± 0.57[b]	7.44 ± 1.88[a]
Brushing of the body	0.44 ± 0.28[a]	0.28 ± 0.16[b]
Digging of the soil	0.46 ± 0.25[a]	0[b]
	0.22 ± 0.15[a]	0[b]

a, b means with different superscripts are significantly (P<0.05) different.

DISCUSSION

The results obtained in this study showed that *panicum maximum* was the most dominant forage specie in this area. This was followed by *axonopus compressus, ellusine indica* and *amaranthus spinosus*. The least dominant forage specie in this area was *chromolaena odurata*. This means that the soil type, soil composition and the topography of the ecological zone favoured the growth of these forage species more than others. It is a well-known fact that soil structure, soil composition, climate and topography of a region influence its vegetation (Odo et al., 2001). Incidentally the most abundant forage specie was the most preferred in this grazing area. By implication, it means that the dry matter (DM) content and moisture content of the forages preferred most were higher than those of the least preferred forages. It has been reported by Gibb et al (1998) and Komwihangilo et al. (2007) that the DM content and moisture content of grazed forages increased bite rate and bite mass. The nutrient composition of forages also influence bite rate and bite mass. Forages that have high acid-detergent fibre, sodium or nitrogen content were preferred most compared to forages with low content of these nutrients (Osolo et al., 1994). Animals usually prefer foods that meet their nutritional need (Hughes, 1993). During grazing, zebu cattle bites more and spent more time than muturu on some forage species such as *ellusine indica*, *axonopus compressus, imperata cylindrica* and *cynodon piectostachus*. This could be related to the fact that zebu has a bigger body size and therefore more rumen fills time than muturu cattle. The differences in biting rate could also be as a result of differences in the nutrient requirements of the two breed of cattle. Observation on grazing behaviour showed that muturu showed highest time in playing and bullying than zebu cattle. This behaviour could be due to the fact that muturu has a shorter rumen filling time than zebu cattle. The results also showed that zebu exhibited higher preference for digging of soil than muturu cattle. This could be related to the fact that zebu cattle has horn and use it in searching for root crops and minerals in the soil especially iron. The courtship behaviour exhibited by both breeds of cattle during the grazing period could be due to the effect of sun light on the activities of ovarian hormones (Odo et al., 2001).

CONCLUSION AND RECOMMENDATION

It was concluded from this study that *panicum maximum* was the most dominant while *chromolaena odurate* was the least noticeable forage species in this area. Panicum maximum was the most preferred forage by the grazing animals compared to other forage species. Zebu significantly (P<0.05) bites more than muturu on *ellusine indica*, *axonopus compressus, imperata cylindrical, cynodon polystachus, centrosome pubescens*, *aspilla Africana* and *ageratum conizoides.* Muturu showed significantly (P<0.05) greater preference of *sida acuta* and *tridax procumbens* than zebu cattle. The findings of this study will be useful in the establishment of pastures and grazing management of zebu and muturu in this ecological zone of the country.

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EFFECT OF WITHIN HERD ENVIRONMENTAL FACTORS ON MILK, FAT AND PROTEIN YIELDS IN RED DANE CATTLE IN ZIMBABWE

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ABSTRACT: *A study was carried out to establish within herd environmental factors affecting milk yield, butterfat and protein in Zimbabwean Red Dane cattle. 305-day lactation records were obtained from the Livestock Identification Trust (LIT) containing herds with cows that calved from 2004 to 2009. A General Linear Model (GLM) procedure of the Statistical Analysis System version 9.1.3 was used to determine the effect environmental factors on milk yield and composition. Age at calving fitted as covariates, the effect of calving interval and herd-year-season were analysed. Milk yield, fat and protein content obtained increased with an increase in calving interval. It is thus important to pre-adjust data for these environmental factors when carrying out genetic evaluations of production traits in dairy cattle.*

ORIGINAL ARTICLE

Key words: *Environmental Factors, Herd-Year-Season, Calving Interval, Age At Calving*

INTRODUCTION

In animal breeding, environmental factors are factors that are not part of the genetic make-up of an animal. These factors are not transmitted from parent to offspring. Environmental factors tend to obscure the animal's true genetic ability. When the genetic effect on a trait is weak, it is lowly heritable and the environment has the greatest influence on that trait. Environmental variance, which by definition embraces all variation of non-genetic origin, is a source of error that reduces precision in genetic studies. Missanjo (2010) observed that selection within the best environment allowed better gene expression and improved selection response.

Milk, butterfat and protein yields are some of the factors that drive economic profitability of dairy farms. Therefore, striving to increase milk, butterfat and protein yields per animal, while decreasing feed and other costs, can lead to economic gains (Nyamushamba et al., 2013). Whilst it is generally recommended that animals should be selected within the environment in which the animals and their progeny are reared. The magnitude of environmental influence should be considered. Efforts to improve traits that are greatly influenced by the environment should primarily focus on managerial inputs that modify the conditions under which the genotypes are expected to perform. The variation in milk, butterfat and protein yields can be attributed to several non genetic factors. These include age at calving, calving interval, days dry, season (month) of calving, herd and parity. Research has shown that in Zimbabwe, agro-ecological regions affect milk production (Kunaka and Makuza, 2005; Missanjo, 2010). It is therefore critical to provide information on both the genetic and non genetic factors that influence milk production. The information may reveal the need to have mating and hence calving periods that occur at certain times of the year to produce higher yields with less input. A study on the non-genetic-factors affecting milk, protein and butter fat yield in Red Dane cows in Zimbabwe is therefore justifiable. The results can be used as a management tool, to improve selection criteria by accounting for within herd non-genetic factors that affect milk yield and composition.

MATERIALS AND METHODS

Environment

Zimbabwe is located in Southern Africa in the tropical savannah region. The total land is 390,759 km2 and it is divided into five agro ecological regions. Rainfall patterns and crop production progressively deteriorate from regions I to V with region IV and V considered to be more suitable for livestock production compared to cropping

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activities (Gambiza and Nyama 2000). In the regions with low rainfall, dairying is assisted by production of drought-resistant fodder crops. Most dairy farms are located within 40 km of the major cities and towns (USDA 2009).

Data and data edits

The standard 305-day milk production records of pure bred Red Dane were obtained from Zimbabwe Livestock Identification Trust. Nyamushamba (2012) described the data set and the edits. This gave a data set of 1 321 records with cows calving in the period 2004-2009 respectively. Individual animals were grouped by year of birth from 2002 to 2007. Records were of individual cow milk yield, butterfat and protein contents.

Statistical analysis

The data was analysed using an animal model of the General Linear Model (GLM) of Henderson Type III sum of squares in Statistical Analysis Systems version 9.1.3 (SAS, 2009). The data was fitted to the following animal model; $Yij = \mu + HYS_i + CI_j + AC(b1 + b2) + E_{ij}$

Where:

Y_{ij} is the observed value for all milk traits (305-day milk yield; fat and protein content;
μ is the overall mean common to all observation;
HYS_i is the fixed effect of herd-year-season i (i = 1, 2, 3.....n);
CI_j is the fixed effect of calving interval j (i =305, 320, 335.....455);
AC is the age at calving
b1 and b2 are the linear and quadratic regression coefficients respectively on age at calving (AC) in months; and
E_{ij} is the random animal effect, eij ~ (N (0,σ2e)

RESULTS AND DISCUSSION

Environmental factors which significantly affect milk, butterfat and protein yields in Zimbabwean Red Dane cattle are shown in Figures 1, 2, 3 and 4. These results consistent with those observed from previous studies for other dairy breeds. Age at calving, herd year season and calving interval has a significant effect on milk, butterfat and protein yields of dairy cattle in Zimbabwe (Makuza, 1995; Mandizha, 1998; Imbayarwo-Chikosi, 1999; Kunaka, 1999; Missanjo et al., 2011; Nyamushamba et al., 2013).

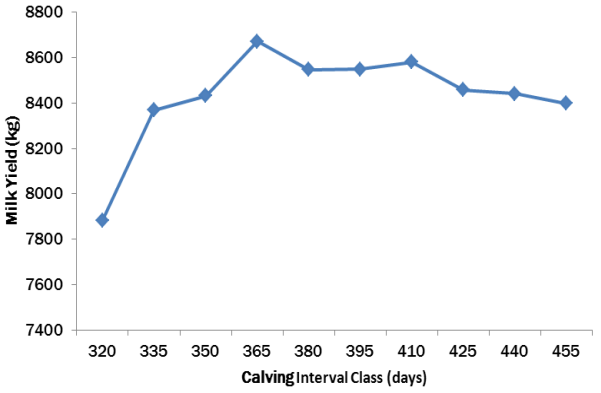

Figure 1 - Effect of calving interval on milk yield of Red Dane cattle

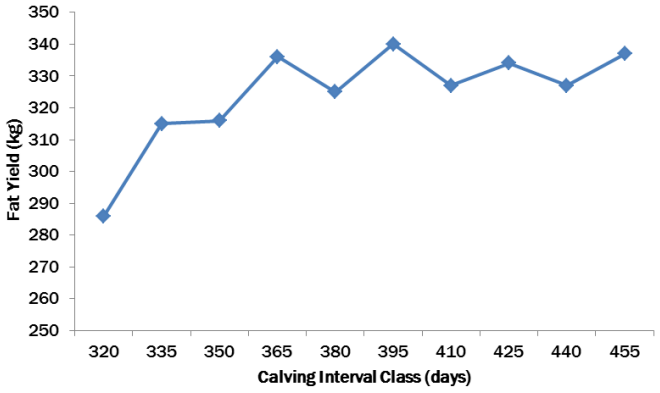

Figure 2 - Effect of calving interval on fat yield of Red Dane cattle

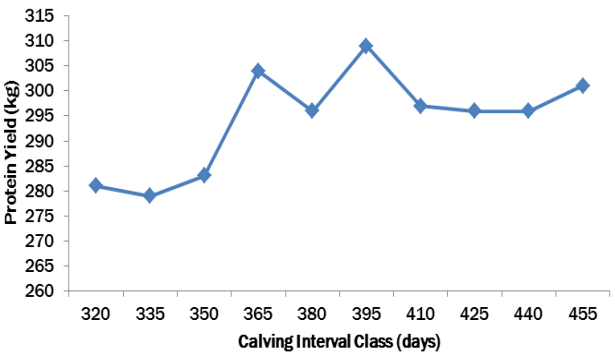

Figure 3 - Effect of calving interval on protein yield of Red Dane cattle

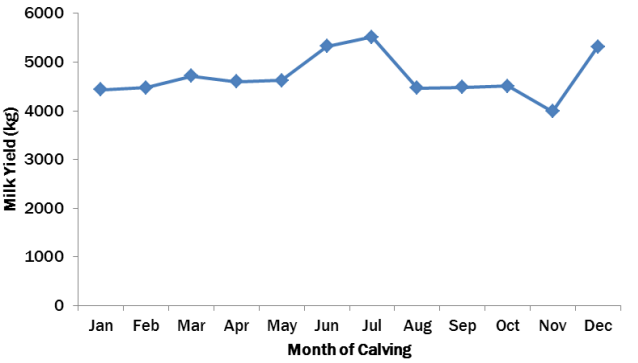

Figure 4 – Effect of month of calving (season) on milk yield of Red Dane cattle

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Effect of Calving Interval on milk yield and composition

Milk, butterfat and protein yields of the Red Dane cattle were significantly affected by calving interval (P<0.0001). These production traits demonstrated a continual increase in yield as the calving interval increased (Figures 1, 2 and 3). These results are in line with those reported by Muchenje (1997), Mandizha (1998), Imbayarwo-Chikosi (1999) and Missanjo (2010) that calving interval significantly affect milk yield and composition of dairy cattle. The ideal calving interval is 365 days for dairy breeds whereby the producer is assured of one calf from each cow annually. This would also ensure that the cow can replenish its body reserves and regenerate secretory tissues without over-conditioning.

Effect of Herd-Year-Season (HYS) on Milk Yield and Composition

Herd-Hear-Season had a significant (P<0.0001) effect on milk, butterfat and protein yields of Red Dane dairy cattle in Zimbabwe. The months of June and July gave the highest milk yield whilst in August to November its milk yield decreased. This is because the breed is not heat tolerant during the hot season and during the winter season there is high voluntary feed intake.for the Red Dane cattle. The results reported in this study are consistent with literature (Imbayarwo-Chikosi, 1999 and Missanjo, 2010) that herd-Year-Season significantly affects milk yield and milk composition in dairy cattle in Zimbabwe. It is therefore expected for different herds to exhibit different levels of production because of variations in the level of management. Different agro-ecological zones can also contribute to the differences between herds in Zimbabwe (Kunaka, 1999).

CONCLUSION

Herd-year-season and calving interval significantly affected milk, butterfat and protein yields for Red Dane cattle in Zimbabwe. Milk, butterfat and protein yields increased with an increase in age in both breeds. It is thus necessary to pre adjust data for these environmental factors when carrying out genetic evaluations of production traits in Zimbabwean Red Dane.

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RESPONSES OF ALBINO RATS TO HIGH RICE BRAN DIETS: EFFECTS OF TYPE OF RICE BRAN AND LEVEL OF X-ZYME™ (An Exogenous Enzymes + Probiotics Feed Additive)

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ABSTRACT: *The experiment was conducted to determine the effects of high (60%) rice bran-based diets with rice brans of different qualities (Type A-poor and Type B-good) and 2 levels of X-zyme™ (an exogenous enzymes+probiotics feed additive) on the growth performance and carcass characteristics of albino rats. Thirty albino rats were randomly allotted to five dietary treatments, T1 (maize-based, Control), and four other diets containing rice bran with differing quality (A and B) plus X-zyme™ at two levels (250 and 500mg/kg) labeled: T2 (Type A RB+250mg X-zyme™ per Kg feed), T3 (Type A RB+500mg X-zyme™ per Kg feed), T4 (Type B RB+250mg X-zyme™ per Kg feed) and T5 (Type B RB+500mg X-zyme™ per Kg feed). There were 6 rats on each treatment, housed individually in plastic cages and each rat served as a replicate. Feed and water were provided ad libitum and their growth performance monitored for 28 days after which the rats were euthanized for carcass measurements. Data collected showed significant (P<0.05) differences in weight gain, feed intake, feed efficiency and the feed cost per 100g gain with better growth performance trends for treatments T1 (Control), T4 and T5 (Type B rice bran). Also, there were significant differences in the weights of kidneys, liver, lungs, heart and the empty stomach. It was concluded that, the composition of agro industrial by-products such as rice bran may have an effect on how efficiently they are utilized by monogastric farm animals even when some nutrient releasing and growth promoting feed additives have been added.*

ORIGINAL ARTICLE

Keywords: *Exogenous Enzymes, High Levels, Probiotics, Quality, Rice Bran.*

INTRODUCTION

Feeding has become a major cost item in the production of monogastric livestock such as pigs and poultry contributing to about 70% of the total cost of production in Ghana (Boateng et al., 2008). This may be due to the fact that most of the ingredients used in non- ruminant animal feed are also being used as food for humans. Donkoh and Attoh-Kotoku (2009) had emphasized that maize which is the major energy source in poultry diets for example is a major staple for humans in most sub- Saharan African countries. Thus, some farmers have resorted to using agro-industrial by-products (AIBP) which are cheap and readily available. Atuahene et al. (2000) identified rice bran as one such product that is relatively inexpensive and can be used as an alternative for maize; which has appropriately been described as being expensive and backbreaking for most non- ruminant livestock farmers. Chung (2001) had explained that there are bound to be differences in the chemical composition of some of these feed ingredients depending on the source from which they were obtained.

Boateng et al. (2013) indicated that some farmers use rice bran in feeding their monogastric farm animals in Ghana even though there is a dearth of information available in support of the nutritive value and the extent to which it supports growth and concluded that, with the addition of suitable dietary enzyme complexes which will help degrade the complex non-starch polysaccharides (NSP) in this by-product, up to 60% can be fed to monogastric farm animals. Furthermore, probiotics have been noted (Ensminger et al., 1990) to accelerate biological processes and improve the intestinal microbial balance as well as improve the utilization of nutrients when fibrous products are fed to monogastrics. Therefore, this study was done to ascertain the effects of feeding two different rice bran-based diets supplemented with 2 levels of X-Zyme™, an exogenous enzymes and probiotics complex on the growth performance and carcass characteristics of albino rats.

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MATERIALS AND METHODS

Location and duration of Experiment

The study was carried out at the Livestock Section of the Department of Animal Science, Faculty of Agriculture, Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana and it lasted a period of four weeks.

Source of feed ingredients

Two rice bran (RB) types based on the degree of adulteration with rice hulls/husk were obtained and used in the experiment. Type A, which contained more hulls/husks and considered low quality, and Type B, rice bran which contained less hulls/husks and perceived to be of higher quality were obtained from two different locations in the Ashanti Region of Ghana. All other ingredients used in this experiment including the additive, X-zyme™ were obtained from the open market in Kumasi.

Experimental Animals, Feeds and Design

Thirty albino rats (15 males and 15 females) with an average initial live weight of 84g were allocated to 5 dietary treatments namely; T1 (Control, a maize-based diet), T2 (Type A RB+250mg X-zyme™/ kg feed), T3 (Type A RB+500mg X-zyme™/ kg feed), T4 (Type B RB+250mg X-zyme™/ kg feed) and T5 (Type B RB+500mg X-zyme™/ kg feed);in a Completely Randomized Design (CRD) experiment. Each treatment was replicated six times and there was a rat in each replicate. Each treatment consisted of 3 males and 3 female albino rats. Table 1 is a summary of the composition of the different dietary treatments used in the experiment.

Table 1 - Percentage composition of the five diets

Feed ingredient	Dietary Treatments				
	T1	T2	T3	T4	T5
	Type of RB				
	-	A	A	B	B
Xzyme™/kg diet, mg	0	250	500	250	500
Maize	65.0	11.0	11.0	11.0	11.0
Rice bran	-	60.0	60.0	60.0	60.0
Wheat bran	13.40	13.40	13.40	13.40	13.40
Fishmeal	8.0	5.0	5.0	5.0	5.0
Soya bean meal	11.60	8.60	8.60	8.60	8.60
Oyster shell	1.25	1.25	1.25	1.25	1.25
Common salt	0.25	0.25	0.25	0.25	0.25
Dicalcium phosphate	0.25	0.25	0.25	0.25	0.25
Vitamin-trace mineral premix*	0.25	0.25	0.25	0.25	0.25
Calculated Composition (%)					
Crude protein	17.94	17.95	17.95	17.95	17.95
Crude fibre	4.00	10.02	10.02	10.02	10.02
Calcium	1.11	0.90	0.90	0.90	0.90
Phosphorus	0.60	1.41	1.41	1.41	1.41
Lysine	0.96	0.94	0.94	0.94	0.94
Methionine	0.36	0.35	0.35	0.35	0.35
ME (Kcal/kg)	3165.5	2832.5	2832.5	2832.5	2832.5

*Vit. A, 12,000 IU; Vit. D, 200 IU; Vit. E, 10 IU; Vit. K, 0.002mg; Vit. B_1,0.002mg; Vit. B_2, 0.0045mg; Vit. B_6, 0.004mg; Vit. B_{12}, 0.01mg; pantothenic acid 0.012mg; nicotinic acid 0.003mg; folic acid 0.001mg; biotin 0.015mg; manganese 0.06mg; iodine 0.001mg; zinc 0.05mg; iron 0.025mg; copper 0.005mg; selenium 0.001mg/kg.

Housing, Management and Feeding of Rats

The rats were housed individually in rectangular plastic containers measuring 27×21×15cm, each of which was covered with wire mesh to aid ventilation. Feed was provided in a cylindrical metallic feeding troughs fixed to a corner of the container and water was given to rats by means of a glass bottle fitted with glass nipples which were placed on top of the wire mesh on each cage. Feed and water were provided *ad libitum*. All recommended health and biosecurity practices were regularly carried out during the course of the study.

Data Collection

Weekly feed intake and weight gain were recorded and used as basis in calculating daily feed intake, daily weight gain and the feed conversion ratio. The prevailing market prices of the ingredients used in the experiment were employed in determining the price per 100g of feed and the amount of money needed for each rat to gain

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100g of weight. At the end of the experiment, all rats were euthanized and the weights of viscera, liver, heart, lungs, spleen, kidneys and full and empty GIT were taken. Internal organ developments in relation to that of the total body were also calculated.

Statistical Analysis

All data collected on the rats were subjected to analysis of variance (ANOVA) using the Genstat (2007) Statistical Package (version 12.1) and the least significant difference (LSD) was used to separate the treatment means.

RESULTS AND DISCUSSION

Growth Performance

The growth performance of the rats fed the five experimental diets is as summarized in Table 2. There were significant ($P < 0.05$) differences in feed intake, weight gain and feed conversion ratio with rats on dietary treatment T4 consuming significantly ($P < 0.05$) more feed than those on T1 and T2. However, rats on treatment T3 and T5 recorded similar ($P > 0.05$) feed intakes to those on all other treatments. Also, rats on dietary treatments T4 and T1 recorded significantly ($P < 0.05$) better final weights and weight gains than those on T2 and T3. No significant ($P > 0.05$) differences were recorded between rats on treatment T5 and rats from all other treatments with regards to feed intake and weight gain. Dietary treatment T1 was more efficiently utilized ($P < 0.05$) by rats than dietary treatments T2 and T3; but treatments T4 and T5 however had similar ($P >0.05$) ratios as treatments T1 and T3 but their values were better ($P < 0.05$) than that of T2. The addition of more X-zyme™ (500mg/kg) reduced the rate of gain in the rats fed the good quality rice bran but these differences were not substantial ($P > 0.05$), the high quantity of X-zyme™ however resulted in numerically ($P > 0.05$) better gains in rats fed the poor quality rice bran. Boateng et al. (2013) observed significant ($P < 0.05$) changes in total feed intake, daily feed intake and FCR when rats were fed up to 60% RB-based diets supplemented with X-zyme™. Increased ($P < 0.05$) feed intake values were also registered when rats were given diets supplemented with a DFM product containing *Lactobacillus* strains (Anukam et al., 2005). The increase in feed intake for rats on the type B rice bran-based diets may be explained by observations of Conte et al. (2003), El-Deeb et al. (2000) and Teichmann et al. (1998), who all recorded increased feed intakes and live weight gains when broiler rations containing rice bran was supplemented with exogenous enzymes notably phytases and xylanases. Mabrigal et al. (1995) also recorded reduced feed intake and live weight gain but better efficiencies with increased inclusion of defatted rice bran.

Cost of production

The replacement of maize with higher levels of rice bran in the diets of rats resulted in a reduction in the cost of 100g of feed (Table 2). Dietary treatments containing rice bran of poorer quality (Type A) were slightly more expensive than those with prepared with the good quality (Type B) rice bran. This can be attributed to the fact that rice bran is not sold by the weight but by a flat rate per bag; thus, a bag with more husk will be expensive than one with a lower quantity of husk because husks are lighter.

It cost significantly ($P < 0.05$) more to raise albino rats on dietary treatment T2 than T4 and T5. Rats on the Control (T1) and T3 treatments recorded similar ($P > 0.05$) cost per 100g gain as animals on all other treatments namely T2, T4 and T5. Boateng et al. (2013) had earlier reported reduced feed cost per gram weight gain when levels of rice bran in rat diets were increase from 20 to 60%.

Table 2 - Growth and Economic Performance of the Rats

Parameter	Treatments					P	LSD	Sig.
	T1	T2	T3	T4	T5			
Type of RB	-	A	A	B	B			
Average initial weight, g	83.8	83.8	84.2	83.8	84.0	1.000	14.88	NS
Average final weight, g	186.5^{a}	133.3^{b}	143.8^{b}	190^{a}	165.7^{ab}	0.019	38.7	*
Total feed intake, g	341^{b}	330^{b}	377^{ab}	446^{a}	401^{ab}	0.020	72.3	*
Average daily feed intake, g	12.19^{b}	11.79^{b}	13.46^{ab}	15.91^{a}	14.31^{ab}	0.020	2.583	*
Average daily weight gain, g	3.66^{a}	1.76^{b}	2.13^{b}	3.79^{a}	2.91^{ab}	0.005	1.192	**
Feed conversion ratio	3.71^{c}	8.27^{a}	6.38^{ab}	4.29^{bc}	5.06^{bc}	0.004	2.362	**
Feed cost/100g(GH¢)#	0.101	0.057	0.058	0.054	0.055	-	-	-
Feed cost/100g gain(GH¢)	0.375^{ab}	0.471^{a}	0.370^{ab}	0.231^{b}	0.278^{b}	0.022	0.1471	*

*Significant (P<0.05), **Significant (P<0.01), NS=non-significant, LSD=Least significant difference, SIG=Significance, P=probability abc, Means on the same row bearing different superscripts are significantly different (P<0.05), #1Ghana cedi (GH¢) is equivalent to 0.5 dollars (US)

Carcass Characteristics

Table 3 shows a summary of the carcass composition and organ development of the rats on the five experimental diets. Weight of the kidneys, liver, lungs and empty GIT were significantly (P<0.05) different. The absolute weights of hearts for rats on the different treatments were also different (P<0.001). Generally the absolute

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values for most of the above parameters were considerably lower for the rats fed dietary treatments T2 and T3 and they follow similar trends as the final weights and the weight gain of the rats.

It is worth stating that the differences in the weights of all these organs were harmonious to the individual animals since the development of all organs as indicated in Table 3 were not significantly ($P > 0.05$) different. The relative weight of empty GIT was similar ($P > 0.05$) for rats on treatments T1, T3 and T5 which were significantly ($P < 0.05$) higher than those recorded for rats on treatment T2. Darkwa et al. (2013) recorded significantly lower relative weights for empty GIT in rats when they were fed diets containing varying levels of dried brewers' spent grains supplemented with Bergazym (an exogenous enzyme complex). High dietary fibre levels such as those contributed by the high inclusion levels of rice bran have been shown to affect the size and weight of the gastrointestinal tract in both pigs and rats (Pond et al., 1988; Anugwa et al. 1989; Hansen et al., 1992) but this was not exactly so in this study since rats on the Control diet (T1) recorded figures similar to, and in some cases, greater than their counterparts on the high fibre diets.

Table 3 -Carcass Parameters of the Rats

Parameter	Treatments					P-value	LSD	Sig.
Absolute weight (g)	**T1**	**T2**	**T3**	**T4**	**T5**			
Viscera	39.6	29.2	33.4	42.1	39.7	0.060	9.590	NS
Kidneys	1.468^{ab}	1.235^{c}	1.295^{bc}	1.557^{a}	1.475^{ab}	0.027	0.217	*
Liver	8.80^{ab}	5.86^{c}	6.81^{bc}	8.95^{a}	7.81^{abc}	0.028	2.121	*
Lungs	1.308^{ac}	1.073^{bc}	1.063^{c}	1.420^{a}	1.347^{ab}	0.043	0.281	*
Spleen	0.725	0.473	0.637	0.672	0.690	0.072	0.182	NS
Heart	0.743^{a}	0.465^{c}	0.577^{bc}	0.717^{a}	0.675^{ab}	0.001	0.130	***
GIT(full)	24.8	19.3	22.1	27.9	26.6	0.090	6.720	NS
GIT(empty)	11.17^{a}	6.48^{b}	9.16^{ab}	11.51^{a}	11.65^{a}	0.002	2.713	*
Organ developments (% of BW)								
Viscera	21.52	21.71	22.98	22.06	23.97	0.294	2.597	NS
Kidneys	0.807	0.935	0.897	0.822	0.895	0.099	0.107	NS
Liver	4.725	4.358	4.685	4.683	4.715	0.458	0.465	NS
Lungs	0.703	0.807	0.733	0.743	0.813	0.115	0.097	NS
Spleen	0.390	0.348	0.440	0.357	0.420	0.284	0.099	NS
Heart	0.405	0.353	0.398	0.377	0.410	0.557	0.078	NS
GIT(full)	13.48	14.28	15.17	14.57	16.05	0.138	2.026	NS
GIT(empty)	6.17^{a}	4.96^{b}	6.30^{a}	5.98^{ab}	7.04^{a}	0.015	1.114	*

*Significant (P<0.05), **Significant (P<0.01), NS=non-significant, LSD=Least significant difference, SIG=Significance, P=probability abc, Means on the same row bearing different superscripts are significantly different (P<0.05)

CONCLUSION

The addition of high levels of rice bran with higher husk content resulted in poor growth in rats compared to when rice bran with low quantities of husk and a maize-based diets were fed despite the addition of a complex of probiotics and exogenous enzymes. This experiment has shown that the composition of rice bran may have an effect on how efficiently it is utilized by monogastric farm animals when apparently appropriate exogenous enzymes and probiotic combinations have been added. The increase in the content of X-zyme™ added did not improve the growth performance of rats on the 2 rice-bran based diets. Farmers are therefore advised to check the quality of the rice bran they use in the quest to rear animals more efficiently and economically.

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NUTRITIONAL EVALUATION OF PROCESSED MANGO *(Mangifera indica* - Kent) SEED KERNEL MEAL AS REPLACEMENT FOR MAIZE IN THE DIET OF GROWING CROSSBRED RABBITS

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ABSTRACT: *A study was conducted to investigate the effect of different inclusion levels of sun-dried and parboiled mango seed kernel meal in diets of growing rabbits. Thirty crossbred male rabbits of between 6-8 weeks old with average initial weight of between 630.70g-646.36g were used. Five diets were formulated to contain 0 (control) 10 and 20% sun-dried mango seed kernel meal (SMSKM) and 10 and 20% parboiled mango seed kernel meal (PMSKM) substituted for maize of the control diet. The rabbits were randomly divided in to five groups of six rabbits each with each rabbit serving as replicate in a complete randomized block design experiment. Feed and water were offered ad libitum. The response criteria shows that the average daily feed intake ranged from 63.51 to 71.57g for all the five diets. Effects of dietary treatments on weight gain and feed conversion ratio were not significant (P>0.05). The relative weights of the organs examined (liver, spleen, heart, testis, lung, kidney) were not significantly (P>0.05) different across dietary treatments. The feed cost/ kg reduced significantly (P<0.05) as the levels of inclusion of MSKM increased. It was concluded that SMSKM and PMSKM can be included up to 20% level in growing rabbit rations without adverse effect on growth performance and carcass characteristics of growing rabbits. Mango seed kernel used in this study is of no direct value for man hence its utilization as a feed ingredient will lower feed cost and encourage increased production of meat and by implication availability of more animal protein to the populace.*

Key words: *Mango Seed Kernel Meal, Parboiled, Crossbred Rabbits, Performance, Carcass Characteristics*

ORIGINAL ARTICLE

INTRODUCTION

The World Health Organization recommended 76g protein intake of which 34.0g should be of animal origin (Akintola, 1999). This has been difficult to achieve in most developing countries due to insufficient availability, high cost of conventional feed stuffs resulting from stiff competition between man and animal for the few available feedstuffs especially cereal and legume grains. Tewe (1988) observed that under the prevailing circumstances, it is unlikely that there will be surplus from conventional cereals and pulses upon which livestock production can develop: thus his suggestion of waste-to-wealth approach to solve the animal feed crisis.

Bamgbose et al. (2004) reported that maize *(Zea mays)* as a major energy source in poultry feeds accounts for between 50 and 55% of most poultry feeds. It is equally used in human nutrition thus creating a stiff competition between man and livestock. The resulting effect is high cost translating into high feed cost. This has necessitated the search for substitutes such as agro-industrial by-products and other farm residues that can replace maize wholly or partly. Some unconventional ingredients have been investigated as partial or total substitute for maize, they include fermented cassava peel meals (Osei et al. 1990); Sugar beet pulp (Garcia et al. 1993); Mango seed kernel meal (Farinu et al. 1999); Neem leaf meal (Adeyemi and Onyimonyi, 2009. Urea-treated and fermented Brewer's dried grain (Isikwenu et al. 2011) and Pigeon pea seed; (Mathew et al. 2010).

Mango trees can be found in several locations in Nigeria in its improved and native forms. The seeds that house kernels are always discarded as waste after eating the juicy mesocarp. The gathering of the seed could constitute a serious problem but the establishment of mango fruit canning industries has led to its concentration at specific locations since the seeds are treated as waste. In addition, the availability of mango seed kernel decorticator will ease and hasten the processing or breaking of mango kernel (Morton, 1987).

Mango seed kernel meal (MSKM) has been reported to be a good non conventional ingredient. Faniyi (1997) reported its importance in poultry production while Arogba (1997) provided the physical, chemical and

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functional properties of Nigerian mango *(Mangifera indica)* kernel and it processed flour. Chemical analysis and metabolizable energy of mango seed kernel meal as determined by Arogba (1997) revealed that it contains Tannin an astringent compound, thus necessitate processing the seed before it could be safely fed to animals. The nutrient composition of Mango seed kernel on dry matter basis was estimated in Nigeria to be 6.16% crude protein, 13.63% ether extract, 2.23% ash and 73.35% nitrogen free extract (Farinu et al. 1999) while El-Alaily et al. (1976) reported that the gross energy is 4.7Kcal/g.

The under-utilization of whole mango kernel in African countries particularly Nigeria could be partly due to the limited knowledge of the toxicological status of the mango kernel, the functional properties of the kernel flour and appropriate processing technology (Arogba, 1997). Faniyi (1997) reported that broiler birds can utilize up to 30% level of mango seed kernel meal as an energy source during starter and finisher phases but that appropriate protein and ME requirements of the birds should be taken care of in the diets. However Odunsi et al. (1997) reported that the inclusion of raw mango seed kernel meal above 10% have been reported to cause a significant decrease in daily weight, feed to gain ratio as well as feed intake of broiler birds. Information on the nutritional potential of mango seed kernel meal as feed ingredient for rabbits is scarce.

This study was designed to evaluate the growth performance and carcass characteristics of growing rabbits fed diets containing processed mango seed kernel meal.

MATERIALS AND METHODS

Location

The experiment was carried out at the Rabbitry unit of the Teaching and Research Farm, Ladoke Akintola University of Technology Ogbomoso Oyo state, Nigeria. The area is located within the derived savannah zone of Nigeria.

Collection and processing of test ingredients

Mango (Cherry variety), seeds were collected from various dumping sites of major markets within Ogbomoso town. It was cut open manually and the mango kernel removed from each half of the seed. The removed kernels were divided into 2 parts for further processing.

Sun drying

One part of the mango seed kernel was sun dried for one week to attain constant weight and milled into sun dried mango seed kernel meal (SMSKM).

Parboiling

The second part was parboiled for 5 minutes in water preheated to l00°C, drained, sun dried and milled to form parboiled mango seed kernel meal (PMSKM). Other ingredients were obtained from a reputable feed mill within Ogbomoso town.

Preparation of experimental diets

Five diets were formulated. Diet 1 was the control diet with no mango seed kernel meal. Diets 2 and 3 contained sun dried mango seed kernel (SMSKM) at 10 and 20% inclusion levels while diets 4 and 5 contained parboiled mango seed kernel meal (PMSKM) at 10 and 20% inclusion levels respectively. The gross composition of the experimental diets is presented in Table 1.

Table 1 - Gross composition of the experimental diets

Ingredients		SMSKM		PMSKM	
	0%	10%	20%	10%	20%
Maize	49.80	38.88	27.94	38.88	27.94
Soybean	8.20	9.12	10.06	9.12	10.06
MSKM	0.00	10.00	20.00	10.00	20.00
Wheat offal	20.00	20.00	20.00	20.00	20.00
PKC	16.00	16.00	16.00	16.00	16.00
Dicalcium Phosphate	2.00	2.00	2.00	2.00	2.00
Fishmeal (72%)	2.00	2.00	2.00	2.00	2.00
Limestone	1.00	1.00	1.00	1.00	1.00
Salt	0.50	0.50	0.50	0.50	0.50
Premix [1]	0.50	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
Protein	16.00	15.89	15.78	16.02	16.04
Crude fibre	5.19	5.12	5.05	5.13	5.07
ME(Kcal/kg diet)	2709.74	2549.42	2646.14	2648.45	2644.23

[1] Vit. A 40,000 iu, Vit. D 800,000.00 iu, Vit. E 8000.00 iu, Vit $K_3$800.00mg, Vit. B, 1,200.00mg, Vit.B2 200.00mg, Niacin 18,000.00iu, calcium pantothenic 4000mg, Biotin 20mg, Vit B6 1600.00mg, Vit. B12 8.0 iu. Folic acid 400.00 mg cholin chloride 120.00 mg, manganese 48,000 mg, Iron 40,000mg, Zinc 32,000 mg, Copper 3,400mg. Iodine 600mg, Cobalt 120mg, Selenium 48mg anti-oxidant 48g

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Animals and management

Thirty 6-8 weeks old crossbred rabbit bucks were used for the experiment. They were randomly assigned to five dietary treatments of six rabbits per treatment in a complete randomized block design. The rabbit were allowed one-week adjustment period during which they were fed with the control diet and given prophylactic treatment of Ivomec (tectin) at the 0.2ml per rabbit against endo and ecto-parasites before they were placed on experimental diets.

Housing

The rabbits were housed individually in wood-wire cages equipped with earthen feeding and drinking troughs. They were housed under ambient temperature of about 27°C and natural light of about 12hours per day. The house was well ventilated. Daily routine management practices include cleaning of the hutches and surroundings, washing of the feeders and the drinkers, replacement of left over feed with fresh feed and provision of clean water.

Feeding

Weighed quantity of feed (120g) divided into two rations of 60g each was fed to the animals twice a day (8.00 am and 3.00 pm) and water was provided *ad-libitum.* The Left overs were weighed daily to determine the feed intake and the record kept for each animal. This was done throughout the experimental period which lasted for 59 days. The feed intake was determined daily as the difference between feed supplied and the orts.

Weight changes

Records of live weight changes of each animal were taken by weighing at the beginning of the experiment and at weekly intervals throughout the experiment. Weight gain was determined as the difference between the weight of the previous week and the present week.

Carcass evaluation

At the end of the experiment, four rabbits randomly selected from each treatment were tagged and fasted over night to reduce their gut contents. After weighing to determine the final live weight, the rabbits were stunned and immediately slaughtered by severing the jugular veins. After evisceration, the organs were removed and weighed. The carcasses were later scalded to remove the fur and the difference between the carcass weight before and after scalding were taken as the fur weight.

Laboratory analysis

The standard methods of AOAC (1990) was used to determine the proximate compositions of the test ingredients and the experimental diets.

Statistical analysis

All the data collected were subjected to two-way analysis of variance (ANOVA) using SPSS computer analytical software according to Field (2000). Duncan's Multiple Range test of the same software was used to separate the means.

RESULTS AND DISCUSSION

The proximate composition of the test ingredients is presented in Table 2. The SMSKM used in the study contained 5.45, 5.91, 2.25, and 0.89% for crude fat, crude protein, ash and crude fibre respectively; while the PMSKM contained 4.62% crude fat, 7.22% crude protein, 2.69% ash, and 1.0% crude fibre. The PMSKM shows a higher protein of 7.22% compared with SMSKM which had 5.95 % CP.

This is similar to values reported by Faniyi (1997) and El-Alail et al. (1976). This may be an indication that parboiling had positive effect on the protein content of MSKM which is in line with the findings of Arogba (1997) that processing brings about conformational changes of protein molecules and nutrient availability. The moisture content of both SMSKM and PMSKM were similar, an indication that either of the processing methods does not have effect on the moisture percentage and dry matter content of the processed mango seed meal. The ash contents of the test ingredients were similar to values reported by Elegbede and Achoba (1996) but less than that of Faniyi (1997) for parboiled mango seed kernel meal. The crude fibre was however lower than that reported by Faniyi (1997). This may be due to differences in varieties of mango used or the degree of ripeness before processing.

Table 2 - Proximate composition of processed mango seed kernel meal

Parameters (%)	Sun dried MSKM	Parboiled MSKM
Crude protein	5.91	7.22
Ether Extract	5.45	4.62
Crude fibre	0.89	1.00
Nitrogen free extract	85.5	84.47
Ash	2.25	2.69
Dry matter	93.75	94.06

MSKM – Mango seed kernel meal

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The performance characteristics of weaner rabbits fed processed mango seed kernel meal is presented in Table 3. There was no significant (P>0.05) difference in the feed intake, weight gain, and feed-to-gain ratio between rabbits fed with SMSKM and PMSKM implying that the pre-treatment methods did not have any effect on these parameters. This agrees with the report of Kareem (2001) who fed albino rat with mango seed kernel meal (MSKM). The results suggest that the PMSKM and SMSKM were well tolerated by the rabbits.

The daily weight gain range of between 12.85 and 14.08g obtained in this study is higher than 10.1g reported by Adama and Nma (2002) when groundnut leaves were fed to rabbits. It is also higher than the range (10.61-11.53g/day) reported by Olabanji et al.2007 who fed sunflower leaf-blood meal based diet to rabbits but similar to 12.00g reported by Omole and Ajayi (1976) who feed dried brewer's grain to rabbits. These imply that the test ingredient is as good as or better than the other non-conventional ingredients used. The weight gain range reported by Agunbiade et al. (1999) was however higher (17.65-18.80g/day) compared with the values obtained in this study. The difference may be as a result of the age of rabbit at the commencement of the experiment, feed quality and environmental factors.

Rabbits used for this study had higher feed intake than those reported by Olabanji et al. (2007). This may be because of the fact that the feeds used for this study were pelleted. The higher feed intakes consequently resulted in better weight gain. The feed-to-gain ratios of between 4.95 and 5.78 observed although higher than the range reported by Adejumo (2002) were however similar to values obtained by Iheukwuemere et al. (2002) for rabbits on rice milling waste. This implies that the test ingredients compared favourably with other unconventional ingredient such as rice milling waste, cassava leaf meal and gliricidia leaf meal. Feed cost per kilogram feed reduced significantly (P<0.05) as the inclusion level of MSKM increased implying some cost reduction on the feeds.

Table 3 - Performance characteristic of weaner rabbis fed graded levels of SMSKM and PMSKM

		SMSKM		PMSKM			
Parameters	0%	10%	20%	10%	20%	**SEM**	**SL**
IW (g)	631.33	632.63	646.36	630.70	631.72	34.49	NS
FLWt (g)	1462.00	139.50	1435.0	1430.0	1390.17	43.71	NS
ADWG (g/day)	14.08	12.91	13.37	13.35	12.85	0.63	NS
AFI (g/day)	71.57	65.37	63.51	67.69	68.64	1.68	NS
FCR	5.27	5.28	4.95	5.15	5.78	0.25	NS
FC/kg feed (₦)	67.95	62.17	53.89	63.17	54.89	0.99	*
FC/Kg wt. gain	357.97	327.96	257.20	325.13	317.20	15.62	*

*=Significant difference, NS=No Significant difference (P>0.05), FLW=final live weight, SMSKM=Sun dried mango seed kernel meal, PMSKM=Parboiled mango seed kernel meal SEM=Standard Error of means, SL = Significant level, FCR=Feed conversion ratio, FC=Feed cost, AFI=Average Feed intake, ADWG=Average daily weight gain, IW=Initial weight.

The main effects of processing methods on the performance of weaner rabbits is presented in Table 4. Sun drying or parboiling did not affect (P>0.05) the performance of rabbits in term of weight gain, feed to gain ratio and feed intake. The main effect of inclusion levels of MSKM on the performance of weaner rabbits is also presented in Table 5. The effect of inclusion levels was not significant (P<0.05). This shows that varying the inclusion levels between 10% and 20% did not have effect on the final weight, dressing percentage, feed to gain ratio and feed intake. In addition, the interactions between processing method and inclusion level were significant (P<0.05) thus indicating that the effect of processing methods on the performance of rabbits are independent of the inclusion levels and vice versa.

The carcass characteristics and relative organ weights of weaner rabbits fed graded levels of SMSKM and PMSKM is presented in Table 6. Relative weights of heart, liver, kidney and spleen as well as weights of the head, fur and abdominal fat of rabbits fed with SMSKM and PMSKV were not significantly (P>0.05) different from the control diets. The dressed weight usually expressed as dressing percentage is an indication of value of meat that could be obtained from the animal. The study shows that dressing percentage of the rabbits which ranged from 56.90 to 61.45% were not significantly (P>0.05) different from each other.

Table 4 - Main effect of processing methods on performance of rabbits fed processed MSKM

Parameters (g)	**Control**	**Sun drying**	**Parboiling**	**SEM**	**SL**
Initial wt. (g)	631.33	639.50	631.21	56.72	NS
Final wt. gain (g)	1462.00	1414.70	1410.08	71.40	NS
Total wt. gain/animal (g)	830.67	775.20	778.88	58.22	NS
Av. Gain/day/animal	14.08	13.14	13.20	0.987	NS
Total feed intake (kg)	4.22	3.80	4.02	0.155	NS
Feed gain ratio	5.27	5.11	5.46	0.402	NS
Feed cost/kg feed (₦)	67.95	58.03	59.03	0.95	NS
Av. Feed intake/day/rabbit (g)	71.57	64.44	68.16	2.635	NS
Feed cost/kg wt. gain (₦)	357.97	292.58	321.17	23.75	NS
Dressing percentage	61.45	56.91	57.35	0.68	NS

SEM = Standard Error of means

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Table 5 - Main effect of inclusion levels on performance of rabbits fed processed MSKM

Parameters	Control	10%	20%	SEM	SL
Initial wt. (g)	631.33	631.67	639.04	56.72	NS
Final wt. gain (g)	1462.00	1412.25	1412.58	71.40	NS
Total wt. gain/animal (g)	830.67	780.58	773.54	58.22	NS
Av. Gain/day/animal	14.08	13.23	13.11	0.987	NS
Total feed intake (kg)	4.22	3.93	3.90	0.155	NS
Feed gain ratio	5.27	5.21	5.36	0.402	NS
Feed cost/kg feed (₦)	67.95	62.67	54.39	0.95	NS
Av. Feed intake/day/rabbit (g)	71.57	66.53	66.07	2.635	NS
Feed cost/kg wt. gain (₦)	357.97	326.55	287.20	23.75	NS
Dressing percentage (%)	61.45	57.14	57.35	0.678	NS

SEM = Standard Error of means

Table 6 - Carcass characteristic and relative organ weights of weaner rabbits fed SMSKM and PMSKM

Parameters		SMSKM		PMSKM			
	0%	10%	20%	10%	20%	SEM	SL
Head (%live eight)	9.16	9.13	9.51	8.92	9.51	0.15	NS
Dressing percentage (%)	61.45	56.90	56.93	57.38	57.31	0.72	NS
Heart	0.40	0.44	0.44	0.40	0.40	0.01	NS
Lung	0.97	1.01	1.07	0.92	1.09	0.04	NS
Kidney	1.00	1.06	1.16	1.01	1.01	0.03	NS
Spleen	0.10	0.13	0.12	0.10	0.10	0.01	NS
Abdominal fat	2.08	1.80	2.07	2.10	2.10	0.18	NS
Liver	4.47	5.11	5.47	4.80	4.80	0.15	NS
Paired testis Wt.	0.30	0.31	0.25	0.26	0.26	0.02	NS
Fur	10.64	16.67	13.82	14.10	14.10	0.98	NS

NS=No Significant difference (P>0.05), SMSKM=Sun dried mango seed kernel meal, PMSKM=Parboiled mango seed kernel meal, SEM= Standard Error of means

Madhusadha et al. (1986) reported that presence of anti-nutritional factors is associated with enlargement of organs like liver and pancreas but Al-Dabagh and Abdulla (1963) remarked that factors like age, diet and body weight affected organ weights. However, Bamgbose et al. (2004) reported that dressed weight and internal organ weight characteristics are veritable indicators of the level of reduction or otherwise of anti-nutritional factors.

There was no enlargement or atrophy of the internal organs beyond normal thus indicating that the rabbits were able to tolerate the test ingredients. Also the higher weight of fur observed from the rabbit fed with MSKM compared to control may be a good indicator for the farmer interested in the fur production. The concern of the farmer is the production cost, the reduction in the feed cost per kilogram and total feed cost observed, showed that rabbits cost of production can be reduced using sun dried or parboiled mango seed kernel.

CONCLUSION

It could be concluded that processed mango seed kernel meal holds potential for fattening rabbits as an energy source. The fur production was favoured by the use of mango seed kernel meal. This may also be an additional advantage for those interested in fur production. Therefore SMSKM and PMSKM can be included up to 20% in growing rabbit rations without adverse effect on growth performance and carcass characteristics of growing rabbits. The use of this non-conventional feed ingredient of no direct human value will lead to lower production cost and more revenue will accrue to the farmers thus encouraging them to produce more and ultimately making more animal protein available to the populace.

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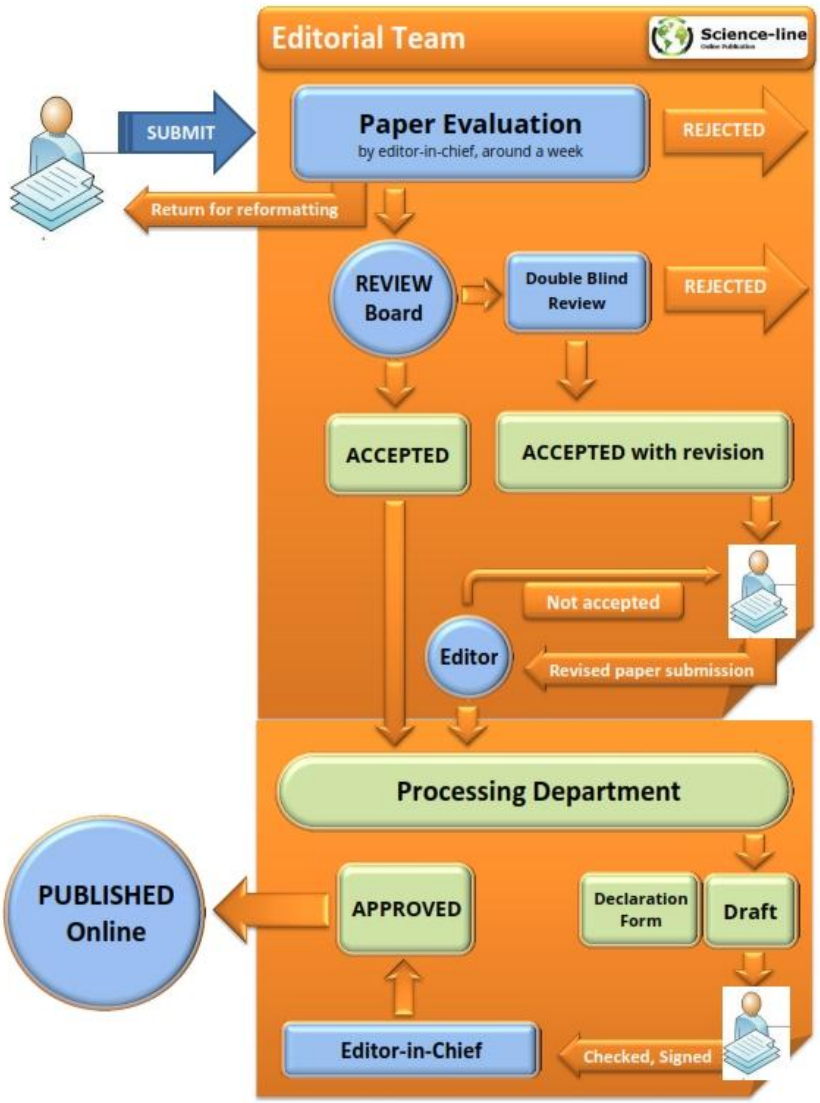

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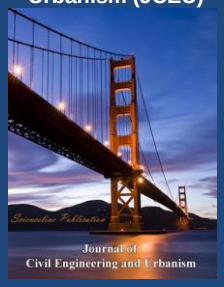

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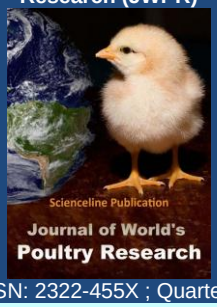

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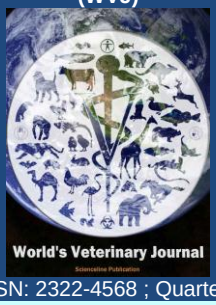

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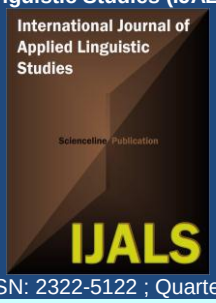

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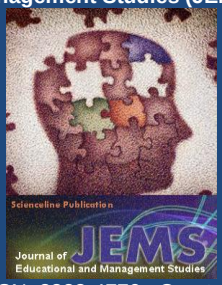

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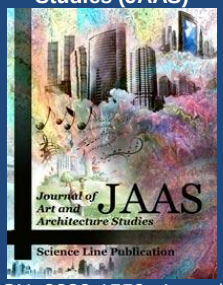

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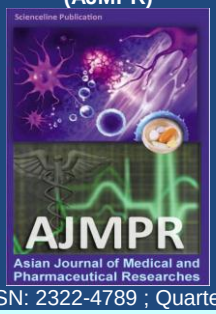

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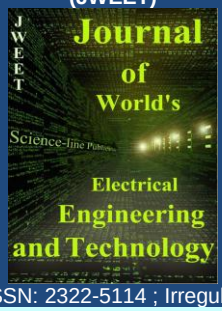

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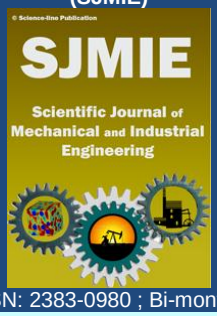

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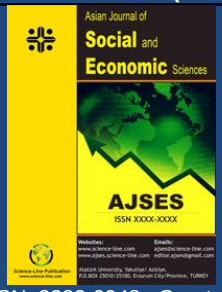

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