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Effect of Supplementation on Performance of Calves on Smallholder Dairy Farms in Bahati Division of Nakuru District, Kenya

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Abstract: Inadequate feeding and high disease prevalence are considered as the major setback to dairy production on smallholder farms in Kenya. Under such circumstances, heavy losses of young calves occur. This is the situation presently on these farms. The current study was conducted in Bahati division of Nakuru district over a period of 3 years. Out of 120 smallholder farmers randomly visited and interviewed, 60 of them were selected to participate in the trial, based on whether they have dairy cattle and willing to collaborate. The selected farmers were trained on data recording and provided with a heart-girth measuring tape, a spring balance (25 kg), a 10-litre plastic bucket (for feed weighing), a 1-litre graduated jug (for measuring milk) and a record book. They were then divided into two groups (Control and test) of 30 each. Control group was asked to continue with their ordinary calf management, where supplementation was not offered. Test farmers were asked to strictly follow the research calf-feeding schedule where Napier grass cv Bana was fed as a basal diet and supplemented with protein rich forages (Lucernne; Sweet potato vines cv Munsinya; Desmodium cv Green leaf and fodder shrubs (*Leucaena leucocephala* and *Sesbania sesban*). Parameters of study were growth rate, mortality, morbidity and dynamics. The collected data was stored in MS-excel and later subjected to appropriate statistical models (SAS) to established the calf performance difference between the 2 farm groups and livestock production systems. The results showed that calves in test farms performed better (370 g/d) compared to those in control farms (307 g/d)($P<0.01$). The study further revealed that calves supplemented with an assortment of protein rich forages showed a rapid body weight gain (375 and 417 g/d) compared to those offered SPV as a sole protein supplement (345 g/d) ($P<0.05$). It was further observed that the overall female calf mortality in zero grazing test farms was low (6%) compared to semi-zero and free grazing test farms (15 and 20%, respectively)($P<0.05$). In the same farms mortality of male and female calves was different ($P<0.05$). Mortality for male calves was observed to be higher (Test-zero: Male – 13%; Female – 6%; Control-zero: Male – 11% and Female 9%). The same trend was observed across the test and control farms in semi-zero and free grazing systems. On calf dynamics, off-take for male (33 – 78%) calves was observed to be much higher that for female calves (6 – 33%)($P<0.001$). It was therefore concluded that protein supplementation, using farm grown forages improves performance of dairy calves on smallholder farms. The authors recommend that resource-poor farmers emphasize on cultivation of forage legumes so as to have sufficient protein rich diets for young dairy calves.

Key words: Legumes, forages, daily weight gain, off-take, mortality, calf survival

Introduction

Long-term sustainability of any dairy production system depends on a sound herd management. As part of herd management, good calf rearing is essential as it ensures availability of future replacement stock. Loss of dairy calves on smallholder farms is acknowledged as one of the main setbacks to increased dairy production in Kenya (Gitau *et al*., 1994a). It is reported that poor housing, malnutrition and poor disease control strategies are the main factors limiting survival and performance of dairy calves on these farms (Gitau *et al*., 1994a,b,c; Mulei *et al*., 1995). Methods of rearing dairy calves in Kenya vary from farm to farm. In majority of smallholder resource – poor farms, dairy calves are commonly open grazed or tethered on natural tropical pastures throughout the year without protein supplementation. They are also mostly housed together with other livestock, particularly small ruminants. As a result of inadequate feeding and poor management, high mortality of dairy calves on smallholder farms in Kenya have been reported (Gitau *et al*., 1994a). Most of the calf mortalities on smallholder farms occur at early

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age. Other research findings showed a similar scenario across many small farms in Africa (Payne 1990; Latif *et al.*, 1989; Leng, 1992). Jagun (1982) reported that, over 29% of losses in calves occur during the first 30 days post-partum. In Kenya, calf mortality rates of 35% have been reported (Lanyasunya *et al.*, 1998; Gitau *et al.*, 1994a). The calf losses are strongly attributed to malnutrition and diseases. Diseases such as gastro-enteritis due to *Colibacillosis*, *Samonellosis*, *Coccidiosis* and *Heminthiasis* and tick-borne (East Coast Fever, *Babesiosis*, *Anaplasmosis* and Heart water) compounded by malnutrition are reported to be the major killers of dairy calves on smallholder farms in Kenya and other parts of Africa (Kariuki, 1974; Ongare *et al.*, 1985; Gatongi *et al.*, 1987; Mulei and Rege, 1989; Maingi and Gichigi, 1992; Nyangito *et al.*, 1996; Moll *et al.*, 1986; Tekdek and Ogunsusi, 1987; Negesse, 1994). The economic impact of calf losses is worsened by the small herd sizes (1 to 3 heads) on these farms (Schiere and Ibrahim, 1986). Poor plane of nutrition predisposes calves to diseases. The current calf feeding regimes where tropical grasses constitute the primary diet, makes it unlikely that calves have balanced nutrient supply for long enough to enable them pass the critical stage (Payne, 1990). Calves are rapidly growing animals and therefore cannot meet their nutrient requirements from poor quality tropical pastures alone (Barret and Larkin, 1974). It is reported that, good feeding and care of calves greatly improves their survival rate (Kabuga, 1990; Gitau *et al.*, 1994a). For a heifer calf to attain full productive potential, appropriate feeding is essential. Regular protein supplementation is particularly critical. For smallholder farmers in Kenya, farm grown legume forages remain the best option for addressing protein deficiencies in calf diets. The current study was conducted to evaluate performance of dairy calves supplemented with protein rich forages on smallholder farms.

Materials and Methods

The current study was conducted in Bahati division of Nakuru district over a period of 3 years. Bahati is one of the most dairying divisions of Nakuru district. At farm level dairy production is the most important income earner. Selection of farms to participate in the trial was done through a 3- week reconnaissance survey. During the survey, a structured questionnaire was administered to gather farm baseline data. About 120 smallholder farmers (with an average of 2.0 acres and dairy herd size of about 4 heads) practicing mixed farming were randomly visited and interviewed. A transect-walk approach was applied and every farm falling on the transect line, was interviewed. Based on whether they have dairy cattle and are willing to collaborate, 60 of the interviewed households were selected to participate in the trial. The selected farmers were divided into two groups (Control and test) of 30 each. All the selected farmers and the frontline extension staff present in the area of study were then trained on data recording and general herd management. To facilitate data recording each of the 60 farm households was provided with a standard heart-girth measuring tape (for weight estimation), a spring balance (25 kg), a 10-litre plastic bucket (for feed weighing), a 1-litre graduated jug (for measuring milk) and a record book. All the farmers in control group were asked to continue with their ordinary calf management system where supplementation and housing were not provided. Each of the test farmers was further provided with a movable individual calf pen compartmentalized with water and feed troughs, a daily calf feeding schedule, a calf performance monitoring chart and forage planting materials. While calves in control farms were expected to, primarily, feed on diets based on tropical pastures, those in test group were fed on Napier grass (*Pennisetum purpureum*) cv Bana as a basal diet and supplemented with protein rich forages (Lucernne: *Medicago sativa*; Sweet potato vines: *Ipomoea batatus* cv Munsinya; Desmodium: *Desmodium intortum* cv Green leaf and fodder shrubs (*Leucaena leucocephala* and *Sesbania sesban*). Calves in test farms were also regularly de-wormed. In each of the 60 farms, calf performance (body weigh change, mortality and morbidity) was monitored on daily basis. This was conducted by individual farmers with the help of extension staff. Research workers visited the trial farms once every two weeks. To determine system effects, all the farms (60), irrespective of research category (control or test) were later stratified according to the existing livestock production systems (zero, semi-zero and free grazing). The collected data was stored in MS-excel and later subjected to appropriate statistical models to established the calf performance difference between the 2 farm groups and livestock production systems. Measurements of calf weights were scatter plotted using Lotus software.

Results

Body weight gains of the first batch of 116 calves aged about 170 days were compared (Table 1, 2). The results showed that calves in test farms performed better (370 g/d) compared to those in control farms (307 g/d) ($P<0.01$). The study further revealed that calves supplemented with an assortment of protein rich forages showed a rapid body weight gain (375 and 417 g/d) compared to those offered SPV as a sole protein supplement (345 g/d; Table 2) ($P<0.05$). Comparatively, calves in control group performed poorly.

Statistical models developed to compare body weight changes of male and female calves in different production systems are presented in Table 3 (N = 116 and age: about 170 days).

Both the age of the calf and the weight of the dams at the

Table 1: Average daily gain (g/d) of the first 116 dairy calves in the study farms

	Body weight gains		
Category	N	Mean	S.E.
Overall	116	338	13
Control farms	55	307[a]	20
Test farms	61	370[b]	18

Means with different subscript ([a, b]) are significantly different (P<0.01)

Table 2: Average daily gains (g/d) of calves offered different protein supplements in test compared to non-supplemented in control farms

	Body weight gains		
Category	N	Mean	S.E.
Test farms:			
Sweet potato vines (SPV)	17	345[a]	66
Desmodium + SPV[+]	20	375[b]	30
Fodder shrubs + SPV[+]	24	417[b]	60
Control: No supplement	55	307[a]	19

The subscript (+) implies "plus other assorted protein rich legumes); Means with different subscript ([a, b]) are significantly different (P<0.05)

Table 3: Live weight models for 116 calves differentiated for calf sex and production system in the study farms

System	Calf sex	N_R	Model	R^2
Zero-grazing	Male	120	Wt = 0.074*DmWt + 0.250*CAge (d) + 16.7	0.47
	Female	151	Wt = 0.085*DmWt + 0.339*CAge (d) + 12.0	0.46
Semi-zero grazing	Male	49	Wt = 0.105*DmWt + 0.297*CAge (d) + 78.0	0.77
	Female	68	Wt = 0.036*DmWt + 0.339*CAge (d) + 51.8	0.71
Free grazing	Male	78	Wt = 0.078*DmWt + 0.236*CAge (d) + 19.3	0.67
	Female	77	Wt = 0.137*DmWt + 0.258*CAge (d) – 2.1	0.60

Wt – calf weight; DmWt – Dam weight; N_R – Number of heart-girth measurements used; CAge – calf age in days

first measurements after calving, explained between 45-77% of the observed variations in calf weight by sex and production (grazing) system. At 810 days of study, the number of calves, which had participated in the trial, was 123 (Table 4). This number increased to 140 calves at the end of the trial (1170 days). As the number of calf records increased, considerable variations in live weight development, mortality, morbidity and dynamics became apparent. These variations were observed across all the production systems. It was observed that the overall female calf mortality in zero grazing test farms was low (6%) compared to semi-zero and free grazing test farms (15 and 20%, respectively)(P>0.05). In the same farms mortality of male and female calves was different (P<0.05). Mortality for male calves was observed to be higher (Test-zero: Male - 13%; Female - 6%; Control-zero: Male - 11% and Female 9%). The same trend was observed across the test and control farms in semi-zero and free grazing systems (Table 4). On calf dynamics, off-take for male (33-78%) calves was observed to be much higher than for female calves (6-33%)(P<0.001). Off-take for female and male calves ranged between 6-29% and 40-69% respectively. Control farms recorded higher off-take (Female: 11- 33% and Male: 33-78%).

The statistical models developed to compare body weight changes of male and female calves over 1170 days of study (N = 140) on different production systems are presented in Table 5.

Fig. 1 and 2 presents the scatter plots of individual calf body weight changes stratified according to sex and livestock production system monitored over 1170 days. The scatter plots clearly illustrated that female calves performed better than male calves.

Discussion

The results obtained showed that improved management of dairy calves had a positive impact on their growth and survival. Protein supplementation increased their rate of daily weight gain. This was quite in agreement with research findings obtained elsewhere. Gitau *et al.* (1994a and b) reported an average body weight gain of 210 g/d without supplementation on smallholder farms in Kiambu district, Kenya. With minimum supplementation, de Jong (1996) and Larbi *et al.* (1992) reported weight gains of about 481 and 370 g/d respectively. Karachi and Dzowela (1990) reported that calves supplemented with SPV and other protein rich legumes gained 2.5 times more than calves on grass alone. The same author further demonstrated that calves supplemented with

Table 4: Calf structure, mortality and dynamics at 810 days in the study farms

System	Farm type	Calf sex	N	Mortality	Sold (%)
Zero grazing	Test	Female	33	6	6
	Test	Male	16	13	69
	Control	Female	3	0	33
	Control	Male	9	11	78
Semi-zero grazing	Test	Female	7	15	29
	Test	Male	2	0	50
	Control	Female	9	22	22
	Control	Male	9	0	70
Free grazing	Test	Female	10	20	20
	Test	Male	10	50	40
	Control	Female	9	22	11
	Control	Male	6	33	33

N – number of calves.

Table 5: Live weight development models for 140 calves stratified according to production systems, calf sex and dam weight in the study farms

System	Calf sex	Model
Zero grazing	Male	$Wt = 1.858*DmWt + 0.344*CAge\ (d)\ 2.158^{-3}*DmWt^2 - 342$
	Female	$Wt = 0.588*DmWt + 0.355*CAge\ (d)\ 6.918^{-4}*DmWt^2 - 70$
Semi-zero grazing	Male	$Wt = 0.790*DmWt + 0.256*CAge\ (d)\ 2.158^{-3}*DmWt^2 + 69$
	Female	$Wt = 0.847*DmWt + 0.315*CAge\ (d)\ 1.287^{-2}*DmWt^2 + 179$
Free grazing	Male	$Wt = 0.129*DmWt + 0.238*CAge\ (d)\ 1.351^{-4}*DmWt^2 + 3$
	Female	$Wt = 0.920*DmWt + 0.278*CAge\ (d)\ 1.380^{-3}*DmWt^2 - 108$

Wt – calf weight; DmWt – Dam weight; CAge – calf age in days

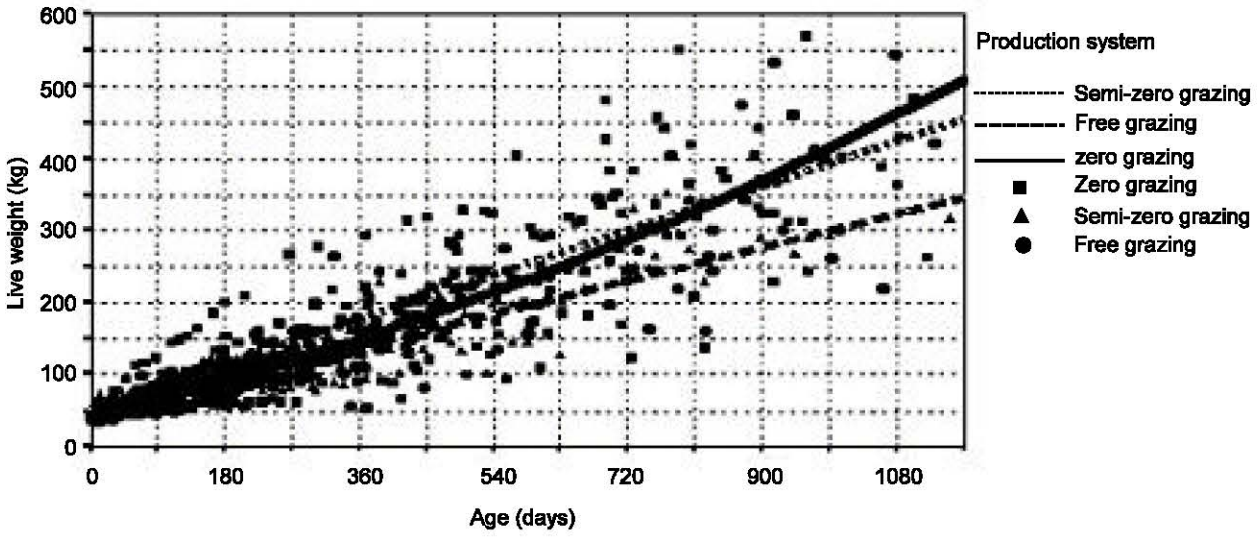

Fig. 1: Live weight development of female calves monitored over 1170 days in the study farms

SPV showed 49% more efficiency in utilizing their feed than calves fed on grass alone. The observed improved calf growth rate was strongly attributed to the ability of the supplementary forages to provide sufficient nitrogen to spur rumen microbes activity. This enabled the animals to utilize low quality roughages more efficiently. The improved calf survival in test farms was also attributed to the use of individual calf pens. This minimized the rate at which disease causing pathogens and parasites are transmitted to the calves. The high off-take of male calves on the study farms showed that, majority of smallholder farmers do not prefer keeping them on-farm. Cost of rearing exacerbated by limited resource is strongly attributed to the observed high off-take of male calves. The study also revealed that generally, animals in zero grazing system performed better than those in

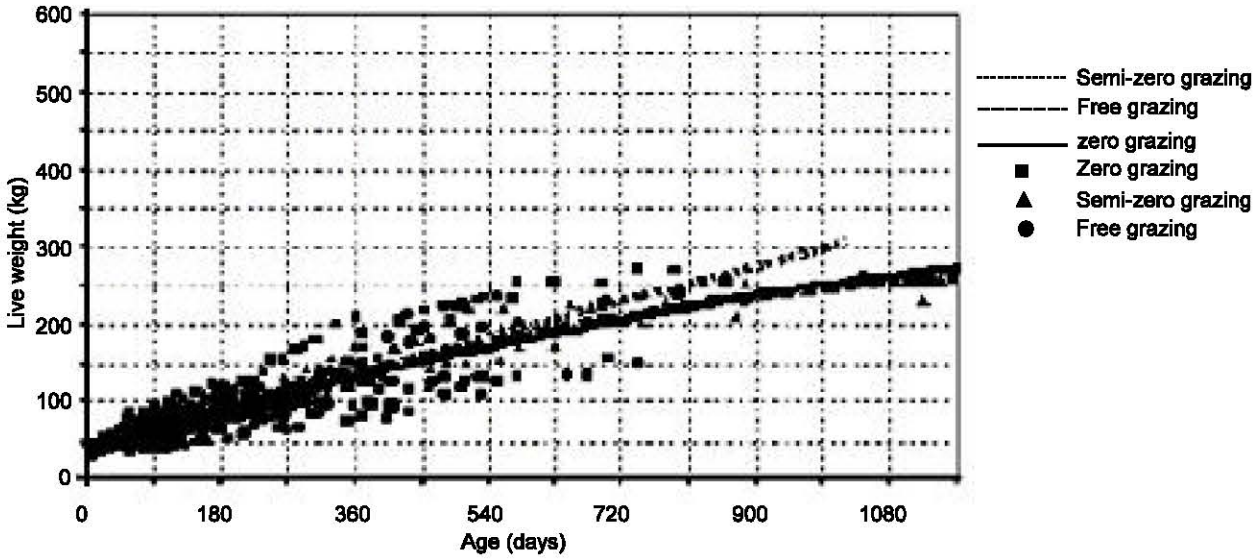

Fig. 2: Live weight development of male calves monitored over 1170 days in the study farms

semi-zero and free grazing. Improved attention and/or management given to zero grazed animals are probably the factors behind their comparatively good performance.

Conclusion: From the results obtained, it can be concluded that protein supplementation improves performance of dairy calves on smallholder farms. It is therefore recommended that, farmers pay serious attention to supplementation of calves so as to improve their future performance as adult animals. Appropriate use of farm grown legume forages can on one hand satisfy the nutritional needs of calves and on the other reduce calf-feeding cost. This is particularly relevant for resource-poor farmers. Employment of management strategies that ensure minimum transmission of disease causing pathogens and parasites to the calf will complement improved plane of nutrition. This ensures that the heifer calf attains her full production potential.

References

Barret, M.A. and P.J. Larkin, 1974. Milk and beef production in the tropics. Oxford Univ. Press. U.K., pp: 128 - 132.

Gatongi, P.M., J.M. Gathuma and W.K. Munyua, 1987. The Prevalence of gastrointestinal nematodes in cattle in Tetu division of Nyeri district, Kenya. Bull. Anim. Hlth. Prod. Afr., 35: 294-297.

Gitau, G.K., C.J. O'Callaghan, J.J. McDermott, A.O. Omore, P.A. Odima, C.M. Mulei and J.K. Kilungo, 1994a. Description of smallholder dairy farms in Kiambu district, Kenya. Prev. Vet. Med. 21: 155-166.

Gitau, G.K., J.J. McDermott, J.E. Adams, K.D. Lissemore and D. Walter-Toews, 1994b. Factors influencing calf growth and daily weight gain on smallholder dairy farms in Kiambu district, Kenya. Prev. Vet. Med., 21: 179-190.

Gitau, G.K., J.J. McDermott, D. Waltner-Toews, K.D. Lissemore, J.M. Osumo and D. Muriuki, 1994c. Factors influencing calf morbidity and mortality in smallholder dairy farms in Kiambu district of Kenya. Prev. Vet. Med., 21: 167-177.

Jagun, A.G., 1982. Calf mortality on Shika farm during 1995 to 1979. Bull Anim. health prod. Africa, Zaria, Nigeria, pp: 133-137.

de Jong, R., 1996. Dairy stock development and milk production with smallholders. Ph.D thesis. Agricultural University Wageningen. Netherlands, pp: 22-29.

Kabuga, J.D., 1990. Calf losses and reproductive disorders in a herd of Holstein-Friesians. Ph.D. Wageningen Agricultural university. The Netherlands, pp: 20-27.

Karachi, M.K. and B.H. Dzowela, 1990. The potential of sweet potato (ipomea batatas (L) Lamb) as a dual purpose crop in semi-arid crop/livestock systems in Kenya. In: Utilization of research results on forage and agricultural by-product materials as feed resources in Africa. PANESA/ARNAD, pp: 518-531.

Kariuki, D.P., 1974. Studies on calf diseases with special reference to infection with Escherichia colli. M.Sc thesis, University of Nairobi, Nairobi.

Lanyasunya, T.P., 1998. Effect of changes in calf rearing practices at smallholder dairy farms in Bahati Division, Nakuru District, Kenya. Msc. Thesis. Wageningen Agricultural University. The Netherlands, pp: 1-68.

Larbi, A., J. Ochang, S. Grosse, T. Alemu and J.C. Harnadec, 1992. Desmodium intortun cv Greenleaf and Macrotyloma axillatre cv Archer as dry season protein supplements for Jersey calves and milking cows in Ethiopia. Bull. Anim. Prod. Africa, 40: 87-91.

Latif, A.A., D.K. Punyua, P.B. Capstick, S.P. Morzaria and A.S. Young, 1989. Oxytetracycline for protection of cattle under endemic East Coast fever challenge in Kenya. VIII Int. Congress of protozoology, 10-17 July, Tsukuba, Japan.

Leng, R.A., 1992. Drought feeding and strategies. In: Theory and practice. Oxford. pp.10-139.

Maingi, N. and M.N. Gichigi, 1992. Gastrointestinal nematodes in cattle on four farms in Nyandarua district Kenya. Bull. Anim. Prod. Africa., 40: 9-10.

Moll, G., A. Lohding, A.S. Young and B.L. Leitch, 1986. Epidemiology of Theileriosis in calves in an endemic area of Kenya. Vet. Parasitol., 19: 255-273.

Mulei, C.M., G.K. Gitau and P.G. Mbuthia, 1995. *Causes of calf mortality in Kabete area of Kenya*. Onderstepoort J. Vet. Res., 62: 181-185.

Mulei, C.M. and J.E.O. Rege, 1989. An examination of the incidence of ECF, Anaplasmosis and Babesiosis in the bovine in Kabete area of Kiambu District of Kenya. Bull. Anim. Hlth. Prod. Afr., 37: 213-216.

Negesse, T., 1994. Prevalence of Bovine flatworms in different classes of cattle at different seasons and altitudes of southern Ethiopia. Bull. Anim. Hlth. Prod. Afr. 42: 199-203.

Nyangito, H.O., J.W. Richardson, D.S. Mundy, A.W. Mukhebi, P. Zimmel and J. Namken, 1996. Economic impacts of East Coast fever immunization on smallholder farms,Kenya: a simulation analysis. Agri. Econ., 13: 163-177.

Ongare, J.O., W.K. Munyua, A.J. Willson and F.G.R. Rinkanya, 1985. Survey of ticks resistance in Kiambu district of Kenya : A comparison of two resistance test methods. Bull. Anim. Hlth. Prod. Afr., 33: 89-99, 198-203.

Payne, W.J.A., 1990. An introduction to animal husbandry in the tropics. 4th edition. Longman Sci. Tec., London, pp: 320-323.

Schiere, J.B. and M.N.M. Ibrahim, 1986. Socio-economic considerations relevant for developing small farmers (livestock) production. In: Rice straw and feeds in Ruminants rations. Wageningen Agricultural University. Wageningen, pp: 25-35.

Tekdek, L.B. and R.A. Ogunsusi, 1987. Gastro-intestinal parasitism in young calves around Zaria, Nigeria. Bull. Anim. Hlth. Prod. Afr., 35: 185-190.