Global Veterinaria 23 (4): 188-195, 2021
ISSN 1992-6197

DOI: 10.5829/idosi.gv.2021.188.195

Study on Prevalence of Milk Fever and its Subsequent Complication on High Blood Level Dairy Cows with Assessment of Calcium Content from their Feed Resources in Urban and Peri-Urban Dairy Farms of Adama and Bishoftu Districts, Ethiopia

Leta Muleta

Animal Health Control and Drug Dispenser, Liban Jawi Districts, Oromia, Ethiopia

Abstract: Cross sectional study was undertaken to estimate question based prevalence of milk fever and complicated disorder and assessment of calcium content of major dairy feed sources. A total of 120 dairy farms were selected purposively, 60 dairy farms from each districts (Bishoftu and Adama). In this study the overall prevalence of milk fever was 56.9% in Bishoftu and 43.1% in Adama districts and 55% and 41.7% in urban and peri urban area respectively. The incidence of milk fever was analyzed based on production system, it is 51.4% and 23.1% in intensive and semi intensive production system respectively with P =0.05. Based on farm size the incidence of milk fever increased (P <0.05) with increasing the farm size (25.6%, 35.7% and 71.7%) for small, medium and large farms, respectively. Retention of placenta, delayed uterine involution, delayed onset of puberty, dystocia and emaciation were the major disorder considered in farms with high incidence of milk fever. All these disorders are statically significant. Ration constituent samples (n=20) were analyzed for calcium content per kg of dry matter indicated that poultry manure, alfalfa and oats vetch contained high calcium content but the calcium content of the same feed was different in different localities. Over feeding and under feeding of calcium, absence of mineral supplementation and improper supplementation was the major cause of the milk fever and the owners of dairy farms and private animal owners should be aware of the disease themselves how to manage peripartum intake of calcium.

Key words: Adama · Bishoftu · Ethiopia · Calcium · Milk Fever · Dairy Cow

INTRODUCTION

Minerals are structural components of body and play significant role in activities of enzyme, hormone, as constituents of body fluids and tissues and as regulators of cell replication and differentiation. Five percent of the body weight of an animal consists of minerals and at least 15 mineral elements have been identified as nutritionally essential for ruminants. These are seven major or macro minerals and eight trace or micro minerals [1]. Most of them are deficient in the diet of livestock in most of the regions of the world [2].

The dietary concentrations of the feeds are unknown or highly variable due to availability, season, location, forage species and animal potentials, it is important to determine mineral concentrations in animals region-wise, to estimate needs of livestock so as to obtain optimum productivity [3].

Mineral deficiencies, imbalances and toxicity of certain mineral elements may cause reproductive disorders as minerals play an important role in health, production and reproduction of the livestock [4]. After energy and protein, minerals are the major nutrients required and should be given priority in order to optimize reproduction in dairy cattle [5]. Beside energy and protein, deficiency of these elements such as calcium, phosphorus, iron, zinc and copper in blood have been reported to be a predisposing factor for the occurrence of retention of placenta and repeat breeding in dairy cows [6]. The Ca: P ratio alteration may affect ovarian function through its blocking action on pituitary gland. This results in prolongation of first estrus and ovulation, delayed uterine involution, increased incidence of dystocia, retention of placenta and prolapse of uterus [7]. Moreover low calcium level in blood is also associated with anoestrus whereas excess of calcium can affect the reproductive status of

Corresponding Author: Leta Muleta, Animal Health Control and Drug Dispenser, Liban Jawi, Oromia, Ethiopa. Tel: + 251916890921.

animal by impairing absorption of phosphorus, manganese, zinc, copper and other elements from gastrointestinal tract.

A major concern in the mineral feeding of dry cows relates to providing optimum levels of calcium and phosphorus in order to decrease the occurrence of milk fever [8]. Hypocalcaemia develops when the serum calcium drops below 7.5 mg/dL from the normal 8 - 10 mg/ dL and milk fever sets in when it further drops to below 6.5 mg/dL [9]. The prevalence of milk fever is 30.2% and milk fever is highly associated with parity and milk yield [10].

Assessment of the quantity and quality of available feed resources in relation to livestock requirement has not been yet well addressed in most livestock production areas of Ethiopia. The adequacy of the diet in essential minerals can be determined by chemical analysis of animal body tissue, fluids and forages which are being eaten by the animals [11]. Most of macro and micro minerals are deficient in the diet of livestock in most of the regions of the world and hence it is believed that the same may be true in Ethiopia. However, to infer conclusion dairy feed resource mineral assessment that covers large regions should be conducted as mineral in feed resources depends on soil mineral contents. one of the strategies to supply dietary minerals for dairy animals was to cover a high proportion (50 % or more) of dairy animal requirements with a mineral mix composition with minimal or, in some cases, no consideration of mineral content in the other dietary ingredients, i.e. forages, grains and byproducts [12]. Mineral chemical analyses (mainly macro minerals) of the different dietary ingredients of dairy feeds are used to adjust mineral contents in dairy diets [12]. Therefore the objectives of the study was to assess the prevalence of milk fever in urban and peri-urban dairy farms and to determine calcium contents of most commonly used dairy feed.

MATERIALS AND METHODS

Study Area: The study was conducted in urban and peri urban areas of Bishoftu and Adama towns from November 2019 up to June 2020. Bishoftu is located 45 kms South East of Addis Ababa, the capital city of the country. The area is located at 9°N latitude and 40°E longitudes at an altitude of 1850 meters above sea level in the central high land of Ethiopia. It has an annual rainfall of 866 mm of which 84% is in the long rainy season (June to September). The dry season extends from October to February. The mean annual maximum and minimum temperatures are 26°C and 14°C, respectively with mean relatively humidity of 61.3% (16). Adama forms a Special Zone of Oromia and is surrounded by East Shoa Zone. It is located at 8.54°N 39.27°E at an elevation of 1712 meters, 99 km southeast of Addis Ababa. The mean annual maximum and minimum temperatures are 31°C and 16°C, respectively with mean relatively humidity of 67.3%. The city sits between the base of an escarpment to the west and the Great Rift Valley to the east (Adama - Wikipedia.htm).

Study Population: The study populations were high blood level cows in any parity stage of lactation similarly data collection from individual households focused on one lactating cow and dry cow from all dairy farms of urban and peri-urban area of Bishoftu and Adama towns and considering all conventional and no convention dairy feed resources which were available for their dairy

Study Design: A cross sectional study design was employed to assess dairy animal feed resources and their quality under the study area. Totally For this study, 120 dairy farms were selected purposively from urban and peri-urban area of Adama and Bishoftu districts based on primary and secondary data and information about physiological status of the animal and production potential of the animals. The blood samples were collected through stratified random sampling from lactating cows and dry cows of only 60 dairy farms. Totally 120 blood samples 120 questionnaires and 60 dairy feed samples were collected from the two districts.

Data Collection

Questionnaire Survey: Household level data was collected from interested dairy householders by employing interview based on questionnaires. The questionnaires was pre-tested and readjusted before the actual data collection started. Moreover, field observations on feed resource type, feeding practice, management system, herd size; milk yield from dairy cows was an important component of the study process. The contents of the questionnaires focused primarily on dairy cows feed resource, habit of mineral consideration in feeding of animal, major occurring diseases in dairy farm like milk fever and its associated complication.

Feed Sample Collection and Feed Sample Preparation

Feed Samples: Approximately 300g of feed samples from 60 dairy farms were collected using paper bag from urban and periurban area of Bishoftu and Adama town and taken to Bishoftu Agricultural Research Center, nutritional laboratory. Samples with high moisture contents were

dried in hot oven at 45°C. After that composite of feed were prepared according to feed types and collection site. The mixed feeds were weighted again and grinded by grinding mill. Then mineral matter and calcium analysis were finally measured in National Veterinary Institute (NVI) nutrition laboratory based on the lab protocol.

Data Analysis: The data collected were entered in Microsoft Excel (MS-Excel, 2007) and analyzed using SPSS (2009) statistical software and the results are explained using descriptive statistics and Pearson Chi square test for possible explanation of statistical significant difference between variables with 95% confidence interval and 5% degree of freedom that is, P value of less than 0.05 is considered to be significant.

RESULTS

Results of Surveys: From dairy households interviewed, 31.1% of dairy households depended on selling crop production and dairy production, 27.9 % of households depended on dairy product and trade activity, 16.4% of households were government employer and depended on dairy production and the last 24.6% of households depended on selling only dairy products, crop products and animals. But Only 34.4% dairy house holders used improved forage. The pie chart (Fig. 1) shows the family income of dairy household in Bishoftu and Adama districts.

From 120 dairy households subjected to interview, dairy farm 24 (20%) fed grass hay during the dry season, dairy farms 6(5%) fed it during the wet season and 42(40%) farms fed it during both seasons. Teff staw was added to the ration in 102(85%) dairy farms during dry period and in 4(3.3) dairy farms during wet season. Wheat straw is included in the ration of 68 (56.7%) dairy farms during dry period and none of them provide it during wet season. Wheat bran is provided in 92(76.7%) dairy farms during dry season and 7(5.7%) dairy households during wet season. Poultry manure is provided in 8 (6.7%) dairy farms during wet season and 3(2.5%) dairy farms in both seasons, the left 109 dairy farm fed no poultry manure. Nouge seed cake is provided in 5(4.2%) of dairy farms during wet season and 55(45.8%) of dairy farms in both seasons, the left 60(50%) of dairy farm were not provide nouge seed cake. Brewery by-product was provided in 5(4.2%) of dairy farms during dry season and 3(2.5%) of dairy farm in both season, the left 112 (93.3) of dairy farms were not provide. Molasses is provided in 9(7.5%) of dairy farm in dry season and 1(0.8%) of dairy farm provide during both seasons, the let 110(91.7) dairy farms were not provide. Silage is provided in 5(4.2%) of dairy farms during dry period and 118(95.5%) of dairy farms were not provide in both seasons. Elephant grass is provided in 2(1.7%) of dairy farm during dry season and 3(2.5%) of dairy farms during wet season, the left 115(95.8%) of dairy farms were not provide in both seasons. Oats vetch is provided in 37(30.8%) of dairy farms during dry season and 83(69.9%) of dairy farms were not provide. Alfalfa was provided in 1(0.8%) of dairy farm during dry season and 6(5%) of dairy farms during wet season, the left 113(94.2%) of dairy farm were not provide. The following table shows the percentage of different feed stuff at different time. From dairy households interviewed 68.3% (82) of dairy farms were provide different mineral supplementation, 25 dairy farms were not supplement and the left 13 dairy farms had no idea about mineral supplementation. 17(14.2%) of dairy farms supplement sodium chloride, 39(32.5%) of dairy farm supplement mineral block and sodium chloride, 32(26.7%) of dairy farm supplement Bole Soil 3(2.5%) of dairy farm supplement bole soil and sodium chloride, 3(2.5%) of dairy farm supplement mineral block, sodium chloride and bole soil and the left 7(5.8%) of dairy farm were has no idea about mineral supplementation. These dairy farms were supplement the mineral through licking 8(6.6%), through feed 76(63.3%), through drinking water 5(4.2%), through feeding and drinking water 16(13.3%) and the left dairy farms has no idea about supplementation.

Results of Laboratory: Totally 20 feed types were analyzed for calcium content: 13 feeds from Bishoftu and 7 feeds from Adama. The calcium content of these feed types was determined in NVI nutritional laboratory (Table 1).

Prevalence of Milk Fever: The Overall prevalence of milk fever was 47.5% in both districts and it encounters 55% in Bishoftu and 41.7% in Adama district. The prevalence of milk fever was 23.3% and 43.3% in urban and peri-urban area. Based on production system, the incidence of milk fever is high (P=0.05) in the intensive system (51.4%) compared to semi intensive production system (23.1%). Based on farm size, the incidence of milk fever ascended (P <0.00) linearly with increasing the size of the farm (25.6%, 35.7% and 71.7%) from small to large. The incidence of milk fever had low 39.7% when improved forages has been supplemented in the diet and 60.3 % when improved forages was not provided.

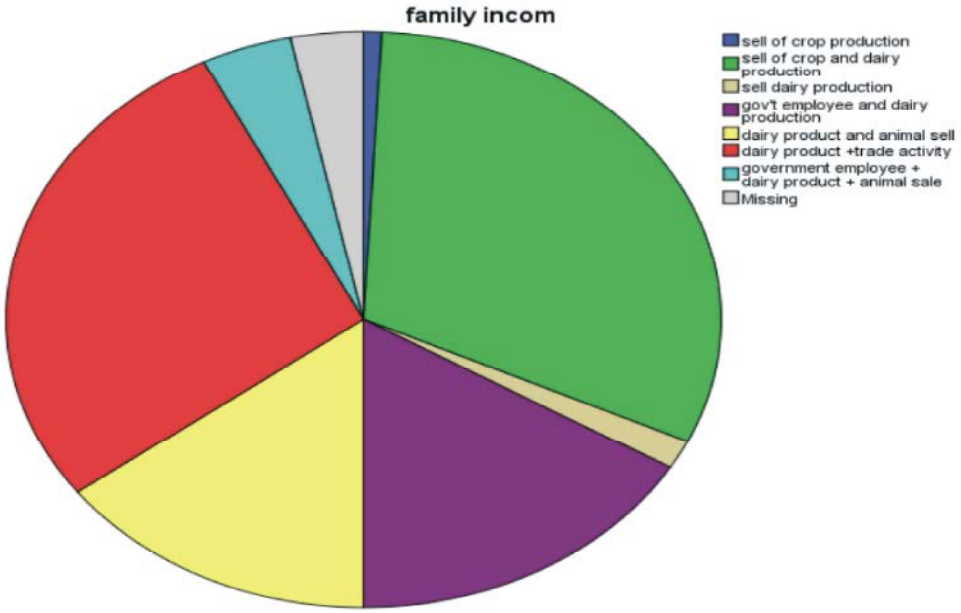

Fig. 1: Family income of dairy householders

Table 1: Calcium content of different feed types in gram per kilogram of dry matter

Feed sample from Bishoftu			Feed sample from Adama		
Feed type	Dry matter %	Ca g/kgDM	Feed type	Dry matter	Ca g/kgDM
Hay	97.693	15.35	Hay	95.783	12.18
Wheat straw	95.947	19.11	Wheat straw	97.253	11.99
Teff straw	95.99	12.15	Teff straw	96.61	15.53
Wheat bran	99.09	15.14	Concentrate	97.607	15.37
Wheat middling	97.448	11.97	Grounded bean	98.313	11.87
Ground maize	98.507	10.15	Cotton seed cake	97.020	16.30
Nouge seed cake	99.11	11.77	Sugarcane	96.587	12.08
Silage	90.733	12.86			
Oats vetch	97.46	17.10			
Napier grass	98.263	13.57			
alfafa	97.68	18.77			
Brewery by product	95.64	15.68			
Poultry manure	95.54	34.89			

Table 2: The prevalence of milk fever in different district and management system

Factor	No of farms interviewed	No of farm encounter milk fever	Prevalence of milk fever	χ^2	P value
District			2.13	0.144	
Bishoftu	60	33	55%		
Adama	60	25	41.7%		
Production level				1.201	0.273
Urban	60	32	23.3%		
Periurban	60	26	43.3%		
Mngt system				3.724	0.054
Intensive	107	55	51.4%		
Semintensive	13	3	23.1%		
Farm size				21.41	0.000
Small	39	10	25.6%		
Medium	28	10	35.7%		
Large	53	38	71.7%		
Improved forage production	42	23	54.8%	1.069	0.301
No production	78	35	44.9%		
Mineral supplementation	82	50	61%	16.87	0.000
No supplementation	25	6	24%		

Table 3: The prevalence of milk fever and disorders considered

	Milk fever			
Dirders considered	Yes	No	χ^2	P value
Delayed uterine involution				
Yes	65.2%	34.8%	3.248	0.072
No	44.4%	55.7%		
Retention of placenta				
Yes	54.7%	45.3%	7.488	0.006
No	24%	76%		
Incidence of dystoci				
Yes	80%	20%	4.381	0.03
No	45.5%	54.5%		
Infertility				
Yes	59.5%	40.5%	9.569	0.002
No	30.4%	69.6%		
Incidence of emaciation				
Yes	56.5%	44.4%	7.519	0.006
No	26.7%	73.3%		
Incidence of mastitis				
Yes	47.2%	52.9%	0.496	0.46
No	56.2%	42.8%		

The affected milk quality and quantity was analyzed in both districts which is 50.8% and 49.2% at Bishoftu and Adama districts respectively and it had encountered 49.2% and 50% on urban and peri urban respectively. The affected milk quality and quantity was also analyzed based on management system which had encountered 88.1% and 11.8% in intensive and semi intensive management system respectively with P>0.05 and it had encountered 35.6% where improved forages provided and while 64.4 % was encountered were improved forages not provided. Bole afar supplementation is more in Adama 51.4 % than Bishoftu 48.6% with $P > 0.05$.

DISCUSIONS

The family income of Bishoftu and Adama dairy farm householders were more dependent on crop production and dairy production, this is might be due to favorable condition of the area for crop cultivation, but they were less concentrated on improved forage production.

This study shows that different feeds contain variable calcium concentration even the same feeds from different area possess different content of calcium this might be due to soil content and time of harvesting of feeds. It is also documented that the availability of Ca in different feed is affected by factor which affects its presence in the soil like soil pH, interaction with other cation and alkaline soil. In this study the chicken manure was recorded as the most rich source of calcium as compared to the other sources of dairy feeds which contain 0.32g of Ca/kg of DM. This result exactly matches with previous results [13]. Alfalfa also founded as the most Ca content feed next to poultry manure which only fed in urban area of Bishoftu districts. It also documented that Alfalfa, long considered suspect in causing milk fever because of high calcium level. It also has high potassium levels. Grass hay can have lower levels, but over-fertilizing with potassium on hay fields increases both soil and hay potassium levels. High soil potassium often occurs in fields where manure has been applied for many years. Some have recommended harvesting forage separately for dry cows from fields where soil potassium levels are not high. A pre-mix of anionic salts and added calcium with a carrier such as soybean meal or ground corn is ideal. A pre-mix avoids improper mixing of anionic salts and allows changes in anionic salt content of the diet [14]. The present study shows that the calcium content of all straw was found between 11.99 -19.11 g per kg of dry matter. Similarly, nutrient composition of straw used in dairy cattle diets (0.13-0.33 g/kg DM) and oats vetch fall with the normal range (0.18-0.27g/kg DM) [15]. Most roughage is relatively good sources of calcium [16] Cereal hays, silages and such crop residues are relatively low in calcium. Although leguminous roughages are excellent sources of calcium, even non-legume roughages may supply adequate calcium for maintenance of cattle [17]. The present found that calcium content of wheat midling, wheat bran, cotton seed cake, brewery byproducts, grains and nouge seed cake not only present in normal range recommended by NRC [1] but is higher than previous reports [18].

Even though the improved forage production is high in Bishoftu the incidence of milk fever also high in Bishoftu districts. This is because the dairy farm owners did not know very well about the nutrient composition of the various feeds in Bishoftu and additional supplementation of bole soil in Adama districts. The overall prevalence of milk fever currently obtained is more or less related with the result obtained in Gondar [10]. The incidence of milk fever was more prevalent in Bishoftu district than Adama district but the difference was not statically significant this may be due to more supplementation of Bole Soil in Adama districts. The incidence of milk fever were encountered more on urban area than rural area this is due to large population of high blood level dairy cow with high milk yield in urban area and the urban dairy householders provided high Ca content feed like alfafa, elephant grass and poultry manure but they did not know their nutritional content.

Additionally in peri urban areas most dairy house holders provided different supplementation with no statistical difference. Similarly the incidence of milk fever was more encountered in intensive production system than semi intensive system and also more encountered in large farm size than medium and small farm size and the difference on management system and farm size is significant. The results of the study show that the occurrence of milk fever is low in the small herd size. There may be many possible reasons in the favor of results; i.e. the small herds are easily manageable; identification of occurrence of disease is quick and also farmers use conventional methods in which one is the frequent feeding of oral calcium which is favorable for preventing the disease [19]. Under semi extensive management system most dairy cows provide low milk yield and production of calcium in milk also reduced. Moreover, bioclimatic constraints such as drought or high temperature reduce the cow productivity [20]. Housing improvement could increase milk production y reducing the effect of these constraints.

The present study showed that the incidence of infertility was high following occurrence of milk fever. It has been suggested that milk fever results in reduced fertility in dairy cows due to its effect on uterine muscle function, slower uterine involution [21] and reduced blood flow to the ovaries [22]. There are also indirect effects of milk fever on fertility, which are mediated through dystocia, retained placenta and endometritis. Whiteford and Sheldon [23] reported that cows with clinical hypocalcaemia had a greater diameter of the gravid uterine horn and non-gravid uterine horn between 15 and 45 days post-partum (indicative of slower uterine involution) and a significantly reduced likelihood of having a corpus luteum (indicative of ovulation since parturition) than normal cows. Furthermore, Kamgarpour *et al.* [24] reported that cows with subclinically hypocalcaemic have fewer ovulatory sized follicles on days 15, 30 and 45 post-partum and smaller follicles at first ovulation than normal cows. Others, Borsbery and Dobson [21] reported an increased number of services per conception (1.7 versus 1.2), an increased calving to first service interval (68 versus 61 days) and an increased calving to conception interval (88 versus 76 days) for milk fever cows, in five UK dairy herds with an incidence rate of clinical milk fever of 7.5%. This study shows that the occurrences of retained placenta are high following occurrence of milk fever. This result agrees with the study in New York dairies (2, 190 cows), there was a very strong association between parturient hypocalcemia (milk fever) and retained Placenta. The odds ratio (multiplicative increases in occurrence) suggested that a milk fever cow was 3.2 times more likely to retained her placenta than a cow that had not had milk fever. The other study also indicated that increased risk for the occurrence of retained placenta following milk fever, milk fever cows being up to three times more likely to experience retained placenta than normal cows [25]. This is due to direct and indirect effect of milk fever on occurrence of retained fetal placenta: directly through lower blood calcium level [26] and indirectly dystocia is a risk factor for retained placenta [27]. This study observed high incidence of dystocia following the presence of milk fever. It has been recognized for some time that milk fever and subclinical hypocalcaemia reduce the ability of the transition cow to effect smooth and skeletal muscle contraction [28]. The present study revealed that the occurrence of uterine prolaps is high following the occurrence of milk fever. This is due to loss of uterine muscle tone due to hypocalcemia in cows where suffering from milk fever is a major cause of uterine prolaps. This result was agrees with the findings of Tadesse and Belete [29]. Cows with milk fever are developing dystocia 6 times more than that of normal cows. This is because of a reduced ability of smooth and skeletal muscle contraction for cow's long period in labour, which predisposes to dystocia. Both milk fever and subclinical hypocalcaemia cause an increase in the normal cortisol response at parturition. Cortisol is believed to be an important component of the suppressed immunity experienced by peri-parturient dairy cattle. Cows that have suffered from peri-parturient immuno-suppression are eight times more likely to develop mastitis than normal cows. This phenomenon is mainly due to a reduction in smooth muscle sphincter and hence an easy routine for infection after milking and an exacerbated suppression of immunity milk fever cows when compared with normal cows [30]. Hypocalcemia also greatly increased the risk of mastitis [31].

CONCLUSION AND RECOMENDATION

In Ethiopia, dairy cattle are mainly fed on natural pasture (grazing and/or hay), crop residues and different agro-industrial and locally available by-products as supplementary feeds. Macrominerals are very important nutrients in dairy rations and producers will continue to focus on optimizing production, health and efficiency of their dairy herds. The study result shows that milk

fever is one of the major disease problems dairy farms. Over feeding and under feeding of calcium, absence of mineral supplementation and improper supplementation was the major cause of the milk fever. Having the above conclusions, the following recommendations are forwarded: The owners of dairy farms and private animal owners should be aware of the disease themselves how to manage peripartum intake of calcium. Government officials of the respective sector in the town should give attention to milk fever and should make the, drugs (e.g. calcium borogluconate, calcium oral gel etc.) available in the market at reasonable costs.

REFERENCES

1. NRC (Nutrient Requirements of Dairy Cattle), 2001. Seventh Revised Edition. National Academy Press. Washington, D.C, USA.
2. Goswami, T.K., R. Bhar, S.E. Jadhav, S.N. Joardar and G.C. Ram, 2005. Role of dietary zinc as a nutritional immune modulator. Asian-Aust. J. Anim. Sci., 18: 439-452.
3. Sharma, M.C., C. Joshi, S. Gupta, C. Joshi and S. Gupta, 2003. Prevalence of mineral deficiency in soil, plants and cattle of certain districts of Uttar Pradesh. Ind. J. Vet. Med., 23: 4-8.
4. Sharma, M.C., C. Joshi, G. Das and K. Hussain, 2007. Mineral nutrition and reproductive performance of the dairy animals: a review. Indian J. Anim. Sci., 77: 599-608.
5. Bindari, Y.R., S. Shrestha, N. Shrestha and T.N. Gaire, 2013. Effects of nutrition on reproduction-a review. Adv. Appl. Sci. Res., 4: 421-429.
6. Kumar, A.S., 2014. Blood biochemical profile in repeat breeding crossbred dairy cows. Inter. J. Vet. Sci., 3(4): 172-173.
7. Sathish Kumar, 2003. Management of infertility due to mineral deficiency in dairy animals. In: Proceedings of ICAR summer school on "Advance diagnostic techniques and therapeutic approaches to metabolic and deficiency diseases in dairy animals". Held at IVRI, Izatnagar, UP (15th July to 4th Aug.), pp: 128-137.
8. Yasothai, 2014. importance of minerals on reproduction in dairy cattle. In. Jo. Sci, Env and Tech.
9. Thirunavukkarasu, M., G. Kathiravan, A. Kalaikannan and W. Jebarani, 2010. Quantifying Economic Losses due to Milk Fever in Dairy Farms. Agri. Eco. Res. Rev., 23: 77-81.
10. Samuel, A., G. Tadesse, Tewodros and C. Mersha, 2012. Incidence of Milk Fever on Dairy Cows and its Risk Factors in Gondar Town, Northwest Ethiopia. Global Vet., 9(6): 659-662.
11. Shakira, G., L. Asma, H. Imdad and A. Mukhtar, 2011. Macro-Minerals Concentrations of Major Fodder Tree Leaves and Shrubs.Animal Nutrition Programme, Animal Sciences Institute, National agricultural Research Centre, Islamabad, Pakistan.
12. Alejandro, R., 2010. Mineral Balances on Dairy Farms Effect of Trace Minerals on the Environment. Da. Sci., pp: 39-42.
13. Wade W. McCall, 1980. Chicken manure. General home garden series no. 2.
14. John F. Smith, 1998. Controlling Milk Fever and Hypocalcemia in Dairy Cattle: Use of Dietary Cation-Anion Difference (DCAD) in Formulating Dry Cow Rationsechnical Report 31.
15. Tom, A. and H.Patrick, 2006. Nutrient Composition of Straw Used in Dairy Cattle Diets Focus on Forage, 1: 1-3.
16. Onyeonagu, C.C., P.N. Obute and S.M. Eze, 2013. Seasonal variation in the anti-nutrient and mineral components of some forage legumes and grasses. Afr. J. Biotechnol., 12(2): 142-149.
17. Kubkomawa, H.U. Olawuye, L.J. Krumah, E.B. Etu and I.C. Okoli, 2015. Nutrient requirements and feed resource availability for pastoral cattle in the tropical Africa: A Rev., 3(6): 2051-2057.
18. Fekeda, F., A. Getnet, K. Gezahegne and P. Shiv, 2015. Mineral profiles of agro-industrial by-products and locally available supplementary feeds and their implications for dairy cattle nutrition in Ethiopia. J. Anim. Prod., 15(1): 17-30.
19. Syed Ahad, R.Z., 2016. Use of preventive measures against milk fever in Punjab, Pakistan. Degree project in Animal Science, pp: 1-41.
20. Kibwana, D.K., A.M. Makumyaviri and J.L. Hornick, 2013. Effect of improved feeding and housing, Friesian blood level and parity on milk production of Ankole x Friesian Cows, pp: 1-13.
21. Borsberry, S. and H. Dobson, 1989. peripartuirent diseases and their effect on reproductive performance in five dairy herds. Vet. Rec., 124(9): 217-9.
22. Jonsson, N.N. and R.C.W. Daniel, 1997. Effect of hypocalcaemia in blood flow to the ovaries of sheep. J. American Vete. Ass., 44: 281-287.

23. Whiteford, L.C. and I.M. Sheldon, 2005. Association between clinical hypocalcaemia and postpartum endometritis. Vet. Record, 157: 202- 204.
24. Kamgarpour, R., R.C.W. Daniel, D.C. Fenwick, K. Mcguigan and G. Murphy, 1999. Postpartum subclinical hypocalcaemia and effects on ovarian function and uterine involution in a dairy herd. Vet. J., 158: 59-67.
25. Houe, H., S. Østergaard, T. Thilsing-Hansen, R.J. Jørgensen, T. Larsen, J.T. Sorensen, J.F. Agger and J.Y. Blom, 2001. Milk fever and subclinical hypocalcaemia. An evaluation of parameters on incidence risk, diagnosis, risk factors and biological effects as input for a decision support system for disease control. Acta. Vet. Scan., 42: 1-29.
26. Melendez, P., J.A. Donovan, C.A. Risco and Goff, 2004. Plasma mineral and energy metabolite concentrations in dairy cows. American J. Vet. Res., 65: 1071-7076.
27. Correa, M.T., H. Erb and J. Scarlett, 1993. Path analysis for seven postpartum disorders in Holstein cows. J. Da. Sci., J. 76: 1305-1312.
28. Kimura, K., T.A. Reinhardt and J.P. Goff, 2006. Parturition and hypocalcemia blunts calcium signals in immune cells of dairy cattle. J. Dairy Sci., 89: 2588-2595.
29. Tadesse, E. and L. Belete, 2015. An Overview on Milk Fever in Dairy Cattle in and Around West Shoa. World J. Biol. and Medical Sci., 2: 115-125.
30. Goff, J.P., 2004. Macro mineral disorders of the transition cow. Vet Clin of North America., J. Dairy Sci., 20: 471-494.
31. Curtis, C.R., H.N. Erb, C.J. Sniffen, R.D. Smith, P.A. Powers, M.C. Smith, M.E. White, R.B. Hilman and E.J. Pearson, 1983. Association of parturient hypocalcaemia with eight periparturient disorders in Holstein cows. J. American. Vet. Ass., 183: 559-561.