Practical Field Applications for Reducing Infectious Diseases of 0-6 Months Calves and Their Results

Sevim KASAP [1], Ethem Mutlu TEMIZEL[1], Gulsah AKGUL[2], Sezgin SENTURK[1*]

[1]Department of Internal Medicine, Faculty of Veterinary Medicine, Uludag University, Bursa, Turkey.
[2]Department of Internal Medicine, Faculty of Veterinary Medicine, Siirt University, Siirt, Turkey.

Geliş Tarihi: 27.03.2018 **Kabul Tarihi: 28.05.2018**

Abstract: Neonatal calf diseases are among the most common diseases in cattle breeding. In order to prevent these diseases; it is important that the care and feeding of the calves are carried out correctly. Furthermore, care and feeding of the mother in dry period is also important as it affects the health of both mother and calf. Moreover, maternal antibodies in colostrum are effective in prevention of many diseases for the newborn calves. The incidence of deaths in cattle is generally greater at 0-6 months of ages. In this study, diseases and mortalities of calves between the age 0 and 6 months were evaluated in a farm of dairy cattle Antalya, Turkey, between the years 2013 and 2014.
Keywords: *Calf, Dry period, Neonatal period, Preventive medicine.*

0-6 Aylık Buzağılarda Bulaşıcı Hastalıkların Azaltılması ve Sonuçları için Pratik Saha Uygulamaları

Özet: Sığır yetiştiriciliğinde karşılaşılan hastalıklar arasında neonatal buzağı hastalıkları çok önemli bir yere sahiptir. Buzağıları bu hastalıklardan korumak için bakım ve beslenme doğru bir şekilde yapılmalıdır. Aynı zamanda annenin kuru dönemdeki bakım ve beslenmesi de hem doğum sonrası annenin sağlığı hem de yeni doğan yavrunun sağlığını etkilemektedir. Bunun dışında kolostrum ile alınan maternal antikorlar da neonatal buzağıyı birçok hastalıktan korumaktadır. Sığırlarda görülen ölümlerin sıklığı genellikle 0-6 aylık yaşlarda daha fazladır. Bu çalışmada, 2013-2014 yılları arasındaki 0-6 aylık buzağıların hastalık ve mortalite oranlarının karşılaştırılması ve değerlendirilmesi amaçlanmıştır.
Anahtar Kelimeler: *Buzağı, Kuru dönem, Neonatal dönem, Koruyucu hekimlik.*

Introduction

Neonatal calf diseases are one of the most common diseases in cattle breeding. Mortality has mostly been reported in 0-6 months old beef cattle due to both infective and non-infective diseases. In this time period, economic losses are especially observed because of infectious agents. Therefore it is essential to minimize the risks through conducting preventive medicine. Pneumonia occurring throughout transport into the common living area from individual pens and neonatal diarrhea constitute the most striking problems in calves (Mee, 2008; Mohd et al., 2012; Østeras et al., 2007; Senturk, 2012). Among the reasons in calf mortality, diarrhea and pneumonia are the two major problems.

The most important infectious causes of neonatal calf diarrhea are *Cryptosporidium spp., Escherichia coli, Rotavirus, Coronavirus*, and *Salmonella spp.*(Gulliksen et al., 2009; Foster and Smith, 2009; Senturk, 2012; Yong-il and Kyoung-Jin, 2014) . Pneumonia can occur for a variety of reasons (infective and non-infective) and is called enzootic pneumonia in calves between 2 and 6 months of age (Batmaz, 2015; Svensson et al., 2006). The most common infective agents causing enzootic pneumonia are *Mannheimia haemolytica, Pasteurella multocida, Mycoplasma spp, Bovine herpesvirus-1, parainfluenza-3 virus, Bovine respiratory syncytial virus*, and *Bovine viral diarrhea virus (BVDV)*. Inadequate colostrum intake and passive transfer failure are among the most important factors that predispose to the formation of diseases in calves (Senturk, 2014). The time of drying off the cows 2 months prior to the parturition is known as the dry period. Care and feeding of the mother in dry period are also important as it affects both of the mother and the calf's health. The dry period is a significant period for colostrum formation with highest antibody concentration and is vital for the newborn calf (Annen et al., 2004; Batmaz, 2015). Proper nutrition program implemented during the dry period reduces incidence of metabolic diseases, especially fatty liver disease, and provides the high maternal antibody titers in colostrum (Batmaz, 2015; Watters et al., 2008).

In this study, diseases and mortalities of the calves between the age of 0 and 6 months were evaluated in a dairy cattle farm in Antalya, Turkey, between the years 2013 and 2014. Hence an effort was made for detecting the effectiveness of the preventive medicine program that was started in 2013 to prevent diseases and mortalities. The aim of this study was to emphasize the effect and importance of dry period and colostrum managment on calf mortalite rates.

Materials and Methods

The study was conducted on a Holstein-Friesian breeding farm consisting of 2500 cattle in Antalya, Turkey between 2013 and 2014. In the study, 676 (2013) and 651 (2014) calves aged between 0-6 months were evaluated. All calves were from the same herd. Diseases and mortalities of the calves were classified into two groups consisting of 0-2 month(s) and 2-6 months group. The veterinarians reported that calves of ages between 0 and 6 months had shown clinical signs that express infectious diseases. Also, diagnoses of those who died were made by means of necropsy findings.

In 2013, newborn calves were directly taken into individual calf pens and were given colostrum with a feeding bottle of the amount as 5% of the calves' weights. In calves without sucking reflex; colostrum was given via esophagus tube along with a 20 cc subcutaneous septicemia serum. The quality of the colostrum was not measured in 2013 years. Pregnant animals in the dry period were injected with one dose of the vaccine including *Rotavirus, Coronavirus*, and *E. coli* antigens 1 month before parturition. In 2013, for the etiologic diagnosis of neonatal diarrhea in calves; immunochromatographic rapid field test kits were used for detecting *Cryptosporidium, Rotavirus, Coronavirus*, and *Escherichia coli K 99* antigens (Anigen Rapid, BoviD-4 Ag test Kit, Bionote Inc, Korea), and rapid test kits for detecting antigens of giardiasis (Giardia IC, agrolabo, Inc., S.p.A) in feces. Similarly, evaluation of BVD antigens in feces of calves with diarrhea was made with rapid test kits. Cows in the last period of pregnancy in 2013 have not been evaluated for negative energy balance and other metabolic disorders. In 2014, in order to detect the negative energy balance (NEB), which directly affects the quality of the colostrum, betahydroxybutyric acid (BHB) levels (STAT Site® M Stanbio, EKF Diagnostics Company, Texas, USA) were measured. All samples were taken using coccygeal veins from 20% of animals after 4-6 hours of feeding one time in the last 3 weeks of the dry period. Additionally, colostrum qualities of the cows that gave birth in 2014 were measured with Brix refractometer (Brix Refractometer, Embrun Inc., Ontario). Brix values that equal 22% and more were classified as good quality colostrum, 19-21% as moderate and under 19% as poor quality qualified colostrum (Senturk, 2016). Moderate quality colostrum was mixed with quality colostrum to achieve a Brix value of 22%. Colostrums that were categorized as poor quality was not given to calves, instead, good quality colostrum with a Brix value over 22% that was stored before given to calves. In 2014, as a management process, when the calf was born, they were allowed to suck their mothers. Newborn calf was kept with their mothers for them to lick the calves. After 2 to 3 hours, calves were disinfected with chlorine dioxide and were taken to observation units where they were observed for three days for their sucking reflex, body temperature and stool structures. Afterwards, calves that did not show any problem were put into their individual pens. In 2014, for the etiologic diagnosis of neonatal diarrhea in calves; immunochromatographic rapid field test kits were used for detecting *Cryptosporidium, Rotavirus, Coronavirus*, and *Escherichia coli K 99* antigens (Anigen Rapid, BoviD-4 Ag test Kit, Bionote Inc, Korea), and rapid test kits for detecting antigens of giardiasis (Giardia IC, agrolabo, Inc., S.p.A) in feces. Similarly, evaluation of BVD antigens in feces of calves with diarrhea was made with rapid test kits. In calves with diarrhea that were older than 3 weeks; search for oocysts in feces were made with flotation method in addition to the clinical findings for coccidiosis (Arslan and Sari, 2013). Diagnosis of respiratory infections and other possible infections was made on the basis of clinical examination findings and necropsy evaluation of dead animals. In 2014; pregnant animals at their 7^{th} and 8^{th} months of the pregnancy was vaccinated in order to ensure high colostral antibody levels against *Rotavirus, Coronovirus*, and *E. coli*. Thereafter, starting from 2014, vaccination was applied against *BHV-1 (IBR), BVD-Type 1* and *Type 2 (cytopathogenic - noncytopathogenic), PI3, BRSV*, and *Histophilus somni* infections to all pregnant animals that were at their last 2 months of dry period (Vira Shield 6+Somnus, Egevet, Turkey).

In line with the high values of BHB in the last 3 weeks of the dry period; the ration was readjusted by an animal nutritionist. 15 g of methionine, 6 g of choline, and 4 g of lysine per animal were added in the ration for the last one-month of the dry period in order to prevent negative energy balance and

possible fatty liver disease. 3 weeks prior to parturition, 10 ml of Vitamin E + Selenium (Yeldif flk, Ceva-Dif, Istanbul, Turkey), 30 ml of phosphorus (Fosfovet flk, Vilsan, Istanbul, Turkey), 15 ml of B_{12} vitamin (Dodeks flk, Vetas Inc., Istanbul, Turkey), and 40 ml of phenoxy-2-methyl-2-propionic acid (Liver flk, Vetas Inc., Istanbul, Turkey) were applied intramuscularly. In addition to these injections, animals were given 300 ml of propylene glycol for 5 days. In the years 2013 and 2014, causes, numbers, and percentages of calf deaths were evaluated, and differences between these years were compared.

Statistical analysis: Student's t-tests and Mann-Whitney Ustatistic were used to test the significance of differences between the study and control groups. A p-values $p \leq 0.001$, $p < 0.05$ were considered significant. All statistical analyses were performed using the Sigma Stat 3.1 for Windows statistical package (Systat Software, Point Richmond, CA).

Results

According to the examination records of the farm in 2013, 676 calves were born. Among them a total of 376 calves (56%) had moderate to severe enteritis during the first 2 months of their lives, subsequently, 76 calves (11%) died in relation of enteritis (Table 2). *Cryptosporidium, Coronavirus*, and *E.coli (K99)* were commonly detected using the quick antigenic fecal test kits (Table 1). Upper respiratory tract infections and pneumonia were diagnosed in 158 calves (23%) during the same period on the basis of clinical findings including high body temperature, dyspnea, cough, depression, loss of appetite, eye or nasal discharge, and pathological pulmonary auscultation. Among these animals, 15 (2%) of them died because of pneumonia, moreover, these animals had concurrent diarrhea with pneumonia or had a history of diarrhea (Table 2). Omphalitis, sepsis or liver necrosis were also detected in 12 animals (2%), and 3 of these animals (0,5%) died due to sepsis or liver necrosis. In 2013, the number of calves who were transferred from individual calf pens to housing groups was determined as 582. 152 calves (26%) were detected to have infective pneumonia in this group between ages of 2 - 6 months, and 73 (13%) of them died. On the other hand, 58 animals (10%) were determined to have clinical and mainly subclinical coccidiosis which was diagnosed based on the flotation method. Much more severe pneumonia was noted in the animals diagnosed with coccidiosis. The percentage of animals died only due to coccidiosis was determined as 6 (1%) (Table 2).

Table 1. Results of rapid test kits for Cryptosporidium, Coronavirus and E. coli (K99) in first 2-month-old calves with enteritis in 2013 and 2014

Results of rapid test kits	Number of infected calves in 2013 (n=376)	Number of infected calves in 2014 (n=198)
Cryptosporidium	95	67
Rotavirus	24	6
Escherichia coli K 99	Not alone	5
Coranavirus	18	7
Cryptosporidium + Rotavirus	23	23
Cryptosporidium + Rotavirus + Coronavirus	38	15
Cryptosporidium + Rotavirus + Escherichia coli K 99	72	18
Cryptosporidium + Coronavirus	71	32
Cryptosporidium + Rotavirus + Coronavirus+ E.coli K99	12	6
Cryptosporidium + E.coli K99	23	19

Table 2. Mean values and the percentage of disease and death in 2013 and 2014.

	0-2 months age		2-6 months age	
	2013	**2014**	**2013**	**2014**
Enteritis	31,3±2,674 / 56%	16,5±1,931[a*] / 30%	4,833±3,407 / 10%	4,75±2,667 / 10%
Death due to enteritis	6,3±2,309 / 11%	1,167±1,528[a*] / 2%	0,5±1 / 1%	0,167±0,389 / 0,3%
Pneumonia	13,167±3,298 / 23%	7,333±1,875[a*] /13%	12,667±3,2 / 26%	9±2,335 [a**] / 26%
Death due to pneumonia	1,25±1,215 / 2%	0,25±0,452[a**] / 0,5%	6,083±1,975 / %13	3,667± 0,888 [a**] / 13%

[a,] * and ** indicate statistically significance and degree for value between 2013 and 2014, *p≤0.001, **P<0.05.

In 2014, 651 calves were born. Among them 198 of the calves (30%) had enteritis that was diagnosed in the first 2 months (Table 1), and 14 of them died (2%). In 88 calves (13%), pneumonia with varying degrees were detected. In the mentioned period, 3 animals died (0.5%) because of respiratory tract infections (Table 2). Omphalitis was detected in only 1(0.2%) animal and 4 calves (0,6%) died

because of trauma or other non-infectious causes. During this period, the number of calves passed from individual calf pens to group housing was determined as 630. In this group between ages of 2-6 months, 108 calves (26 %) were detected to have infective pneumonia and upper respiratory tract infection with varying degrees. In the records, it was detected that 44 calves (13%) died because of infective pneumonia. Also during this period, 57 animals (10%) had diarrhea, among the affected animals 24 of them had subclinical coccidiosis and 4 of them had clinical coccidiosis, and the remaining animals were thought to have diarrhea due to feeding processes. It was observed that 2 animals (0,3%) with clinical coccidiosis died because of nervous form of the disease (Table 2). During this period, 4 animals of 6 months of age died because of chronic arthritis, and these calves were not included in death ratios. In the first month of 2014, there were 65 animals at their last 3 weeks of the dry period and BHB was evaluated in 20 of them and in 13 animals BHB level was between 0.6-1.3 mmol/L.

Discussion and Conclusion

Management factors and feeding strategies for cows in dry period directly affect health of the unborn calves and future infections related to colostrum quality that is also dependent on the dry period management. Subsequently, infectious diseases of the calves are a result of the poor colostrum quality.

Excessive body condition score (BCS) during the dry period can cause hepatic lipidosis, ketosis, abomasal displacement, infertility, metritis, dystocia, and also the formation of poor quality colostrum which is essential for the calves can be seen. On the other hand if BCS is low during the dry period, growth retardation of the fetus, premature calve birth, poor quality and inadequate colostrum production and passive transfer failure related to lack of energy and protein reserves may occur (Annen et al., 2004; Batmaz, 2015; Senturk, 2016). In order to decrease the incidence of the negative energy balance, along with ketosis and fatty liver disease, effective energy and protein intake should be achieved for the cow via ration, especially in the last 1 month of the dry period (Batmaz, 2015). In addition to that, choline, methionine, and niacin, which play an important role in energy metabolism, can be added into the ration. For this purpose, bypass choline of 25 gr, niacin of 6-13 gr, bypass methionine of 15-20 gr can be added per animal into the ration. Then again, chrome, borax, and B12 vitamin applications also give a great contribution (Batmaz, 2015). In the present study, during the last 3 months of dry period in 2013, early diagnosis of metabolic and/or infectious diseases or prophylaxis practices were insufficient as serum BHB could not be measured for determining negative energy balance. Contrariwise, in 2014, serum BHB were measured and occurrence of negative energy balance, incidences of subclinical ketosis, and fatty liver diseases were reported to be increased. It is widely known that these negative results have a greater impact on both health of the calf and the quality of the colostrum (Batmaz, 2015).

In order to reduce these risks, feeding procedures during dry period were re-adjusted. In the last 1-month of the dry period; methionine, choline, and lysine were added to ration while phosphorus, vitamin B_{12}, phenoxy 2 methyl 2 propionic acid, and propylene glycol applications were made 5 days before parturition in order to prevent negative energy balance from occurring. Diseases related with negative energy balance (ketosis, metritis, mastitis, and abomasal displacements, etc.) in postpartum period were tried to be minimized by conducting preventive measures. Decreasing negative energy balance incidence is essential as it is directly related to the quality of the colostrum. Colostrum quality can be measured easily with a brix refractometer and the most ideal results are measured as 22% and above.

During the dry period requirement of vitamin E, selenium, vitamin D_3, and vitamin A increase gradually. In the last week of pregnancy, plasma vitamin E decreases rapidly and becomes minimal at the first 2 weeks of lactation (Senturk, 2016). During the dry period, cows requirement for intake of vitamin E is 1000-2000 IU/day (LeBlanc et al., 2002). A limited amount of vitamin E passes from placenta to fetus, therefore, newborn calves have low vitamin E levels and they need to take vitamin E via colostrum. Parenteral vitamin E application to the mother during pregnancy is important for achieving a high concentration of vitamin E in colostrum; consequently occurrence of the white muscle disease can be prevented. Vitamin E deficiency that occurs during the transition period can cause fatty liver disease, placenta retention, metritis, mastitis, and infertility. Ideally, parenteral vitamin E and selenium application to the animals one week prior to parturition will ensure that vitamin E and selenium levels in the plasma can be kept at a desired level (Larson et al 2004, LeBlanc et al., 2004; Senturk et al., 2010). In this study in 2014, by virtue of parenteral vitamin E and selenium applications to

pregnant animals during the last interval of the dry period; possible insufficiency was compensated both in mothers and calves. Vitamin E and selenium supplementation was intended to protect against infectious diseases and white muscle disease by taking advantages of its immune-modulating and antioxidant effects (Senturk et al., 2010).

The most important problems during neonatal period of the calf are infectious enteritis, respiratory tract infections and the other causes like septicemia respectively (Table 2). Arthritis and inflammation of the umbilical cord can also be seen sporadically. The main reason for these common and severe infectious diseases during the neonatal period is the failure of passive transfer (Larson et al., 2004; Svensson et al., 2006). As the placental transfer of immunoglobulins in ruminants is at the minimum level, calves born as hypogammaglobulinemic, therefore they do not have any sufficient protective immune system against infective agents when they are born. Calves should take high-quality colostrum with a ratio of 5-6% of their body weight right after their birth. The physical appearance of good quality colostrum should be yellow-cream colored, with dense and sticky consistency. It should be also noted that physical appearance of the colostrum is not the exact marker of colostrum quality. The simplest way to understand the quality of colostrum is the measurement of the specific density of the colostrum with a colostrometer. The density of the good quality colostrum should be equal to 1060 unit or more. Colostrum with a density of 1060 or more is roughly equal to 30000 mg/L IgG. Similarly, brix value of the good quality colostrum should be 22 and more (Batmaz, 2015). In this presented study, emphasis was made on the quality of colostrum, which was differed between the years 2013 and 2014. Colostrum qualities were measured with Brix (Brix refractometer, Embrun Inc., Ontario) and medium quality colostrum was mixed with high-quality colostrum thereafter was given to calves. Colostrums that were identified as poor quality were never given to these calves in order to eliminate the risk of failure of passive transfer in calves.

Rotavirus, Coronavirus, and *E.coli* make up the most common pathogens that cause diarrhea in neonatal calves. Vaccination the mothers against this organism during the dry period will provide high antibody levels in the colostrum. Moreover, vaccination against *bovine viral diarhea (BVD), IBR, Clostridum spp, PI-3, BRSV,* and *Pasteurellosis* can provide high immunglobulin concentrations in colostrum and makes it possible for newborn calves to pass neonatal period and even first 3-4 months of their lives with lesser risk (Senturk, 2015). Calves of the unvaccinated mothers can be hipogammaglobulinemic due to insufficient immunoglobuline level despite a sufficient amount of colostrum intake (Senturk, 2015). Application of one dose of combined vaccination including *Rotavirus, Coronavirus*, and *E.coli* to the mother at 7^{th} and 8^{th} months of pregnancy along with improved care and feeding practices, high colostral antibody levels were tried to be achieved in 2014 by comparison to 2013. In addition to that, during the dry period in 2014, vaccination against *BHV-1 (IBR), BVD Type-1* and *Type-2, PI-3, BRSV*, and *Haemophilus somnus* were applied in the last 2 months of pregnancy to all animals. In recent studies, the prevalence of neonatal calf diarrhea was stated as 19.1 % and the recurrence rate was stated as 21.2% (Østeras et al., 2007). Enteritis, which is observed in calves younger than 31 days, is one of the most common diseases among neonatal calves with a death ratio of 4.9% and deaths were commonly seen at 2^{nd} week of their lives (Windeyer et al., 2014). Causes of disease and mortalities in this study were similar to previous studies. According to our results, most common cause of neonatal calf mortality among 0 and 2 months of age was infectious enteritis. However there was a significant decrease in mortality despite similar disease and death causes in 2014 (Table 2). Improvements of mother health, increase in amount of antibody in colostrum, and improved colostrum quality can be achieved with the revision of the dry period nutrition and application of methionine, lysine, choline, vitamin B_{12}, vitamin E, selenium, and phenoxy-2 methyl propionic acid, which have positive effects on immune system, and features of preventing fatty liver diseases as well as negative energy metabolism from occurring. In addition to these, vaccination to all pregnant animals at 7^{th} and 8^{th} months of pregnancy can increase the quality of colostrum, and the importance of maintenance and care conditions were also noted.

Diseases such as respiratory tract infections and coccidiosis that can occur during 2 and 6 months of age are also very important. Although these diseases can occur sporadically, it is a known fact that in some cases coccidiosis can be seen secondary to pneumonia (Smith, 2008; Svensson et al., 2006). In this presented study, the most important diseases in 2-6 months of age were coccidiosis and Bovine Respiratory Disease (BRD) (Table 2). The incidence of these diseases was similar to previous studies (Senturk S, 2018;

Svensson et al., 2006), consequently the most common cause of morbidity and mortality was found to be pneumonia (Table 2). Preventive medicine protocols had a greater impact on the mortality and disease incidence between the year 2013 and 2014 and there was a significant decrease in mortality and disease incidence despite similar disease and death causes in 2014 (Table 2).

As a result, the health of the calves is not only related to procedures after birth but also closely related to care and nutrition of mother during the dry period for decreasing the high ratio of (40%) neonatal mortality in Turkey. In order to decrease the incidence of deaths to a minimum level, close monitoring, appropriate care, and nutrition practices against negative energy balance and fatty liver diseases especially during the dry period should be made. Necessary revisions such as management of good quality colostrum, improving environmental hygiene, and animal welfare should be implemented in an accurate and complete manner.

References

Annen EL, Collier RJ, McGuire MA, Vicini JL, Ballam JM, Lormore MJ, 2004: Effect of modified dry period lengths and bovine somatotropin on yield and composition of milk from dairy cows. *J Dairy Sci,* 87, 3746-3761.

Arslan MO, Sari B, 2013: Protozoon diseases in digestive system of cattle. In 'Parasitic Diseases in Veterinary Medicine', Ed; Ozcel MA, Meta, Ankara, Turkey.

Batmaz H, 2015: Calves health and managment. 1st ed., Alfa Aktuel, Bursa, Turkey.

Foster DM, Smith GW, 2009: Pathophysiology of diarrhea in calves. *Vet Clin North Am Food Anim Pract,* 25, 13-36.

Gulliksen SM, Jor E, Lie KI, Hamnes IS, Løken T, Åkerstedt J, Østerås O, 2009: Enteropathogens and risk factors for diarrhea in Norwegian dairy calves. *J Dairy Sci,* 92, 5057 5066.

Larson RL, Tyler JW, Schultiz LG, Tessman RK, Hostetler DE, 2004: Management Strategies to decrease calf death losses in beef herds. *J Am Vet Med Assoc*, 224,42-48.

LeBlanc SJ, Duffield T, Leslie K, Bateman K, TenHag J, Walton J, Johnson WH, 2002: The effect of prepartum injection of vitamin E on health in transition dairy cows. *J Dairy Sci*, 85, 1416-1426.

LeBlanc SJ, Herdt T, Seymour W, Duffield T, Leslie K, 2004: Factors associated with peripartum serum concentrations of vitamin E, retinol, and -carotene in Holstein dairy cattle, and their associations with periparturient disease. *J Dairy Sci*, 87, 609-619.

Mee JF, 2008: Newborn dairy calf management. *Vet Clin North Am Food Anim Pract*, 24, 1–17. (Kaynak 'introduction' bölümünde bulunmaktadır ve kırmızı renkli olarak belirtilmiştir)

Mohd Nor N, Steeneveld W, Mourits MC, Hogeveen H, 2012: Estimating the costs of rearing young dairy cattle in the Netherlands using a simula- tion model that accounts for uncertainty related to diseases. *Prevent Vet Med*, 106, 214–224.

Østerås O, Gjestvang M, Vatn S, Sølverød L, 2007: Perinatal death in production animals in the Nordic countries—incidence and costs. *Acta Vet Scan Supplement*, 49:14. (Kaynak 'introduction' bölümünde bulunmaktadır ve kırmızı renkli olarak belirtilmiştir)

Senturk S, Mecitoglu Z, Temizel EM, Cihan H, Kasap S, Demir G, 2010: Clinical and biochemical evaluation of cows occuring severe weight loss after calving. *Medicine*, 29, 43-49.

Senturk S, 2012: Internal Medicine in Calves with Controversial case. 2nd ed., Ozsan, Bursa, Turkey.

Senturk S, 2014: Diseases of Respiratory System in Cattle. 1st ed., Ozsan, Bursa, Turkey.

Senturk S, 2016: Management of Epidemic Diseases in Beef and Dairy Cattle (Biosafety). In Proceedings of The Semposium of Herd Health and Management. Antalya, Turkey, pp. 34-37.

Senturk S, 2018: Internal Medicine in Calves with Controversial case. 3nd ed., Ozsan, Bursa, Turkey.

Smith BP, 2008: Large Animal Internal Medicine. 4th ed., Mosby Comp, Toronto, Canada.

Svensson C, Linder A, Olsson SO, 2006: Mortality in Swedish dairy calves and replacement heifers. *J Dairy Sci*, 89, 4769–4777.

Watters RD, Guenther JN, Brickner AE, Rastani RR, Crump PM, Clark PW, Grummer RR, 2008: Effects of dry period length on milk production and health of dairy cattle. *J Dairy Sci*, 91, 2595-2603.

Windeyer MC, Leslie KE, Godden SM, Hodgins DC, Lissemore KD, LeBlanc SJ, 2014: Factors associated with morbidity, mortality, and growth of dairy heifer calves up to 3 months of age. *Prevent Vet Med*, 113: 231–240.

Yong-il CHO, Kyoung-Jin Y, 2014: An overview of calf diarrhea - infectious etiology, diagnosis, and intervention. *J Vet Sci*, 15: 1–17.

***Corresponding author:** Sezgin SENTURK
Department of Internal Medicine, Faculty of Veterinary Medicine, Uludag University, 16059, Bursa, Turkey.
e-mail address: sezsen@uludag.edu.tr