

# An Investigation of Bovine Viral Diarrhoea Virus (BVDV) and Bovine Parainfluenza Type 3 Virus (BPI3V) Infections in Small-Scale Cattle Herds in Afyonkarahisar Province\*

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**Abstract:** Respiratory and reproductive system disorders are the most important problems of ruminant breeding and cause great economic loss. Bovine viral diarrhoea and bovine parainfluenza 3 infections are among the leading respiratory pathogens and are very common in our country. The aim of this study is to serologically investigate the status in family-type small-scale enterprises of these two virus infections throughout Afyonkarahisar province. For this purpose, 1.279 adult cattle blood samples were collected from all the districts, which were not vaccinated recently for these infections. Sera samples were controlled using standard virus neutralization test and seropositive samples were re-tested to determine antibody titers. Pestivirus-specific antibody presence was detected in 978 (74.9%) cattle, and the rates varied between 50.7% (İhsaniye) and 92.8% (Çay) according to the districts. For BPI3V, the least positivity was found in Sinanşa (58.8%) while the highest rate was detected in Emirdağ with 97.5%. In total, 82.7% (1.058 / 1.279) seropositivity was determined.

As a result, the determined values for these economically important infections are not very different from those obtained in the country, but are higher than expected due to the target population. Considering that the domestic animal population has decreased, supporting of small producers with national or regional preventive practices is gaining importance.

**Key words:** Afyonkarahisar, Bovine viral diarrhoeavirus, bovine parainfluenza 3 virus, serology.

## Afyonkarahisar İlinde Bovine Viral Diarrhoea Virus (BVDV) ve Bovine Parainfluenza Type 3 Virus (BPI3V) Enfeksiyonlarının Küçük Ölçekli Sığır Sürülerinde Araştırılması

**Özet:** Solunum ve üreme sistem bozuklukları ruminant yetiştiriciliğinin en önemli sorunlarından ve büyük ekonomik kayıplara neden olur. Bovine viral diarrhoea and bovine parainfluenza 3 enfeksiyonları önde gelen solunum sistemini patojenleri arasındadır ve ülkemizde oldukça yaygındır. Bu çalışmanın amacı, Afyonkarahisar ili genelinde bu iki virus enfeksiyonunun aile tipi küçük ölçekli işletmelerdeki durumunu serolojik olarak araştırmaktır. Bu amaçla tüm ilçelerden, bu enfeksiyonlar için yakın zamanda aşı yapılmamış 1.279 erişkin sığırdan kan örnekleri toplandı. Serum örnekleri standart virus nötralizasyon testi ile kontrol edildi ve seropozitif örnekler antikor titre değerlerinin belirlenmesi için tekrar test edildiler. Pestivirus spesifik antikor varlığı 978 (%74.9) sığırdan tespit edildi ve oranların ilçelere göre %50.7 (İhsaniye) ile %92.8 (Çay) arasında değiştiği görüldü. BPI3V için, en az pozitiflik Sinanşa'da (%58.8) iken, en yüksek oran ise %97.5 ile Emirdağ'da tespit edildi. Toplamda ise %82.7 (1.058/1.279) seropozitiflik belirlendi. Sonuç olarak, ekonomik önemi olan bu enfeksiyonlar için tespit edilen değerler, ülkedede elde edilen oranlardan çok farklı değildir ancak hedef populasyon nedeniyle beklenenden daha yüksektir. Yerli hayvan popülasyonunun azalması dikkate alınarak, ulusal veya bölgesel koruyucu uygulamalar ile küçük üreticilerin desteklenmesi önem kazanmaktadır.

**Anahtar kelimeler:** Afyonkarahisar, Bovine viral diarrhoeavirus, bovine parainfluenza 3 virus, seroloji.

## Introduction

Respiratory diseases (BRD) in cattle are one of the most important health problems of dairy cattle breeding all over the world [12]. Diagnosis and treatment of the disease is very difficult due to the complexity of the etiology (number of viruses, bacteria, fungi and mycoplasma), difficulties in differ-

ential diagnosis, and the need to use a distinct and specific strategy for each agent and serotype.

Clinical acute BRD rates are higher in winter and especially in dairy herds. Cattle of all ages can be affected, but the prognosis is more severe in the offspring. Factors such as lack of optimal immunity in newborns and young animals, passive immuni-

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ty regression, malnutrition, weaning and transport stress increase susceptibility to infectious agents and enhance the severity of clinical signs [26,43]. The major causes of heavy economic consequences are deaths, weight loss, yield losses and treatment costs [22,44]. Annual cost for cattle breeders is estimated at US \$ 750 million in USA [18]. The cost of individual treatment was approximately \$ 15.57 [15], this amount can be as high as \$ 92.26 due to yield losses and treatment charges [25].

A wide variety of pathogens, especially viruses and bacteria, cause BRD separately or at the same time [3]. Studies have shown that the primary agents are usually viruses [11] and creates disposition to secondary bacterial infections. The most important causative agents are Bovine Respiratory Syncytial Virus (BRSV) [13] and Bovine Parainfluenza type 3 virus (BPI3V) [20], which may result in extensive and sometimes fatal lung damage. Besides many other viruses; Bovine Herpesvirus type 1, Bovine Viral Diarrhea, Bovine Adenovirus, Bovine Coronavirus and Influenza Virus, etc. contributes to the multi-etiological spectrum.

Bovine Viral Diarrhea/Mucosal Disease (BVD/MD) virus was first identified in 1946 [28]. The agent is classified in pestivirus genus of the family *Flaviviridae*. According to classifications of the field viruses from all over the world, 7 main antigenic group was determined; BVDV type 1-2, Classical swine fever virus (CSFV), Border Disease virus (BDV) type 1-2-3, and H138 isolate [4]. BVDV type 1 is generally isolated from cattle while type 2 is from small ruminants and vice versa. There are two biotype of the BVDV; cytopathogen (cp) and noncytopathogen (ncp). Pathogenesis of the infection is mainly determined by biotype of the virus and age (immunocompetent status) of the infected host.

Bovine Parainfluenza type 3 virus (BPI3V) is a member of Respirivirus genus of the *Paramyxoviridae* family and closely related to human parainfluenza type 3 [21]. Since the first description in a pneumonic tissue of calves in 1959 [36], disease has been reported all over the world. The viral genome includes single-stranded RNA, helical symmetry, and lipid membrane. The virus mainly affects the respiratory system and leads to susceptibility to bronchopneumonia or secondary bacterial infec-

tions alone [16]. Rates of the infection are very high in Turkey [1,29]. The rates in the goat and sheep are also quite high [9,47].

In this study, it was aimed to serologically examine BVDV and BPI3V infections, the most common viral agents causing respiratory tract diseases, in all districts of Afyonkarahisar province, and to reveal realistic profiles of these infections.

## Materials and Methods

### Sapled animals and study design

Blood serum samples were collected from all of the districts of Afyonkarahisar province; Başmakçı 71, Bayat 44, Bolvadin 87, Çay 84, Çobanlar 66, Dazkırı 57, Dinar 86, Emirdağ 120, Evciler 46, Hocalar 53, İhsaniye 136, İscehisar 93, Kızılören 72, Sandıklı 59, Sinanpaşa 34, Sultandağı 73 and Şuhut 98. Total of 1.279 samples were obtained from 6 months old and above cattle (table 1). Most of the animals were between 2 and 5 years old. The gender of the sampled animals was ignored, but the vast majority of them were female because of their breeding purpose. No clinical signs were detected during sampling. The number of cattle in the sampled herds were among 1 to 30 but was less than 10 in the majority. In addition, there was no Vet service and detailed health records, but according to anamnesis information from farm owners, animals have not been vaccinated in the last two years.

Blood samples were taken from Vena Jugularis in tubes with silicone, centrifuged at 3000 rpm for 10 min. Sera fractions transferred into stock tubes. After inactivation (30 min at 56°C), samples were stored frozen (-20°C) until use in the test.

### Cell culture

Madin Darby bovine kidneys cell culture (ATCC, CCL-22) was used for propagation and titration of the viruses, and virus neutralisation analysis. Eagle's Minimal Essential Medium (EMEM) and Fetal Bovine Serum (FDS) (1-5%) were used as medium. BVDV virus is well recognized as cell contaminant virus [2], test culture was controlled in the aspect of pestivirus antigen (Ag) prior of all tests.

### Test viruses

Reference strains of BVDV (NADL) and BPI3V (SF4) was utilized in the tests.

### Virus Neutralisation Test (VNT)

Standard VNT is a highly sensitive and reliable method for the detection of many cytopathogenic (cp) viruses, especially in the controls of specific antibodies (Abs). For the detection of BPI3V and BVDV virus specific antibodies, the blood serums were diluted 1/5 into 96 well microplate with only medium, then the reference strains (SF4 and NADL) calculated as 100 DKID<sub>50</sub> were added in equal volumes (50 µl). After one hour incubation (5% CO<sub>2</sub>, 37°C), MDBK cell suspension (300.000 cell/ml) was added to all wells and left to incubation for 1-3 days. Wells were controlled everyday by inverted tissue culture microscope and evaluated according to the micro-morphological changes on the cells.

Each seropositive samples were serially diluted as 1/5, 1/10...1/160 and re-tested to determine Ab titer values.

### Results

#### *Titers values of control viruses*

Tissue Culture Infective dose<sub>50</sub> (100TCID<sub>50</sub>) values of the reference test viruses of BPIV-3 (SF-4) and BVDV (NADL) were calculated as 10<sup>-4.5</sup> ve 10<sup>-3.7</sup>, respectively.

#### Serological test results

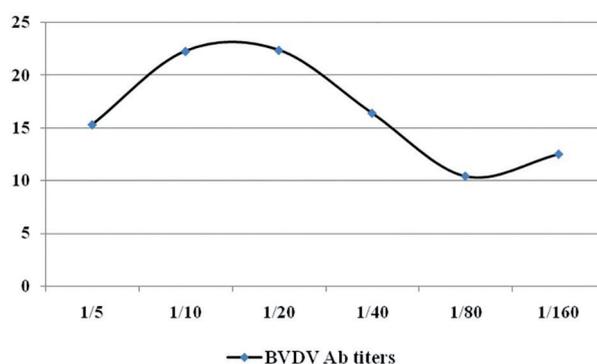
According to the VNT test, serum dilutions of 1/5 and above were accepted as positive for both viruses. Out of 1.279 blood serum samples from 17 districts, 978 (74.9%) samples were found to be positive for BVDV. Proportions were varied between 50.7% (İhsaniye) and 92.8% (Çay). The mean seropositivity rate for BPI3V was higher for BPI3V with 82.7% (1.058/1.279), lowest proportion was detected in Sinanpaşa (58.8%) while highest at Emirdağ (97.5) districts (table 1).

Ab titer ratios of the BVDV seropositive samples peaked at 1/10 and 1/20 dilution points, but a slight increase was observed after 1/80 (figure 1).

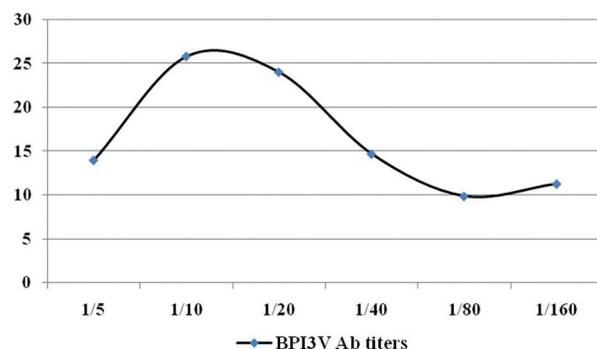
The same titer distribution was also determined for BPI3V, and it was generally seen that the mean Ab titer distribution was similar (figure 2).

**Table 1.** Sample numbers, districts and BVDV - BPI3V Ab (%) data

No	Localisations	Sample No	BVDV		BPI3V	
			Ab (+)	Ab (%)	Ab (+)	Ab (%)
1	Başmakçı	71	52	73.2	64	90.1
2	Bayat	44	37	84	32	72.7
3	Bolvadin	87	77	88.5	76	87.3
4	Çay	84	78	92.8	75	89.2
5	Çobanlar	66	50	75	47	71.2
6	Dazkırı	57	39	68.4	48	84.2
7	Dinar	86	73	84.8	65	75.5
8	Emirdağ	120	92	76.6	117	97.5
9	Evciler	46	39	84.7	36	78.2
10	Hocalar	53	41	77.3	45	84.9
11	İhsaniye	136	69	50.7	127	93.3
12	İscehisar	93	68	73.1	78	83.8
13	Kızılören	72	63	87.5	59	81.9
14	Sandıklı	59	44	74.5	56	94.9
15	Sinanpaşa	34	27	79.4	20	58.8
16	Sultandağı	73	40	54.7	49	67.1
17	Şuhut	98	69	70.4	64	65.3
<b>Total</b>		<b>1.279</b>	<b>958</b>	<b>74.9</b>	<b>1.058</b>	<b>82.7</b>



**Figure 1.** Ab titer distribution of BVDV seropositive samples (%)



**Figure 2.** Ab titer distribution of BPI3V seropositive samples (%)

## Discussion

In this study, the sampling was carried out whole districts of the Afyonkarahisar province to reveal a realistic profile for the two infections. Ruminant pestiviruses are among the most problematic infections in Turkey. In this study, 978 (74.9%) positive BVDV samples were found from 1.279 blood samples from 17 districts. Rates at any localization were not less than 50% and varied between 50.7% (İhsaniye) and 92.8% (Çay).

In previous studies in Afyonkarahisar province, 98.2% seropositivity for pestiviruses was detected in an organized dairy herd containing more than 1.000 cattle [30]. Ratios in small-scale private farms were investigated before using 972 samples from 9 districts in the same province, with an average rate of 84.6% (ranging from 73.6% to 95.2%) [14]. Ruminant pestiviruses were also investigated in goats and found to have an infection rate of 61.8% (435/703) [19].

Investigations in different regions of the country in the last decade show that pestiviruses are quite common in throughout the country. The reported rates in Central Anatolia are 82.6%, 75.2% in Isparta, 71.5% in Diyarbakır and 81.5% in Burdur [31]. Burgu et al. [6] 26 were controlled dairy herds in different regions of the country and sero positivity was reported as 24.8% (2.589/10.419) and 0.32% (40/12.413) Ag positivity in adult cattle.

BPI3V seropositivity rate was found to be higher than pestivirus in this study, and one of the highest in Turkey. Out of 1.279 adult cattle 1.058 was found to be seropositive (82.7%). The least value was 58.8%, while the highest was 97.5% in the studied districts. Studies related to BPI3V more focused on cattle in Turkey, the serological ratios reach 100%. Seropositivity was detected as 88% in 15 of 17 cattle herds located in Southeastern Anatolia [10]. Burgu et al. [8] found 94.37% antibody presence in cattle herds with respiratory system disorders and found that the agent was BPI3V. Yavru et al. [46] was determined 53.9% in the samples taken from a local slaughterhouse in Konya. Özarendeli and Kandil [29] were reported 89.7% in Malatya. BPI3V Abs were determined as 26.4% in goats in the Afyonkarahisar previously [19].

BRD is a multi-factorial problem worldwide. Dairy herds are at greater risk than beef herds [27]. In an epidemiological study of 16.581 cattle herds across France, the acute BRD rate was 9.8% with 6.5% lethality (17). Proportion of acute illness is much higher (35%) in Norway [27]. The severity of acute clinical BRD is basically increased by the presence of immunosuppressive factors. The emergence of clinical disorders of respiratory system infections in autumn and winter is not only due to the effect of cold but also due to the possibility of aerosol transmission in closed management conditions. Bad ventilation, transport, low temperatures, high humidity and population densities are also creates predisposition [12].

Besides the major effective viral agents of ABRD, pathology is largely dependent on secondary pathogenesis. Leukocyte dysfunction during pestivirus infection [40] leads to problems such as prolonged clearance of other viruses [33], immunosuppression [24,33] and susceptibility to secunder infections [35]. BPI3V is among the leading causes of clinical respiratory disorders and is widespread throughout the world. *Pasteurella multocida* and *Mannheimia haemolytica* and some other viruses are frequently isolated during acute BPI3V infection [16,23,39] and also increase the severity of prognosis. It should be noted that pestivirus infections have a potential role in increasing the efficacy of BPI3V infection. In this study, it is difficult to make a definite decision because of the lack of antigen screening data, but the obtained high rates indicate the high level of viral exposure. It is known that BVD is among the major factors in multiple etiologic infections [32,33,35,41]. Due to the presence of a close antigenic relationship between BVDV 1 and 2, the formatted antibodies are cross-react. Circulating type/types are not the subject of this study. However, in a molecular study in Turkey, type 1 isolates were from cattle while type 2 from sheep [48], as expected. BVD is often seen to be complicated with infectious bovine Rhinotracheitis (IBR), BRSV, *Pasteurella spp.*, etc. under field conditions [33,34,37,38]. PI animals can not be clinically diagnosed because of the absence of specific clinical findings, but they are constantly shedding the virus and leading to various health problems and significant economic losses.

Cattle breeding in Anatolia have been carried out almost entirely in small and medium-sized family-type enterprises. Especially in the last two decades, the number of intensive breeding of enterprises is increasing despite the significant decline in the total number of cattle. Nevertheless, the vast majority of current livestock are in small-scale enterprises, especially in rural areas. Traditional management methods are practiced in private small farms and include many objectionable factors; absence of regular health records and vet consultancy, inadequate preventive measures against infections, malnutritions, inappropriate management conditions, etc. However, significant advantages can be mentioned. The most important of them; grasslands usage at the vast majority of the year reduces nutritional expenses and lower level of viral infections which cause to major economic costs.

Afyonkarahisar province is one of the leading provinces in terms of cattle population in Turkey. Cattle breeding are the most targeted beef production. The breeding period is short and the use of pasture is very limited due to the climatic and environmental features of the region. BRD continues to be one of the main health problems in the province. Necessary protective health practices ignored due to short-term breeding. Closed system intensive management style causes high incidence of especially viral infections. Cattle raised in indoor conditions are exposed to a higher burden of airborne pathogens and airborne pollutants such as ammonia, endotoxins and dust particles [12]. Breeding aim was generally dual and most of the disadvantages mentioned above are not the issue in this study. The rate of pestivirus has recently been reported as 98.2% in organized farms [30]. Although the obtained value in this study (74.9%) was not low, it can not be said to be far above the country average [5,7,42,45].

However, both infections investigated were found to be at a higher than expected due to the targeted population. Presence of acute or more likely PI animals in the vicinity seems very possible. Common pasture use in village conditions, proximity of farms to one another and inter-farm iatrogenic transmission may be possible factors for transmission of the viruses.

Considering the persistence characteristics of BVDV, it appears that long-term economic losses

have the potential to continue or increase. This possibility is also valid for BPI3V. The absence of preventive medicine practices is the main problem of small private enterprises. Countrywide or regional extensive studies aiming control/eradication of the prominent infections should be regarded as a requirement, considering narrowed domestic livestock.

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