

FARMERS' ATTITUDES TOWARDS VETERINARY DRUGS USE AND AWARENESS OF ANTIBIOTIC RESIDUES IN DAIRY ENTERPRISES IN TURKEY

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ABSTRACT

Veterinary drugs residues in food derived from animals have a direct impact on human and animal health as well as the food industry. The study aims to evaluate farmers' attitudes toward veterinary drugs use and awareness of antibiotic residues in three provinces and central villages where conventional dairy cattle farms are widely distributed in southern Turkey, using the survey technique. The farmers were surveyed in September to October 2021. The results showed that a significant number of the farmers surveyed in the current study had positive attitudes towards use of veterinary drugs including consultation with a veterinarian, using prescribed veterinary drug, following the instructions in the prescription, reading the prospectus, paying attention the expiration date and the suitability of a drug for a specific disease. In addition, the findings demonstrated that a significant part of the farmers had a higher awareness about the antibiotic residues including use, duration, storage, withdrawal periods of antibiotics and resistance of microorganisms. As a result, the farmers had positive attitudes towards use of veterinary drugs and a higher awareness related to the antibiotic residues in southern Turkey.

Keywords: attitudes; awareness; drug use; antibiotic residues; farmers; dairy enterprises

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INTRODUCTION

Antibiotic residues can be found in milk, eggs, or other edible tissues following the administration of drugs to food-producing animals. Residues of antibiotics in animal-derived foods are more important than other drug groups due to the widespread use of veterinary drugs and their adverse effects (Sundlof, 2014; Doidge *et al.*, 2020). The most important reason for the residues of antibiotics is not the missing dose or wrong drug use but the failure to comply with the legal withdrawal periods (Landers *et al.*, 2012). The negative effects of antibiotic residues on humans include increased the antibiotic resistance in food pathogens, causing redness, urticaria, and anaphylactic shock of penicillin which leads to irreversible blood anomalies of chloramphenicol, and the nephrotoxicity of nitrofurantoin, especially the teratogenic effects of aminoglycosides (Beyene, 2016; Rana *et al.*, 2019).

To minimize mentioned risks of veterinary drug residues, not only strict controls for the authorization, labeling, and use of veterinary drugs in food-producing animals are established but also the surveillance

programs to detect unsafe drug residues in animal-derived foods are run by the national authorities worldwide (Sundlof, 2014). Milk is a part of healthy and balanced diet and milk production in the world reached 881 million tons in 2019. In addition, cow milk constitutes approximately 80 % of world milk production (IDF, Accessed: 11/11/2021). The majority of the total dairy farms in Turkey appears to be small-sized enterprises that have the capacity under the ten animals, although the number of large-scale enterprises in recent years has been on the rise. A production capacity of 20.700-ton milk was reported which was collected from 30.560 thousand animals in 2018 in Turkey (TURKSTAT, Accessed: 11/17/2021). It is important to control antibiotic residues in milk effectively due to the previously mentioned reasons. Therefore, maximum residue limits (MRLs) for a number of antibiotics in milk have been enacted by regulatory authorities. National monitoring programs are required in all EC countries and Turkey to control the veterinary drug residues in animal-derived foods including milk obtained from various animals (EC, 1996; EEC, 1990; Turkish Food Codex, 2007).

Veterinarians and farmers have critical roles for use of antimicrobials in dairy farms. Many studies have investigated farmers' knowledge, attitudes, awareness, behaviors and practices relating to the antibiotic use and antibiotic resistance in dairy farms in the different countries worldwide, such as France (Dernburg *et al.*, 2007), Peru (Redding *et al.*, 2014), the Netherlands (Speksnijder *et al.*, 2017), Denmark (Oliveira *et al.*, 2018), Lebanon (Dankar *et al.*, 2022). These studies indicated that farmers' knowledge, attitudes, awareness can significantly influence their behaviors and practices to antibiotic use for animals. It was obvious that one possible way of the prevent intensive and unnecessary antimicrobials use in animals is to inform farmers about the veterinary drug use and antibiotics, residues, and resistance. The objective of the present study was to investigate the farmers' attitudes toward veterinary drug use and awareness of antibiotic residues in dairy enterprises in Southern Turkey.

MATERIALS AND METHODS

Sample size: Raosoft sample volume calculation method ensuring a 10% error rate, 90% reliability, and 50% response distribution was utilized to calculate the sample size (Raosoft, 2021). The sample size was calculated at about 70 in a total population of 126.691 livestock enterprises in the central villages of Adana, Osmaniye, and Gaziantep provinces in Turkey. Enterprises were also randomly selected with an equal number of participants from each identified location (23 farms from each province).

Survey Method: Before the survey was conducted to participants, a pilot study was performed with ten randomly selected dairy farmers so as to check the clarity, reliability, and validity of the questionnaire. Following the application of the study, the questionnaire was revised, and data collection was carried out with the study population. 4 sections and 32 questions were contained in the questionnaire. The first part of the questionnaire was related to the demographic information of the farmers, the questions in the second part sought the information on dairy cattle enterprises in the study area, the questions in the third part evaluated the farmers' attitudes toward the veterinary drug use, and the fourth part involved the questions about the farmers' awareness of antibiotic residues. This study was approved by the Cukurova University Local Ethics Committee (with protocol 30.08.2021/11/01). The oral consent of participants was also obtained while conducting the questionnaire.

Data analyses: Chi-square test was used to analyze categorical data, and drug use for animals, following the prescription instructions, reading the prospectus, the residues in antibiotics, the use of antibiotic milk

relationship with the frequency of the veterinarian's visit of was measured by Independent t-test. Mean±standard error (SE) and $p<0.05$ as statistical significance were utilized to present the results. Besides, the direction and degree of the relationship were conducted through Pearson correlation analysis. IBM SPSS 22.0 for Windows (SPSS Inc., Chicago, IL, USA) was used to analyze.

RESULTS

Demographic Information of Farmers: Table 1 shows the results of farmers' demographic information. In the study, it was found that 92.86% of farmers in the dairy enterprises who participated in the survey were male. In addition, participants were 43.74 ± 11.59 years old on average and had an average monthly income of \$589.25 (Table 1).

Information on Dairy Cattle Enterprises: Information related to the number of animals in the dairy cattle enterprises is presented in Table 2. There were average of 74.44 cattle per farm, with a minimum of 10 and a maximum of 385 cattle in the enterprises participated in the survey. There were average of 51.5 cows/heifers, 13.5 calves, and 9.4 head of a bull in the farms (Table 2.)

Information related to the annual veterinary visit frequency to the dairy cattle enterprises and their annual veterinary expenses are presented in Table 3. The frequency of veterinarian visits to the dairy farms was 16.71 ± 14.88 times per year on average and 0.60 ± 0.51 times per animal (Table 3). In addition, there were only 4 (5.71%) dairy cattle enterprises visited by a veterinarian once a year. However, there were no significant relationship between the total number of animals in the enterprises and the frequency of visits by the veterinarians ($r=0.21$; $p>0.05$) in the correlation analysis.

The average cost of the veterinarian was $\$763\pm 936$ (min: \$83, Max: \$5.000) per year on average and 16.50 ± 13.50 \$ per animal. Nevertheless, there was a moderate positive correlation ($r=0.63$; $p<0.05$) between the total number of animals in the enterprises and the cost of veterinarians.

Table 4 shows the results related to the annual drug use in the dairy enterprises. The enterprises use an average of 14.85 ± 21.50 boxes of antibiotics, 25.23 ± 44.92 boxes of vitamins, 19.57 ± 35.41 boxes of parasitic drugs, and 20.70 ± 29.57 liters of disinfectant annually. There was no statistically significant relationship between the frequency of visits by the veterinarians and the amount of the drug use ($p>0.05$).

Information related to the annual drug costs classified by drug groups in the dairy enterprises is presented in Table 5. There was an annual average of

\$520 per enterprise and a drug cost of \$19.3 per animal. There was no statistically significant relationship among the frequency of visits by veterinarians and the cost of drug ($p>0.05$).

Farmers' Attitudes Toward Veterinary Drug Use: The data related to farmers' attitudes toward veterinary drug use in dairy enterprises are presented in Table 6.

While 85.7% of the farmers in the dairy cattle enterprises stated that they used veterinary drugs for the cattle in consultation with a veterinarian, 14.3% stated that they used veterinary drugs without consulting a veterinarian. In addition, 82.9% of the farmers stated that they did not use non-prescription veterinary drugs, while 17.1% stated that they used non-prescription veterinary drugs. Likewise, 78.6% of the farmers stated that they followed the instructions in the prescription and 21.4% of them stated that they did not comply with the prescription instructions for the veterinary drug use. Furthermore, 64.3% of the farmers stated that they read the prospectus when using veterinary drugs while 35.7% of them stated that they did not read the prospectus. 74.3% of the farmers obtained the veterinary drugs from a veterinarian, while 27.7% of the farmers purchased them from a Pharmacy-drug store. While 55.7% of the farmers stated that they routinely using veterinary drugs for animals, 44.3% stated that there were no veterinary drugs that they were routinely use for animals. Among the farmers surveyed in the study 30% reported that had they been paying attention to the expiration date when using the leftover veterinary drugs, 17.1% reported that they had been paying attention to the suitability of veterinary drug for the disease, and 52.9% reported that they had been paying attention to both the expiration date and the suitability of veterinary drug for the disease.

In addition, a statistically significant relationship was found between those who used veterinary drugs in consultation with a veterinarian and those who did not use a prescription drug and the frequency of the veterinarian's visit in Table 6 ($p < 0.05$). As a matter of fact, it was found that the veterinarian comes to 18.9 times a year on average in the enterprises that use drugs, and 12.8 times a year on average for those who do not use a prescription drug. However, no statistically significant relationship was found between the routine drug use for animals, following the prescription instructions, reading the prospectus, and the frequency of the veterinarian's visit ($p > 0.05$).

Awareness of Farmers Related to Antibiotic Residues:

The data related to farmers' awareness of antibiotic

residues in the dairy enterprises are given in Table 7. Of the farmers surveyed in the study, 67.1% indicated they knew that the use of antibiotics left a residue in the body. There was a significant correlation between the knowledge about antibiotic residues and the education level of the farmers ($F = 4.735$ $p < 0.05$), while there was no statistically significant relationship between the age and the monthly income of the farmers ($p > 0.05$). Among the farmers 82.9% stated that they paid attention to the duration of antibiotic treatment, and 17.1% of them stated that they did not pay attention to the duration of antibiotic treatment. While 80% of the farmers reported that antibiotics were used for a recommended period of time by a veterinarian, 20% reported that antibiotics were used until the symptoms of the disease subsided. As a reason for not using antibiotics for the recommended period of time by a veterinarian, 64.3% of the farmers stated that the animals were cured, and 35.7% of the farmers thought that the veterinary drug was not effective. Moreover, 60% of the farmers knew that unnecessary use of veterinary drugs might lead to antibiotic resistance development in microorganisms, and 40% stated that they did not know about the antibiotic resistance development. Of the farmers participated in the survey, 74.3% stated that they did not consume milk obtained from cows while using the antibiotics, while 65.4% stated that they consumed milk according to recipe information, and 34.6% stated that they did not consume milk for at least 7 days. 64.8% of the farmers stated that they did not transport the animals for the slaughtering for meat when they used antibiotics, 66.7% stated that they transport the animals for the slaughtering for meat according to the prescription information of the drug, and 33.3% stated that they transport the animals for the slaughtering for meat after waiting for at least 28 days.

There was a significant relationship between the frequency of the veterinarian's visit and the knowledge of farmers related to resistance development in microorganisms due to unnecessary use of the antibiotics ($p < 0.05$; $p = 0.008$). Furthermore, veterinarians visited 20.60 times on the average year to the enterprises where the farmers had awareness related to resistance in microorganisms due to unnecessary use of antibiotics. Conversely, the veterinarians visited on average 10.96 times to the enterprises where the farmers had not knowledge related to the resistance in microorganisms. However, there was no statistically significant relationship between the withdrawal periods of the antibiotics from milk and the harvesting animal, and the frequency of veterinarian visits ($p > 0.05$).

Table 1. Demographic Information of Farmers Participated in the Survey

Gender	Female	5 7.14%
	Male	65 92.86%
Age	18-30 years old	9 12.9%
	31-40 years old	20 28.6%
	41-50 years old	19 27.1%
	51-75 years old	22 31.4%
	Primary School	18 25.7%
Education	Secondary School	16 22.9%
	High School	23 32.9%
	University	13 18.6%
	\$250 and below	6 8.6%
Monthly Income (\$)	251- 500 \$	29 41.4%
	501-750 \$	24 34.3%
	751 \$ and above	11 15.7%

Table 2. Numbers of Animals in the Dairy Cattle Enterprises

Number of Animals	Min	Max	Mean	SE
Cow/heifer	6.00	295.00	51.46	9.84
Calf	3.00	60.00	13.45	2.79
Bull	1.00	35.00	9.44	2.67
Total Animal	10.00	385.00	74.44	12.79

Table 3. Information about the Annual Veterinary Visit Frequency in Dairy Cattle Enterprises and the Annual Veterinary Expenses (\$)

Parameters	Min	Max	Mean	SE
Frequency of Visiting Veterinarians to Enterprises	1.00	60.00	16.72	1.82
Frequency of Visiting Veterinarians Per Animal	0.0	3.33	0.60	0.11
Veterinarian Expenses of Enterprises (\$)	83.33	5.000	763.26	111.99
Veterinarian Cost Per Animal	2.17	57.78	16.50	2.01

Table 4. Information about the Annual Drug Use of Dairy Enterprises

Drugs (box/liter)	Number of Enterprises (N)	Min	Max	Mean	SE	Total (Box/liter)	Box/liter per Animal
Antibiotics	49	1.0	30.0	14.85	3.12	728	0.22
Vitamins	40	2.0	50.0	25.23	7.26	1.009	0.30
Antiparasitic Drugs	37	2.0	00.0	19.57	5.96	724	0.22
Disinfectant (liter)	20	1.5	00.0	20.70	9.35	427	0.13

Table 5. Information about the Annual Drug Costs Classified by Drug Groups in Dairy Enterprises (\$).

Drug expenses (\$)	Min	Max	Mean	SE	Total Cost (\$)
Antibiotic Expenses	16.67	1.666.6	277.40	63.19	9.431
Vitamin Expenses	8.33	1.325.3	172.72	50.77	5.181
Parasitic Drug Expenses	18.55	333.3	92.34	13.75	3.047
Disinfectant Expenses	12.42	1.633.8	196.25	71.13	3.925
Average Drug Expenses	33.3	2.666.7	519.77	72.83	24.305

Table 6. Farmers' Attitudes towards Veterinary Drug Use in Dairy Enterprises.

Questions	Answers	Frequency	Percentage	F/P
1. Do you use veterinary drugs in consultation with the veterinarian?	Yes	60	85.7	F=9.572
	No	10	14.3	P<0.05
2. Do you give non-prescription veterinary drugs to the animals?	Yes / sometimes	12	17.1	F=16.090
	No	58	82.9	P<0.01
3. Do you follow the prescription instructions for the use of veterinary drugs?	Yes / mostly	55	78.6	F=2.353
	No/ rarely	15	21.4	p>0.05
4. Do you read the veterinary drugs' prospectus?	Yes / mostly	45	64.3	F=2.530
	No/ rarely	25	35.7	p>0.05
5. Where do you get the veterinary drugs from?	From the veterinarian	52	74.3	F=1.792
	Pharmacy-drug store	18	25.7	p>0.05
6. Are there any veterinary drugs you routinely use for your animals?	Yes	39	55.7	F=1.141
	No	31	44.3	p>0.05
7. If there are is a leftover drug available at the enterprises what criteria you pay attention before reusing it?	To expiration date	21	30.0	F=4.830 p>0.05
	The suitability of the disease	12	17.1	
	Both of them	37	52.9	

Table 7. Awareness of the Farmers about the Antibiotic Residues in Dairy Enterprises.

Questions	Answers	Frequency	%	F/P
1. Do you have any knowledge about the antibiotic residues in animal-derived foods?	Yes	47	67.1	F=16.019
	No	23	32.9	P<0.01
2. Do you pay attention to the duration of the use when giving the antibiotics to the animals?	Yes	58	82.9	F=1.695
	No	12	17.1	p>0.05
3. How long do you use the antibiotics for the animals?	Until the symptoms of the disease subsided	14	20.0	F=0.126
	As recommended by the veterinarian	56	80.0	p>0.05
4. If the antibiotics are not used as long as the recommended prescription duration by the Veterinarian, what would be the reason?	The animals are cured	36	64.3	F=0.095
	The drug doesn't work	20	35.7	p>0.05
5. Do you know that microorganisms could develop resistance due to unnecessary antibiotics use?	Yes	42	60.0	F=17.924
	No	28	40.0	P<0.01
6. Do you consume milk from cows during the antibiotics are given to the animals?	Yes	18	25.7	F=0.035
	No	52	74.3	p>0.05
7. If your answer is no to the previous question, how many days do you not consume the milk?	At least 7 days	18	34.6	F=1.250
	According to the drug prescription	34	65.4	p>0.05
8. Do you transport the animals for the	Yes	22	31.4	F=3.629

9.	harvesting during the antibiotics are given to the animals?	No	48	68.6	p>0.05
	If your answer is no to the previous question, after finishing the antibiotics how many days you wait before transporting the animals for the harvesting?	At least 28 days	16	33.3	F=1.378 p>0.05
		According to the drug prescription	32	66.7	

DISCUSSION

The present survey examined the farmers' attitudes and awareness in dairy enterprises located in southern Turkey in terms of the veterinary drug use and antibiotic residues. The results of this study indicated that farmers mostly had positive attitudes toward use of veterinary drugs and a higher awareness related to the antibiotic residues.

In Turkey, 77% of the total drug consumption in veterinary medicine consists of drugs used in the fight against bacterial (33%) and parasitic diseases (28%) and products that support animal productivity (16%) (DPT, 2007). Demir *et al.*, (2020) showed that the first three most frequently used drugs in veterinary clinics reported to be composed of antibiotics, antiparasitic drugs and vitamins. In the developed markets such as the EU and the USA, the monetary value of the veterinary health products market is around 5% of the human market. In our country, this rate is around 3% (DPT, 2007). The veterinary market is dispersed according to various animal species, regional differences, and diseases in Turkey. There is no reimbursement system or national health insurance system in the veterinary health products sector, and all costs of treatment are borne by the owner of the animal. For this reason, the economic status of animal owners is an important criterion in the treatment of animals. As a matter of fact, although there was no statistically significant relationship between the frequency of visits of the veterinarian and the amount of drug use and the cost of drugs, the average frequency of visits of veterinarians to farms was 16.50, the annual average cost of veterinarian visits was \$763 and the annual average cost of the veterinary drugs was \$591 for each farms in the current study. Similar to the findings of this study, dairy cattle farms were reported having 168.57 TL (approximately \$96) monthly veterinary medicine-medicine costs (Demir and Ayvazoğlu, 2012). In this context, it could be concluded that the veterinary drug costs might vary according to the disease rates rather than the scale of the enterprise, and it causes substantial expenses for the enterprises.

Due to the increase in population and income, the increasing demand for animal products day by day has paved the way for conventional production, and various veterinary drugs and animal feed additives have been unconsciously used in animal production with the thought of producing a higher amount of product in a short time (Qian *et al.*, 2018; Gonzalez *et al.*, 2020).

However, some studies showed that unnecessary use of veterinary drugs caused residues in animal products and significant health problems in humans, necessitating an increase in the knowledge level of the farmers on the subject. Veterinary drug residues are monitored by various institutions and organizations in many countries all over the world. A National Residue Monitoring Plan is annually implemented for some animal tissues and products in Turkey. The prevention of veterinary drug residues in animal-derived foods can only be achieved by ensuring conscious and controlled use in animals. Especially, farmers' attitudes toward veterinary drug use and awareness of antibiotic residues have a large share as well as veterinarian's practices in dairy enterprises in order to control veterinary drug residues in animal tissues and products. It was eventually demonstrated in the study that a significant part of the farmers in dairy cattle farms used veterinary drugs in consultation with the veterinarian and obtained the drugs from a veterinarian, read the drug prescriptions and administered them to animals in accordance with the prospectus. In addition, it was found that almost half of the farmers had veterinary drugs that they routinely use for animals, and when using the leftover drugs accumulated the farm over time, they paid attention to the expiration date and suitability of the drugs for the disease in the present study. These findings showed that the farmers have positive attitudes towards use of veterinary drugs in this region.

The use of antimicrobial growth promoters in animal food and water was officially forbidden by The European Union in 2006. Restriction progress of antibiotic use in livestock has been slow in the United States. The US Food and Drug Administration have partially restricted the use of growth promoters in 2016 (Matin *et al.*, 2015). Turkey also began to apply the prohibition of the antimicrobial growth promoters for animals in 2005 within the framework of the harmonization laws of the European Union (Anonymous, 2005). However, despite the prohibitions in these countries, most of the antibiotics are still in use for animals to treat and/or prevent diseases and to promote growth in many countries (Muaz *et al.*, 2018). The animal products might contain antibiotic residues due to the fact that animals are given more than the prescribed doses, especially animals that administered antibiotics are transported for the harvesting without complying with the legal waiting period of the drug (Beyene, 2016). It was obvious that knowledge, attitudes, and behaviors of livestock farmers regarding the use of antibiotics in

animals play a significant role for reducing antibiotic residues in animal-derived food such as milk and meat. Nevertheless, the former reports pointed out that a substantial proportion of the farming community does not obtain sufficient information about antibiotic knowledge and antibiotic use (Sudershan *et al.*, 1995; WHO, 2015; Kramer *et al.*, 2017; Chauhan *et al.*, 2018; Sadiq *et al.*, 2018). In contrast with previous surveys among farmers, rabbit and turkey farmers seem to be more aware of higher antimicrobial use (Martino *et al.*, 2019). In the present study, findings demonstrated that farmers had sufficient knowledge about the antibiotic residue and that they applied antibiotics in accordance with the duration of antibiotic use. Moreover, farmers stated that antibiotics were used for a recommended period of time by a veterinarian, and that the animals were not transported for harvesting until the veterinarian's permission. Farmers also indicated that they knew that microorganisms could develop antibiotic resistance due to the use of unnecessary antibiotics. In addition, the farmers did not use the milk obtained during the antibiotic treatment period, and did not transport the animals for the harvesting, and the veterinary antibiotics applied for the animals were the prescription drugs. The results of the current survey indicated that farmers are highly aware of the antibiotic resistance in microorganisms due to the unnecessary use of the antibiotics and they follow the prescription instructions for the withdrawal periods of antibiotics from milk and meat, which are essential to develop the country's livestock.

Conclusion: Farmers' knowledge, attitudes, and awareness might significantly affect their behaviours and practices for the antibiotic use in dairy enterprises and might have a further effect on antibiotic residues in animal-derived foods. The current study indicated that a significant number of the farmers had positive attitudes towards use of veterinary drugs due to the consultation with a veterinarian, using prescribed veterinary drug, following the instructions in the prescription, reading the prospectus, paying attention the expiration date and the suitability of a drug for a specific disease. Furthermore, the most of the farmers had a higher awareness about the antibiotic residues and their resistance in microorganisms because of the use, duration, storage, and withdrawal periods of antibiotics. The results indicated that positive attitudes toward use of veterinary drugs and a higher awareness related to the antibiotic residues among the farmers in southern Turkey. It was concluded that the attitudes and the awareness of the animal farmers in southern Turkey might positively affect farm animals and consumer health.

Ethics Approval: The study approved by the Cukurova University Local Ethics Committee (protocol code: 11/01 and date of approval: 30.08.2021)

Conflict of Interest: The authors declare that they have no conflict of interests.

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Data Availability Statement: The data that support the findings of this study are available from the corresponding author, [PPB], upon reasonable request.

REREFENCES

- Anonymous. (2005). Communiqué on substances that are prohibited to be added to mixed feeds and fed to animals, From the Ministry of Agriculture and Rural Affairs. 16 June 2005. No: 25847 Communiqué No: 2005/24.
- Beyene, T. (2016). Veterinary drug residues in food-animal products: its risk factors and potential effects on public health. *J. Vet. Sci. Technol.* 7(1): 1-7.
- Chauhan, A.S., George, M.S., Chatterjee, P., Lindahl, J., Grace, D., Kakkar, M. (2018). The social biography of antibiotic use in smallholder dairy farms in India. *Antimicrob. Resist. Infect. Control.* 7: 60.
- Dankar, I., Hassan, H., Serhan, M. (2022). Knowledge, attitudes, and perceptions of dairy farmers regarding antibiotic use: Lessons from a developing country. *J. Dairy Sci.* 105(2):1519-1532.
- Demir, P., Aydın, E., Ayvazoğlu, C. (2020). Diseases that veterinary clinical enterprises encounter the most frequently with regard to cattle farming: The example of Adana. *Proceedings of 4th International Congress on Agriculture, Animal Science and Rural Development*, 136-143. Ankara, Turkey.
- Demir, P., and C. Ayvazoğlu (2012). The expectation of livestock farms from veterinary services: Example of Kars province. *J. Fac. Vet. Med. Univ. Erciyes.* 9(3): 169-174.
- Dernburg, A.R., Fabre, J., Philippe, S., Sulpice, P., Calavas, D. (2007). A study of the knowledge, attitudes, and behaviors of French dairy farmers toward the farm register. *J. Dairy Sci.* 90(4): 1767-1774.
- Doidge, C., Ruston, A., Lovatt, F., Hudson, C., King, L., Kaler, J. (2020). Farmers' perceptions of preventing antibiotic resistance on sheep and

- beef farms: Risk, responsibility, and action. *Front. Vet. Sci.* 7: 524.
- DPT. (2007). State Planning Organization, Turkey. IX. Development plan (2007-2013) Pharmaceutical Industry Specialization Commission. Veterinary pharmaceutical industry sub-working group. https://www.sbb.gov.tr/wpcontent/uploads/2018/11/09_%C4%B0lacSanayii.pdf (Accessed: 11/21/2020)
- EC. (1996). Council Directive: 96/23/EC of April 1996 on measures to monitor certain substances and residues thereof in live animals and animal product. *Off J Eur Comm*, L125, 10-32.
- EEC. (1990). Council Regulation: No. 2377/90 of 26 June 1990 laying down a Community procedure for the establishment of maximum residue limits of veterinary medicinal products in foodstuffs of animal origin. *Of J Eur Comm*, L224, 1-8.
- González, N., Marquès, M., Nadal, M., Domingo, J.L. (2020). Meat consumption: Which are the current global risks? A review of recent (2010-2020) evidences. *Food Res. Int.* 137: 109341.
- IDF. (2021). International Dairy Federation Report. <https://fil-idf.org/> (Accessed date: 11/11/2021)
- Kramer, T., Jansen, L.E., Lipman, L.J., Smit, L.A., Heederik, D.J., Dorado-García, A. (2017). Farmers' knowledge and expectations of antimicrobial use and resistance are strongly related to usage in Dutch livestock sectors. *Prev. Vet. Med.* 147: 142–148.
- Landers, T.F., Cohen, B., Wittum, T.E., Larson, E.L. (2012). A review of antibiotic use in food animals: perspective, policy, and potential. *Public. Health. Rep.* 127(1): 4–22.
- Martin, M.J., Thottathil, S.E., Newman, T.B. (2015). Antibiotics overuse in animal agriculture: A Call to action for health care providers. *Am. J. Public. Health.* 105(12): 2409-2410.
- Martino, G.D., Crovato, S., Pinto, A., Dorotea, T., Mascarello, G., Brunetta, R., Agnoletti, F., Bonfanti, L. (2019). Farmers' attitudes towards antimicrobial use and awareness of antimicrobial resistance: a comparative study among turkey and rabbit farmers. *Ital. J. Anim. Sci.* 18(1): 194-201.
- Muaz, K., Riaz, M., Akhtar, S., Park, S., Ismail, A. (2018). Antibiotic residues in chicken meat: global prevalence, threats, and decontamination strategies: a review. *J. Food Protect.* 81: 619-627.
- Oliveira, V.H., Anneberg, I., Voss, H., Sørensen, J.T., Thomsen, P.T. (2018). Attitudes of Danish dairy farmers towards biosecurity. *Lives. Sci.* 214, 153-160.
- Qian, Y., Song, K., Hu, T., Ying, T. (2018). Environmental status of livestock and poultry sectors in China under current transformation stage. *Sci. Total Environ.* 622-623: 702-709.
- Rana, M.S., Lee, S.Y., Kang, H.J., Hur, S.J. (2019). Reducing veterinary drug residues in animal products: A review. *Food Sci. Anim. Resour.* 39(5): 687-703.
- Raosoft, (2021). Sample Size Calculator by Raosoft. Inc. Raosoft.com. Available online: <http://www.raosoft.com/samplesize.html> (Accessed date: 12/18/2021).
- Redding, L.E., Cubas-Delgado, F., Sammel, M.D., Smith, G., Galligan, D.T., Levy, M.Z., Hennessy, S. (2014). The use of antibiotics on small dairy farms in rural Peru. *Prev. Vet. Med.* 113(1): 88-95.
- Sadiq, M.B., Syed-Hussain, S.S., Ramanoon, S.Z., Saharee, A.A., Ahmad, N.I., Mohd Zin, N., Khalid, S.F., Naseeha, D.S., Syahirah, A.A., Mansor, R. (2018). Knowledge, attitude and perception regarding antimicrobial resistance and usage among ruminant farmers in Selangor, Malaysia. *Prev. Vet. Med.* 156: 76–83.
- Speksnijder, D.C., Graveland, H., Eijck, I., Schepers, R., Heederik, D., Verheij, T., Wagenaar, J.A. (2017). Effect of structural animal health planning on antimicrobial use and animal health variables in conventional dairy farming in the Netherlands. *J. Dairy Sci.* 100(6): 4903–4913.
- Sudershan, R.V., Bhat, R.V. (1995). A survey on veterinary drug use and residues in milk in Hyderabad. *Food Addit. Contam.* 12: 645–650.
- Sundlof, S.F. (2014). Veterinary drug foods, materials, technologies and risks, In: *Encyclopedia of Food Safety*, Amsterdam : Elsevier/Academic Press.
- Turkish Food Codex. (2007). Communiqué Amending the Communiqué on Maximum Residue Limits of Veterinary Medicines in Foods of Animal Origin (No: 2007/17). March 9, 2007 and numbered 26457.
- TURKSTAT. (2021). Turkish Statistical Institute (Accessed date: 11/17/2021)
- WHO. (2015). World Health Organization, Antibiotic Resistance: Multi-Country Public Awareness Survey; World Health Organization: Geneva, Switzerland, 2015; <http://apps.who.int/medicinedocs/documents/s22245en/s22245en.pdf> (Accessed date: 09/09/2019).