Animal Health and Welfare, Milk Safety and Hygiene Practices in Dairy Cattle Farms: Türkiye Sample

Gamze AYDIN ERYILMAZ[1*], Ali Vaiz GARİPOĞLU[2], Osman KILIÇ[3]

[1]*Ondokuz Mayıs University, Samsun Vocational School, Department of Park and Garden Plants, Samsun, TÜRKİYE*
[2]*Ondokuz Mayıs University, Faculty of Agriculture, Department of Animal Science, Samsun, TÜRKİYE*
[3]*Ondokuz Mayıs University, Faculty of Agriculture, Department of Agricultural Economics, Samsun, TÜRKİYE*

ORCID ID (By author order)

orcid.org/0000-0002-4440-8687   orcid.org/0000-0001-6681-3336   orcid.org/0000-0002-0129-4034

*Corresponding Author: gamzeaydin@omu.edu.tr

Abstract: Dairy farming is one of the agricultural activities with high added economic value. Remarkable technical and economic developments have occurred in the dairy cow farming sector through subsidies. However, it is difficult to say that Türkiye has reached the level of developed countries in terms of productivity, quality, and hygiene practices in dairy cattle farming. In this study, it was aimed to determine the factors affecting the consciousness levels of dairy cow raisers about the practices related to animal health and welfare in addition to milk safety and hygiene in dairy cow farming. The study was conducted in three districts of Samsun province. The data were collected from 82 dairy cattle farms according to the stratified random sampling method. The results showed that 69.51% of the farms have milking units, 51.22% have delivery rooms, 52.44% have calf cages, 80.49% have an infirmary, and 81.71% have walking areas. While udder cleaning was carried out in all dairy farms, the udder drying procedure was applied in 74.39% of the farms. The percentage of farms with mastitis control (3.66%), wearing gloves (3.66%), and wearing milking outfits (8.54%) were found to be quite low. It is essential to raise the awareness level of milk safety and hygiene in terms of protecting public health, rehabilitating barn conditions, and maintaining animal welfare.

Keywords: Dairy cattle, milk safety, animal welfare, hygiene

1. Introduction

Increasing consumption of dairy and other livestock products provides notable nutritional benefits to large segments of the population in developing countries. However, most people in developing countries can still not attain better-quality diets due to the higher cost (Anonymous, 2022a). In Türkiye, a developing country, livestock is generally considered a secondary farming activity. While in developing countries it is aimed to provide adequate and balanced nutrition for humans, a sustainable development model with respect to social and environmental aspects is sought in developed countries (Kılıç and Aydın Eryılmaz, 2020).

Some remarkable regulations concerning supporting policies aimed at developing livestock were made in Türkiye after 2000. Since 2005, some livestock subsidies (milk promotions, artificial insemination promotions, calf promotions etc.) have been put into practice (Demir and Yavuz, 2010). The adaptation imperative to European Union (EU) criteria for animal food products necessitated the transformation of traditional livestock farms in Türkiye (Saçlı, 2007). The transformations of the dairy sector in Türkiye have occurred in the technical and economic fields. The technical transformations are the number of dairy cows (head), milk production (kg), and dairy farm size and the economic transformations are increases in the amount of processed milk, the value of marketed milk, milk yield, milk/feed parity, and nature of investments.

The share of livestock in agricultural production has increased in developed countries in recent years, but this is not the case in Türkiye

(Anonymous, 2022b). The main problems encountered in the Turkish livestock sector include small farm sizes, weak capital structure, high production costs, and low incidence of farmers who are producing for the market (Turan et al., 2017). In Türkiye, 67.4% of the livestock farms are classified as small-scale farms (1-10 heads) (Anonymous, 2021). In addition, the milk industry occupies a remarkable share (11%) of the food industry (Gümüş, 2015). These problems indicate that the use of modern production techniques is essential for efficient and high-quality production in Türkiye. However, an approach that focuses only on increasing yield and quality is not rational. Like all over the world, the consumer requirements for healthy animal products are progressively enhanced in Türkiye.

Milk is one of the unique food sources in the human diet. This valuable product contains fat, protein (casein and whey), minerals (calcium, phosphorus, etc), and vitamins (B12 and B2, etc) which are vital for healthy nutrition. Besides, milk contains also biologically active compounds (immunoglobulins, antibacterial peptides, antimicrobial proteins, and oligosaccharides) which have significant physiological functions related to human nutrition and health (Park and Nam, 2015). Other significant issues in milk production are hygiene and safety. While milk hygiene and milk safety have the importance they deserve in developed countries, this is not the case in developing countries including Türkiye.

In Türkiye, the total numbers of cattle and lactating cows are approximately 18 million and 6.6 million, respectively. Nearly 90.6% of total milk production (ca. 20 million tonnes) was obtained from cows in 2021 (Anonymous, 2022c). Milk production per animal has increased in all animal species. The highest increase was observed in cattle. Milk yield per lactating cow increased from 2970 kg in 2013 to 3161 kg in 2018. These values are quite lower compared to the average milk yield (6000 kg/lactating cow) in EU countries (Anonymous, 2022b).

Traditional production practices in dairy cattle farms in different regions of Türkiye cause some problems with the production, quality, and marketing of milk (Boz, 2013; Hozman and Akçay, 2016; Muradi and Akbay, 2018; Alkan and Ünlü, 2019; Bakır and Kibar, 2019; Akbay and Akdoğan, 2020). Characteristics and structural problems of dairy cattle farms in Türkiye differ according to regions and even cities. For this purpose, first, the structural problems related to dairy cow farming should be determined by conducting local research, then problem-oriented precautions should be taken to manage the process successfully. In this study, it is aimed to reveal food safety and hygiene practices in milk production, eliminate the errors made in practice, and present the suggested solutions to reach a sustainable production.

2. Materials and Methods

2.1. Research area

This study includes the Bafra, 19 Mayıs, and Canik districts of Samsun province which are located in the Middle Black Sea region of Türkiye (Figure 1). Although agriculture is the leading economic sector in Samsun, the share of the industrial sector in Samsun's economic structure is increasing. Nearly 40.3% of the acreage of Samsun (ca. 9.6 million da) is agricultural land. Samsun province ranks 16th in Türkiye according to the amount of cultivated agricultural land (38.57% of the total acreage of Samsun) (Anonymous, 2022d).
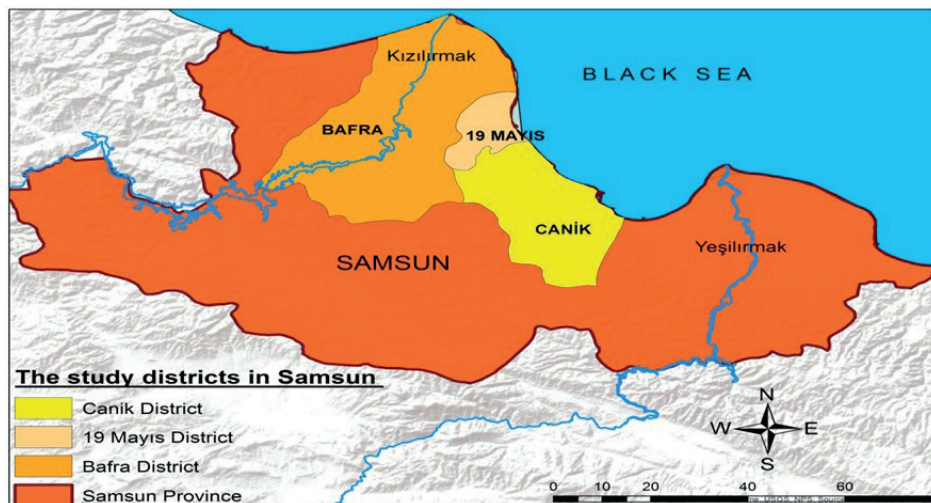

Figure 1. Bafra, 19 Mayıs and Canik districts of Samsun province, Türkiye

The highest part of this area (3.7 million da) was allocated to grain production (59.8%). In Samsun, livestock activities are generally conducted on small farms with a few cows to fulfilling the farm family needs. Nearly 55.47% of the cattle population consists of cross-bred cows (Table 1).

Table 1. Dairy cattle population in Samsun (Anonymous, 2022c)

	Cattle population (2021)	
	Head	%
Pure-bred	59472	27.79
Cross-bred	118692	55.48
Native	35789	16.73
Total	213953	100.00

2.2. Data collection and analysis

The research material is the data collected by questionnaires conducted in the dairy cattle farms placed in the research area. The dairy cow numbers in these farms were determined as the sampling unit of this study. The number of farms was calculated as 82 by using the stratified sampling method (Yamane, 1967).

The questions in the questionnaire were related to the technical specifications of farms, animal health and welfare, milk safety, and milk hygiene (Table 2). The questions related to the specifications of the farmer (dairy cow raiser) (age, duration of education, agricultural experience, and experience in dairy farming) and specifications of the farms (family size, form of saving, number of small ruminants, number of large ruminants, and number of milking animals) were asked in the questionnaire. The questions related to animal health and welfare (milking parlor, delivery room, calf hutch, infirmary, and walking area) were also included in this questionnaire. The questions related to barn hygiene (method and frequency of barn cleaning, and ventilation) and animal hygiene (milker's hygiene before milking, mastitis control, washing and drying procedures of the udder) were asked in this study. The collected data were analyzed via IBM SPSS statistical software.

Table 2. Design of the questions in the questionnaire

Technical characteristics of farmer and enterprise	Technical characteristics of farmer	-Age -Duration of education -Agricultural experience -Dairy farming experience	-Min. -Max. -Std. deviation -Average
	Technical characteristics of enterprise	-Farmland asset -Form of the land saving -Family size -Number of small ruminants -Number of large ruminants -Number of milking cows, yield, milk fat ratio -Production activity (plant and animal production)	-Min. -Max. -Std. deviation -Average -%
Animal health and welfare	Physical facilities	-Milking unite -Delivery room -Calf hutch -Infirmary -Walking area	
Milk safety and hygiene practices	Barn hygiene practices	-Form of cleaning -Frequency of cleaning -Ventilation method	-Frequency -Total score -%
	Animal hygiene practices	-Hand washing -Use of gloves -Use of milking outfit -Mastitis control -Udder washing -Udder drying	
	Milk safety	-Milking machine cleaning before milking - Cleaning of the milk container - Putting each cow's milk into a different milk container -Filtration of milk - Milking machine cleaning after milking - Storing milk under suitable conditions -Daily purchase of milk	

3. Results and Discussion

3.1. Characteristics of the farmers and the farms

The data relating to farms and farmers are shown in Table 3. The average age and duration of education of the farmers are 45.01 and 6.16 years, respectively. In the agriculture and dairy farming sectors, the average experience of the farmers are 25.77 and 22.43 years, respectively. These data show that the farmers are middle-aged, low-educated, and experienced in the agriculture and dairy farming sectors. Nearly 75.61% of farms deal with only livestock production and the remaining deal with livestock production and plant production. The farm sizes were found to be 16.33 da and the family sizes were found as 4.50 persons. The numbers of large ruminants, small ruminants, and milking cows were 12.07, 10.32, and 3.69 heads/farm, respectively. Simmental breed cows constitute the largest part of the cattle population on the farms (1.63 heads/farm).

Table 3. Characteristics of the farmers and the farms

	Minimum	Maximum	Standard deviation	Average
Age (year)	26	67	8.84	45.01
Duration of education (year)	0	15	2.65	6.16
Agricultural experience (year)	2	50	11.05	25.77
Experience in dairy farming (year)	2	50	11.77	22.43
Production type (%)				
Livestock production	-	-	-	75.61
Plant production + Livestock production	-	-	-	24.39
Land area (da)	0	140	21.93	16.33
Family size (heads)	1	11	1.62	4.50
Number of small ruminants (heads)	0	150	26.81	10.32
Number of large ruminants (heads)	2	80	13.87	12.07
Number of milking cows (heads)	1	18	2.41	3.69
Simmental	0	6	1.60	1.63
Jersey	0	6	1.10	0.78
Holstein	0	5	1.07	0.63
Native	0	4	0.84	0.52
Montofon	0	3	0.51	0.18
Angus	0	1	0.11	0.02

The opinions of the producers regarding the fat ratios in milk according to animal breeds are given in Table 4. The highest milk yield (11.28 kg day^{-1}) and the lowest fat content in the milk were obtained from Holstein breed cows. The Simmental breed ranked second for milk yield (10.22 kg day^{-1}) followed by Brown Swiss (9.66 kg day^{-1}), Jersey (8.06 kg day^{-1}), and native (6.66 kg day^{-1}) breeds. The highest fat content was measured in the milk of the Jersey breed (Table 4).

Table 4. Milk yields and fat contents in the milk of the breeds

	Milk yield (kg day^{-1})
Holstein	11.28
Simmental	10.22
Brown Swiss	9.66
Jersey	8.06
Native	6.61

3.2. Animal health and welfare

Dairy cows spend a large part of their daytimes in the barn. Therefore, the conditions of the barn affect animal health, productivity, welfare, and milk quality (Özbeyaz and Ünal, 2018). The results of the present research show that 69.51% of the farms have milking units (Tablo 5). Furthermore, the pregnant cows should be transferred to private delivery rooms, which were cleaned adequately (Maton et al., 1985). While nearly 51.22% of the farms have delivery rooms, 52.44% have calf hutch. In this study, the high rate of the farms having infirmaries (80.49%) and walking areas (81.71%) indicates that the dairy farmers are sufficiently conscious about the health and welfare of their cows (Table 5). İzci et al. (2021) reported that the presence of a clean infirmary with dry soft bedding material and a private area for cows are essential for cow comfort.

3.3. Hygiene and milk safety practices

The practices related to hygiene and milk safety are involved in the process from production to consumption. Milk safety is related to factors such as barn hygiene, milk machine hygiene, hand hygiene, and milk storage conditions. In the present study, the frequency of barn cleaning, type of barn cleaning, and ventilation conditions was considered

for evaluating barn hygiene. The barn cleaning is performed two times a day at 93.90% and three times a day at 6.10% of all dairy cattle barns. The distribution of different farm cleaning types is as follows: Pulling cleaning type at 65.85% of the barns, pulling&washing at 26.83% of the barns, and washing at 7.32% of the barns. Only 3.66% of the barns have a mechanical ventilation system (Table 5). In other words, most of the barns (96.34%) have a natural ventilation system. In our country, one of the main problems in dairy farming is the unconsciousness of the raisers related to the necessity of adequate ventilation in barns. Adequate ventilation reduces heat and impurity levels. Among these impurities are odors, harmful gases (hydrogen sulfide, ammonia, and methane), and pathogens. The inadequate ventilation causes damage (corruption and corrosion) to wooden and metal equipment within the barn. Adequate ventilation helps to eliminate these problems. Furthermore, inadequate ventilation affects milk production and animal health negatively (Özdemir and Karaman, 2008; Alkan, 2015).

Table 5. Distribution of sections in the barn

		Numbers	%
Milking unit	Present	25	30.49
	Absent	57	69.51
Delivery room	Present	40	48.78
	Absent	42	51.22
Calf hutch	Present	39	47.56
	Absent	43	52.44
Infirmary	Present	16	19.51
	Absent	66	80.49
Walking area	Present	67	81.71
	Absent	15	18.29

The use of gloves (3.66%) or milking outfits (8.54%) during the milking process is quite low in all farms surveyed in this study (Table 6). This finding is inconsistent with some previous studies conducted in Türkiye (Tosun and Acar, 2019; Kaygısız and Özkan, 2021). Dairy cow hygiene is highly associated with milk safety. One of the most important factors affecting dairy cow hygiene is the stock person's behavior. The stock person should take the required precautions (hand-washing and wearing gloves etc.) for maintaining dairy cow hygiene and milk safety. Otherwise, the microorganisms causing mastitis can transfer from one cow to another (Deste and Yurttaş, 2018). As known, mastitis is one of the most known dairy cow diseases which threatens animal health, milk safety, and human health. Sarıözkan (2019) reported 0.8 million tonnes of milk production losses due to mastitis in 2019. This amount constitutes nearly 4.3% of Türkiye's cow milk production in 2019. This loss also corresponds to 2% of total animal production and 3% of total milk production in Türkiye. These amounts indicate how important it is to take the necessary precautions for the eradication of this preventable disease. Unfortunately, mastitis control was regularly conducted at only 3.66% of the surveyed farms. While the udder cleaning procedure was performed at all farms, the udder drying procedure was done at 74.39% of the farms (Table 6). Previously, some studies related to udder cleaning procedures were conducted in our country. Yaylak et al. (2016) reported that the pre-milking cleaning procedure was performed at 98.9% of the surveyed farms in their study. These researchers also declared that while 85.9% of these farms preferred the water

Table 6. Milk safety and hygiene practices

			Numbers (%)
Barn hygiene	Cleaning frequency	Morning-Evening	77 (93.90)
		Three times a day	5 (6.10)
	Cleaning type	Pulling	54 (65.85)
		Pulling&Washing	22 (26.83)
		Washing	6 (7.32)
	Ventilation	Natural	79 (96.34)
		Mechanic	3 (3.66)
Dairy cow hygiene	Use of glove		3 (3.66)
	Use of milking outfit		7 (8.54)
	Mastitis control		3 (3.66)
	Udder cleaning		82 (100.00)
	Udder drying		61 (74.39)
Milk safety	Washing milking equipment prior to milking		15 (18.29)
	Washing milk container		62 (75.61)
	Milking each cow's milk into separate containers		4 (4.88)
	Milk filtration		82 (100.00)
	Washing milking equipment after milking		31 (37.80)
	Storing milk at appropriate conditions		79 (96.34)
	Milk selling at daily basis		49 (59.76)

washing procedures, the remaining farms (13%) preferred the dry cleaning procedures. However, in the Tosun and Acar (2019) study, it was stated that none of the surveyed dairy cattle farms performed udder cleaning procedures (pre-milking udder washing, pre-milking control, and udder health controls).

4. Conclusions

This study was conducted to reveal the practices related to animal health and welfare, milk safety and hygiene as well as the factors affecting the consciousness of dairy cattle farmers about these practices. The fact that only half of the farms has delivery room and one-fifth of the farms has infirmary indicates the rehabilitation requirement for the physical conditions of the farms. The cow milk yield is directly related to the physical conditions of the dairy cattle farm. This fact indicates the necessity of state subsidies aimed at the rehabilitation of farms.

In the study, the consciousness level determined by means of wearing gloves and milking outfits, and mastitis control were found to be inadequate. Hygiene during milking not only affects animal health but also threatens milk safety. Since unhealthy dairy products cause serious health problems, precautions should be taken to ensure milk safety. These measures include i) compulsory hygiene-oriented training for dairy cow breeders, ii) routine inspection of milk production on farms, and iii) imposing sanctions on farms where appropriate production techniques are not applied. For this reason, short-term precautions regarding milk safety and hygiene practices at dairy cattle farms in Türkiye are not sufficient. Long-term precautions and implementations are needed for milk safety in Türkiye. To achieve this, first of all, relevant ministries, academicians, production associations, consumer and media organizations, and companies that process agricultural materials should come together, then, these stakeholders should struggle to bring their expectations together.

Declaration of Author Contributions

The authors declare that they have contributed equally to the article. All authors declare that they have seen/read and approved the final version of the article ready for publication.

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Declaration of Conflicts of Interest

All authors declare that there is no conflict of interest related to this article.

References

Akbay, C., Akdoğan, F., 2020. Structure of dairy cattle holdings and market supply of milk: The case of İzmir province, Turkey. *Turkish Journal of Agricultural Research*, 7(3): 287-295.

Alkan, S., 2015. Main problems in dairy cattle barns in Turkey. *Akademik Ziraat Dergisi*, 4(1): 43-48. (In Turkish).

Alkan, S., Ünlü, H., 2019. Determination of general structure of cattle enterprises in Giresun province. *Mediterranean Agricultural Sciences*, 32(1): 109-115. (In Turkish).

Anonymous, 2021. Dairy Industry Statistics in the World and Türkiye. Turkish National Dairy Council, 2021 Dairy Report, Ankara, Türkiye, (https://ulusalsut konseyi.org.tr/wp-content/uploads/2021-Sut-Raporu. pdf), (Accessed: 22.03.2022). (In Turkish).

Anonymous, 2022a. Milk and Human Nutrition in Dairy Products.(https://www.fao.org/3/i3396e/i3396e.pdf), (Accessed: 22.03.2022).

Anonymous, 2022b. Livestock Report-2018. Chamber of Agricultural Engineers, (https://www.zmo.org.tr/ genel/bizden_detay.php?kod=29946&tipi=38&sube =0), (Accessed: 22.03.2022). (In Turkish).

Anonymous, 2022c. Livestock Statistics. Turkstat. (https://data.tuik.gov.tr/Kategori/GetKategori?p=tari m-111&dil=1), (Accessed: 22.03.2022). (In Turkish).

Anonymous, 2022d. Samsun ili mevcut tarımsal üretim sistemlerinin geliştirilmesi ve ürün deseninin yeniden belirlenmesi eylem planı (2021-2025). Ministry of Agriculture and Forestry.(https://samsun.tarim orman.gov.tr/Belgeler/Yayinlar/Tarimsal_strateji/ Samsun_ili_TarimsalUretim_Eylem_Plani.pdf), (Accessed: 22.03.2022). (In Turkish).

Bakır, G., Kibar, M., 2019. Determination of some structural characteristics of dairy cattle breeding enterprises via crosstab analysis in Muş province. *Journal of Agriculture and Nature*, 22(4): 609-619. (In Turkish).

Boz, İ., 2013. Structure and problems of dairy farms in the Eastern Mediterranean Region. *Journal of Agriculture and Nature*, 16(1): 24-32. (In Turkish).

Demir, N., Yavuz, F., 2010. A regional comparative analysis of farmers' approaches to livestock support policies. *Journal of Agricultural Faculty of Atatürk University*, 41(2): 113-121. (In Turkish).

Deste, M., Yurttaş, A., 2018. A research for determining supplier selection criterions and establishment of evaluation system in dairy plants. *Journal of Social Sciences of Mus Alparslan University*, 6(ICEESS'18): 185-194. (In Turkish).

Gümüş, E., 2015. Primary effects of a potential Turkey-USA free trade agreement on the livestock sector in Turkey. European Union Expertise thesis, Republic of Türkiye Ministry of Agriculture and Forestry, Ankara, Türkiye. (In Turkish).

Hozman, S.B., Akçay, H., 2016. Some technical and economical characteristics of dairy cattle farms that are member of cattle breeder's association of Sivas province. *Turkish Journal of Agricultural Economics*, 22(1): 57-65. (In Turkish).

İzci, C., Çuhadar Erdal, F., Zamirbekova, N., 2021. Basic approaches to healing and treatment of claw lesions in cattle. *Eurasian Journal of Veterinary Sciences*, 37(2): 137-150. (In Turkish).

Kaygısız, A., Özkan, İ., 2021. The structural features and hygiene conditions of dairy farms in Tekkeköy district of Samsun province. *Harran Journal of Agricultural and Food Science*, 25(2): 225-233. (In Turkish).

Kılıç, O., Aydın Eryılmaz, G., 2020. Structural characteristics of dairy cattle farms in Samsun province. *Turkish Journal of Agricultural and Natural Sciences*, 7(3): 637-645. (In Turkish).

Maton, A., Daelemans, J., Lambrecht, J., 1985. Housing of Animals. Developments in Agricultural Engineering 6, Elsevier Science Publishers, Netherlands.

Muradi, A.J., Akbay, C., 2018. Structure and marketing opportunities on dairy farms in Konya province, Turkey. *International Journal of Scientific Research and Management*, 6(10): 756-762.

Özbeyaz, C., Ünal, N., 2018. Compost bedded barns in dairy cattle. *Livestock Studies*, 58(1): 54-66. (In Turkish).

Özdemir, M.Y., Karaman, S., 2008. Investigation of suitability and development opportunities of dairy cattle barns for structural and environmental conditions ın central district of Tokat. *Reserach Journal of Agricultural Sciences*, 1(2): 27-36. (In Turkish).

Park, Y.W., Nam, M.S., 2015. Bioactive peptides in milk and dairy products: a review. *Korean Journal for Food Science of Animal Resources*, 35(6): 831.

Saçlı, Y., 2007. Transformation requirements of animal husbandry sector in the harmonization period with the EU. Planning expertise thesis, State Planning Organization, Ankara, Türkiye. (In Turkish).

Sarıözkan, S., 2019. Estimation the financial losses due to mastitis in Turkish dairy enterprises. *Harran University Journal of The Faculty of Veterinary Medicine*, 8(2): 147-151. (In Turkish).

Tosun, S., Acar, D.B., 2019. The comparison of milking hygiene with bulk tank somatic cell count and total bacterial count in dairy herds in Tekirdağ province. *Kocatepe Veterinary Journal*, 12(3): 292-299.

Turan, Z., Şanver, D., Öztürk, K., 2017. The Importance of dairy cattle breeding in the livestock sector in Turkey, contribution to domestic output and comparison with foreign countries. *Academic Review of Economics and Administrative Sciences,* 10(3): 60-74. (In Turkish).

Yamane, T., 1967. Elemantary Sampling Theory. Printice Hall Inc. Englewood Cliffs, Nt.

Yaylak, E., Konca, Y., Koyubenbe, N., 2016. A study on health protection managements and health disorders survey of cattle breeders' association registered farms in Odemis, Izmir. *Journal of Animal Production*, 57(1): 28-40. (In Turkish).