Journal of Animal and Veterinary Advances 5 (11): 1000-1007, 2006

Livestock Transportation from Northeastern Turkey with Respect to Welfare Concerns

[1]Ahmet Yıldız, [2]Zafer Okumuş and [3]Armagan Hayirli
[1]Departments of Animal Husbandry, [2]Surgery and [3]Animal Nutrition and Nutritional Disorders,
Faculty of Veterinary Medicine, Atatürk University, Erzurum 25700, Turkey

Abstract: In this preliminary field study, we investigated factors affecting livestock transportation and welfare issues during livestock transportation in Northeast Turkey. This region provides 14.8% of nation-wide livestock. Thus, livestock production is one of the top income sources for the region. Constituting 33.2% of national grasslands, this region is subjected to heavy grazing and then transfer of animals to other regions. According to demographic distribution, only 3.8% of nation's population inhabit in Northeastern Turkey. However, the slaughterhouses and the meat processing plants are located in the western region of the country due to high demand for red meat. After ending grazing season (between August and January), animals are transferred to Western part for fattening and to Western and Central parts for sale during the Holly Sacrifice. Animal welfare with respect to transportation conditions, surveillance in animal markets was observed to be insufficient in our region. These challenges included health examination of animals prior to transportation by veterinarians, proper disinfections of vehicles, technical problems in loading and unloading due to lacking suitable ramps, compatibility of vehicles for long-distance transport, provision of feed and water during journey and stocking density in vehicles. Transportation of animals with respect to animal welfare is very important for public and animal health, prevention of diseases and increasing economical efficiency of animal production. In conclusion, Ministry of Agriculture should reevaluate legal aspects of animal transportation, open workshops for people in livestock business and strictly enforce law by employing veterinarians who are well trained in animal welfare issues.

Key words: Livestock, transportation, welfare, stress, northeastern Turkey

INTRODUCTION

Transportation of animals is important for public health, animal health and agricultural economics as well as animal welfare. Improper applications involving in the livestock transportation may result in injuries and death of animals and reduced quality of meat[1]. Also, lack of regulations or deviation in enforcement for the livestock transportation and live animal market may risk animal health and public health through transmitting some zoonotic diseases (e.g., hoof and mouth disease, brucellosis and tuberculosis). Since public concerns on animal welfare increase, reevaluation of the applications and regulations on the food-producing animal transportation is necessary. Regulations on the livestock transportation (Acts 91/628/EEC and 95/29EC with reevaluation EC/411/48) have been declared and strictly enforced in North America and European Union[2].

There is a continuous and intensive livestock production taken place (22.6% of the about 10 million cattle and 31.8% of about 20 million sheep) in Northern Turkey. Depending upon mainly relationships of demand and supply between Eastern and Western Turkey, religious holidays (e.g., day of holy sacrifice and holy Ramadan), economical constraints and production variables (e.g., availability and price of forages), Northeastern Turkey can be a major departure route of the animal transportation to Western Turkey.

Turkey ranks the first in the number of livestock animals in Europe. Moreover, during the membership process for European Union, Turkish Government has been adapting European systems including animal welfare and production system. Welfare issues are also greatly concerned in North America[3] and it is postulated that welfare issues affects meat sector[4]. Despite welfare issued given attention worldwide at the legislation level, it appears that European Union states play a leadership role on this subject[5, 6]. The objective of this preliminary field report was to discuss factors affecting the livestock transportation from Northeastern Turkey in the light of report on Welfare of Animals during the Transportation Guideline prepared by the Committee of Animal Health and Welfare under the European Union Commission for the Health and Consumer and Protection Directorate[2].

Corresponding Author: Ahmet Yıldız, Department of Animal Husbandry, Faculty of Veterinary Medicine, Atatürk University, Erzurum 25700, Ilıca-Erzurum, Turkey

MATERIALS AND METHODS

Data of demographic distribution, the number of livestock, capacity of pasture and grazing land, the number of slaughterhouse and meat processing plant were complied from State Statistics Institute and sorted according the agricultural regions of Turkey to determine factors affecting the livestock transportation and its intensity.

The major issues of concern in terms of animal welfare during the transportation were pre-transportation procedures, health examination, vehicles, driver education and attitude, status of route, loading and unloading of animals, stocking density in vehicles, environmental concerns for monitoring and feeding animals during the transportation. These were obtained from interviewing with officers of the Provincial Agriculture and Animal Health Department, livestock producers, brokers and drivers and transportation company owners. Additional observations were made on-site at the live animal markets during loading and slaughterhouses during unloading animals.

RESULTS AND DISCUSSION

Factors affecting the livestock transportation from Northeastern Turkey

Demographic distribution: Demographic distribution is important aspect of agricultural economy in terms of production and marketing products. About 70.8% of the Turkish population inhabit by the shores and in the western regions, whereas only 3.8% of the population reside in the northeastern region Fig. 1. That is, because western and shore regions are much more densely populated than northeastern and/or eastern parts, these regions are unable to supply red meat demand from their regions. Consequently, imbalanced demographic distribution contributed to intensive livestock transportation from Northeastern Turkey.

Livestock distribution: The number of large animals in Turkey has been subject to a dramatic change during last two decades Fig. 2. The number of cattle decreased by the shore and in the eastern regions, whereas it increased in the Aegean, Mediterranean and Marmara regions. Despite a 1.2% decrease in the number of large animals during last two decades, Northeastern Turkey still accounts for 14.8% of the large animal population.

Changes in the number of large animals by regions also reflect the modification of the animal production system. Herd size but not the number of producers increased especially in the Aegean region. There are also

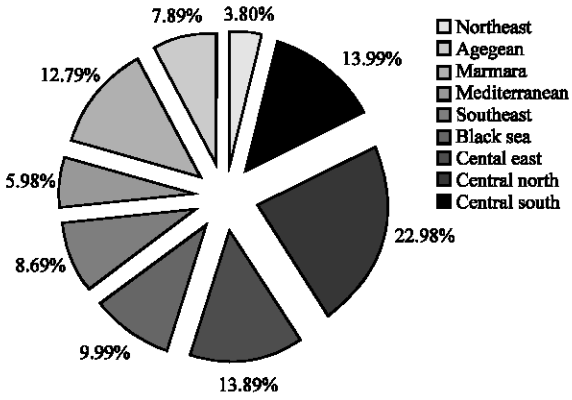

Fig. 1: Demographic distribution of Turkey[7]

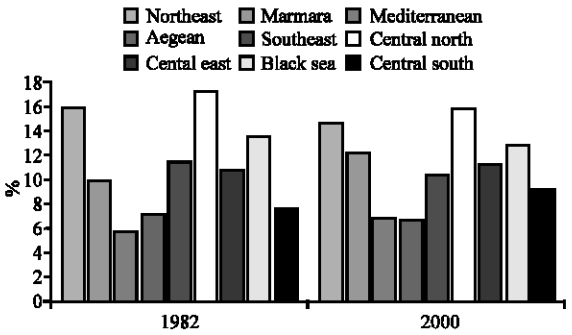

Fig. 2: Distribution of the large animal population according to agricultural regions[8, 9]

differences in breed of the cattle raised by regions. The percentage of western breeds was 36.1, 33.1, 25.8 and 17.3 in Marmara, Aegean, central south and central north, respectively. However, local breeds were predominant in the northeast and southeast regions (66.7 and 72.2%, respectively) Fig. 3, suggesting that animal production is conventional and intensive in the latter and former, respectively. Increased production of western breeds in highly populated western regions partially results from challenges to supply increased demand for red meat. Moreover, adapting intensive animal production system may affect variations in the profitability of animal agriculture by the regions.

Rangeland and cropland distribution: The northeast and southeast regions have the largest rangeland (33.2 and 31.5%, respectively) in Turkey. Despite constituting the second largest cattle population, the northeastern region ranks the sixth in plantation of industrial feedstuffs 9.4% Fig. 4. The region however predominantly is exposed to intensive grazing, which reduces feeding cost. Even western producers transport their young animals to Northeastern Turkey and take advantage of this grassland.

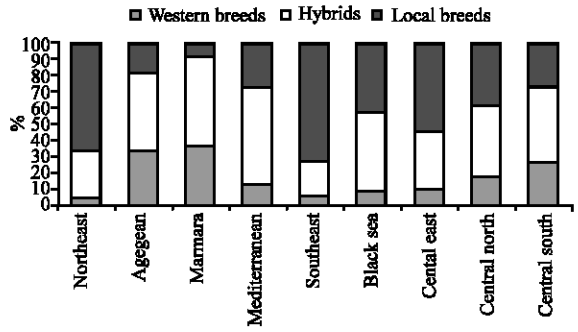

Fig. 3: Distribution of the breeds of large animal population according to agricultural regions[9]

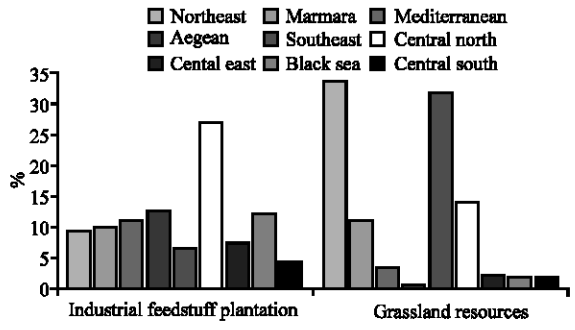

Fig. 4: Distribution of plantation of the industrial feedstuff and grazing resources[9]

Due to lack of technology for ensiling forages, other than drying, local producers suffer from shortage of feedstuffs for wintering. Therefore, they sell animals to western producers or slaughterhouses after grazing season. Most of times, this period coincides with low demand and is associated with reduced sale value.

The livestock transportation is intensive when grazing season (August-January) ends and heavy winter condition begins in Northeastern Turkey Fig. 5. Therefore, producers are unable to benefit from grassland resources economically. Brokers however benefit of availability of grains and other industrial feedstuffs in the western regions by raising post-grazed cattle for 4-6 months.

Livestock transportation during the holy sacrifice day: Northeastern Turkey is major live animal provider to the nation for the Holy Sacrifice celebration. Animals fattened before this religious holiday are transferred to western cities for marketing. In 2004, 117490 large animals were sold from Erzurum district alone. Within two months prior to the Holy Sacrifice celebration, the total number of animals transported accounts for 51.6% of annual transportation.

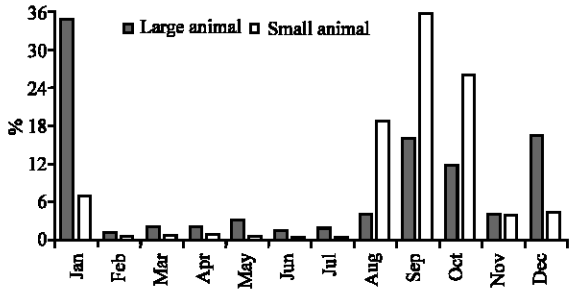

Fig. 5: Transportation rate of large and small ruminants from erzurum district in 2004[10]

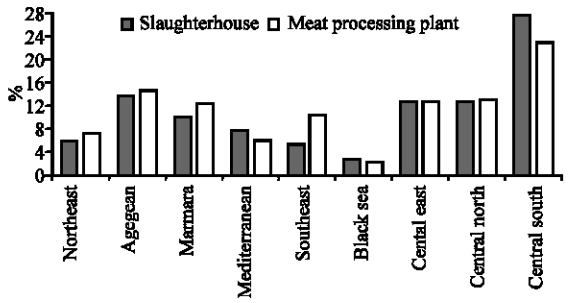

Fig. 6: Distribution of the slaughterhouses and meat processing plants[12]

Livestock transportation to live animal markets: Erzurum Trade of Commerce owns the largest capacity of the live animal market in Northeastern Turkey. It runs 6 days a week and host departure and arrival of livestock animals from vicinities including Erzincan, Bayburt, Gümüşhane, Ağrı, Kars and Ardahan. This market also attracts to western producers.

Slaughterhouse and meat processing plant distribution: As opposed to livestock resources (14.8% in Northeast), the first class slaughterhouses (number and capacity) are located in the Aegean, Central North, Marmara, Central East and Central South regions. That is, distribution of the meat industry is unparallel to that of livestock resource Fig. 6. Obviously, increased human population and consequently demand for red meat, pioneered enhancement of the meat processing plants in terms of the number and capacity in the western regions. Central regions also take advantage of accessibility to livestock resources from east and to marketing products to west. This imbalance leads to inefficient utilization of slaughterhouses and meat processing plant in east. For example, in 2004, there were shipments of 31677 kg carcass, 65153 sheep-goad skins with fleece and mohair, 1759251 kg cattle skins and 10908 sets of internal organs from the Erzurum district[11].

Main reasons for imbalance between the livestock resource and the number and capacity of the slaughterhouses and meat processing plants across the regions, particularly for the Northeast may include differences in the structure of animal production (conventional vs. integrative), demand-supply and sale value of the products and partial immigration of the local producers with their belonging to the western regions due to accessibility to the markets and availability of industrial feedstuffs.

Keskin[13] used the spatial balance model and described the optimum live animal and carcass flows among the regions in 1982, 1991 and 2000. This study showed that there was a continuous live animal flow from the northeast, southeast and central-east regions to others. Also, it was reported that the Marmara, Aegean and Mediterranean regions supplied 46.5, 24.4 and 14.8% of live animal demands from the Northeast, respectively.

Evaluation of welfare issue in the livestock transportation from northeastern Turkey: Improper management and applications during the animal transport may affect animals physically and emotionally and have long-term adverse consequences on the animals[14,15]. Stress may weaken immune response and lead to the outbreak of infectious diseases[16,17]. In addition to supplementation of special additives to the animals for alleviating stress[18], disinfections of vehicles may minimize risk for transmission of infectious diseases. Moreover, infectious diseases may not exhibit clinical signs during incubation or subclinical stage and these may appear with exposure to stressful transportation and thereafter[2].

In general, animal production facilities in Turkey are far enough from urban areas. However, animals are transported to city centers for slaughtering and processing. In short distances, trucks, train and on-foot are major means of transportation. According to Turkish Agricultural Board's report on Red Meat Industry and Its Challenges, it has been well documented that improper transportation has long been causes of economical losses associated with stress related injuries, death and decreased meat quality[19].

Health controls before and after transportation: Turkish Animal Health Enforcement Law 3275 (AHEL) and act 89/13838 mandates animal health control and disease prevention and surveillance during transports and in live animal markets. Every year, the Agricultural Ministry updates detailed approaches on Animal Health and Disease Prevention Programs[16,20]. source of origin and status of health for animals on sale or animals to be transported should be certified by official veterinarians. Presentation of these documents during transportation is compulsory according to the AHEL. This law also mandates disinfections of vehicles after transportation by the animal owner and confirmation and report of disinfections by official veterinarians. The animal owner should be given a confirmation sticker to be attached to vehicle for eligibility of departure. However, during our field trip to the live animal markets, we noticed that some brokers had no license; there were improper ramping system for trucks to unload animals and there were no strict record and enforcement on entrance and exit to these markets. Moreover, the number of veterinarians was insufficient and they were unable to perform their duties and enforce the law stated above effectively. Government veterinarians had also complaints about having broad duties including control of health of animals in markets, documentation, vaccinations and artificial inseminations. In fact, according to government reports, Kars and Erzurum districts had the highest brucellosis prevalence in the country (20.8 and 11.6%, respectively)[16], suggesting that effective enforcement of veterinary issues in the live animal markets and animal transportations from the region is crucial for epidemiology of infectious diseases. Moreover, cattle that are in late pregnancy, with uterine prolapsus, with incoordination, in pain due to injuries or fractures, recumbent, emaciated, hiperexcitable, blind and have broken horn, systemic circulatory and respiratory problems as well as newborns should not also be allowed for transportation[16]. Unfortunately, in some instances, we observed that this requirement was not fulfilled (Fig. 7). To minimize infectious disease transmission, there must be zero tolerance for improper handling of sick animals.

Vehicles: Live animal transportation is generally by means of truck and train and on walking for short distances. On foot transportation however is against the law. Trucking apparently is the most convenient and favorable way of transportation because departure can be flexible, assistance can be available during loading and unloading from the origin (e.g., live animal market) and at the destination (e.g., slaughterhouse), losses can be low and economically feasible as well as faster service. Two types of trucks that are differing in capacity are used. Trucks with wagon dimension of 5×2.20 m are used for short distance transportations of the small number of animals, whereas those of 8×2.40 m are used for intercity transportations of 40-45 heads of young cattle with average of 150 kg live weight or 15 heads of adult cattle with average of 500 kg live weight. Wagons of the trucks are covered with insulated waterproof material during winter. However, these wagons were not specifically designed to transport animals[21], but multipurpose Fig. 8.

Fig. 7: Despite legal notices, a lacking enforcement office at the gate of live animal market

Fig. 8: A multipurpose truck wagon

Trains were less preferable due to longer duration, more expensive and higher risk for losses. However, the ministry of transportation can equip the train wagons in case of request of animal transportation. Wagons can be in the capacity of 18, 20, 22, or 24 m^2 with yielding stocking density of 1.4 m^2 surface areas per head. Moreover, for longer destinations (>36 h), break period may be extended up to 10 h[22].

Drivers and certification: According to the AHEL, drivers must obtain a valid license from local governorship prior to the transportation. In generals, animal owners and brokers hire drivers with experience of animal transportation. It was reported that the number of causalities was greater when inexperienced drivers were hired. Accelerations, driving speed, sudden breaks, speeding at curvatures during journey may affect well-being of the animals. A sheep transportation study by Cockram *et al.*[23] showed that most of balance losses resulted from driving events including acceleration, braking, stopping, cornering, gear changes and damaged road surfaces. They also stated that driving events were responsible for many interruptions to both lying behavior and rumination. Therefore, Drivers should be trained about importance of welfare and zoonosis and given liability certificate upon attendance to the workshops[2].

Fig. 9: An improper docking area

Loading and unloading: Loading was done through outlet of rear wall of wagons. Unloading is tedious, frustrating and challenging due to absence of proper docks or ramps in many live animal markets Fig. 9. This may cause injuries resulting from slipping, tackling and falling down. Animals even may be forced to jump out of wagons. Optimum ramps should be at a maximum of 20° angle from the ground. During loading and unloading, physical abuse or pain creating acts such as pulling or twisting ears and tails should be avoided[2].

Stocking density and environmental conditions: Perhaps, stocking density is one of the most important factors on the animal well-being during transportation[23]. Stocking density can often be abused to reduce the cost of transportation. In fact, space for lying down and distance to feed should be considered, especially in long distance transportation. Lower stocking density also can be detrimental in case of high speed, abrupt break and sharp turns. Due to hierarchical dominance, fights or grooms among males may occur. Placing divider, but not tying is recommended during transportation. Space area per head is not appropriate determinant for stocking density[24]. Council of Animal Welfare of United Kingdom suggests two exponential models for calculating space area[25], depending upon duration or distance, which are as follow:

$$\text{Space area} = 0.021 \times LW^{0.67} \text{ (for less than 12 h)}$$
$$\text{Space area} = 0.0315 \times LW^{0.67} \text{ (for more than 12 h)}$$

where LW = live weight (kg). Thus, cattle weight 300, 400, 500 kg should be provided at least 0.96, 1.16, 1.35 m^2, respectively. For longer distance (>12 h), the number of animals should be reduced by 50%. Moreover, extra 5-7% reduction should be made for transportation of cattle with horns[2]. We calculated that space area was 0.40-0.60 and 1.3-1.6 m^2 for young animals weighing 150 kg and mature animals weighing 500 kg, respectively. These densities may be suitable for short distance, but not long distance transportation Fig. 10.

In our region, live weights of cattle ranged from 150 to 600 kg and stocking density varied accordingly. Large-framed cattle (> 450 kg) are tied to sidewalls of wagons, whereas small-framed cattle are stayed loose in standing position. As a result of exhaustion during the long-distance transportation, incidence of bruises, stampede and mortality increased. Thus, drivers mentioned frequent check of wagons in each break. Some mentioned that they drained vinegar to nostrils and beaten animals with stick to make them up.

Air quality in wagons is important for well-being[26]. Thus, wagons height and air-inlet and outlet are necessary elements of ventilations[27]. Ceiling should be at least 20 cm above the head of animals. Wagons are covered depending upon environmental conditions. In our regions, winter is bitterly cold between December and February and during this time of year 2004, 40836 ruminants have been transported[16]. Temperature in wagons may decrease further during travel due to speed and high altitude. To keep room warm, drivers mentioned that they did not remove cover in winter transportation. This however may reduce air quality and increase humidity, which adversely affect well-being.

Distance and frequency and duration of breaks: According to the database of Erzurum Provincial Agriculture Ministry Animal Health Division, there is intensive livestock transportation from the northeast region to almost all parts of the country[16]. Among these, distance of Erzurum to other major metropolitans including Izmir, Istanbul, Ankara, Konya and Samsun is 1457, 1225, 877, 955 and 571 km, respectively. Duration of travel varies by road conditions, climatological constraints, type of vehicle, the number of animal loaded, the frequency and duration of breaks and drivers. Duration between Erzurum and Istanbul ranged from 20 (60 km h^{-1}) to 30 h (40 km h^{-1}). Due to mountainous geological structure, there are numerous curvatures on the roads, which may be exhausting and stressful for animals and cause injuries, especially in case of high-speed. For a long-distance transportation, animals should be checked the first 3 h if they are adapted to the environment and after 15 h if they are suffered from exhaustion, suffocation and discomfort. We were however informed that animals got excited and agitated in case of stop for break, especially in summer, therefore drivers avoided giving break during the transportation.

Fig. 10: An overcrowded stocking density

Loss of live weight is also known as transportation loss that is affected by duration and distance of travel, environmental conditions and animal conformation and nutritional status[28]. Increased stocking densities, high or low speed of vehicles, high frequency of breaks and extreme hot or cold conditions increase the transportation loss. Decreased stocking density, curvatures on the roads and sudden acceleration or slow down also may contribute to transportation loss. Animal transportation from Northeastern Turkey was associated with 5-15% live weight loss.

Future studies: After this preliminary report, controlled studies should be performed to quantify welfare issues during transportation throughout the year. Provision of comfortable environment during the transportation is important to animal for normal postural and behavioral adjustments. Well-being is often referred to psychological comfort, which is too difficult to attain[29]. The welfare of an animal in response to husbandry practices can be assessed by evaluating efforts to be made by the animal in order to deal with conditions for maintaining normal growth and health status[30]. Thus, welfare regulations should be based on observable and attainable changes in behavior and physiological variables. In laboratory animals, it was shown that stress adversely affected performance[31, 32] and suppressed immune system and well-being[33] of males[34] and females[35] at a different magnitude. There are several noninvasive methods are available to attain well-being. These include stress related physiological and biochemical measurements[36-39] from blood, saliva, feces and urine (e.g., cortisol, phagocytic

ability, hemogram variables, heart rate and rectal temperature). Response differences should be also assessed by breed, age and gender of animals; type of vehicles; and characteristics of journey.

CONCLUSION

Northeastern Turkey will continue to be the major departure of livestock transpiration until the number of slaughterhouses or meat processing plants in the region is increased. The region has the richest grazing opportunity to reduce cost of animal production, with vast agricultural lands and higher number of cattle. Thus, animal production will also continue to be the major source of employment and income in the region. However, technology transfer and professional employment system should be encouraged for the profitability of animal production. Moreover, artificial insemination technology, embryo transfer and gene transfer could increase quality of animals.

In response to increased public concerns, works of animal producers and transporters must be synchronized with emphasis of improving well-being of animals before, during, after transportation. The live animal markets and slaughterhouses should be renovated to have proper facilities such as ramps and docks, for unloading and loading. Drivers and transportation company authorities should be encouraged to attend regular workshops on animal welfare and livestock transport that must be arranged by the provincial government. Welfare issues should be strictly enforced to reduce economical loss as well as protect public and animal health. In conclusion, Northeastern Turkey has a great potential for profitable large animal production. However, lacking technological applications and other economical conditions put the producers in disadvantage. Based on observations, animal welfare before, during and after transportation was mostly neglected. Government technical personnel were unable to perform their duties efficiently due to lack of serious incentives or actions. Facilitating current knowledge on animal welfare issues can benefit to region's animal production industry and public and animal health.

REFERENCES

1. von Borell, E. and D. Schaffer, 2005. Legal requirements and assessment of stress and welfare during transportation and pre-slaughter handling of pigs. Livestock Prod. Sci., 97: 81-87.
2. Anonymous, 2002a. The Welfare Animals During Transport (details for horses, pigs sheep and cattle). European Commission Health and Consumer Protection Directorate-General, Report of the Scientific Committee on Animal Health and Animal Welfare Adopted on 11 March 2002.
3. Rojas, H., L. Stuardo and D. Benavides, 2005. Animal health policies and practices in the Americas: Preliminary study (summary). Revue Scientifique et Technique-Office International des Epizooties, 24: 549-565.
4. Seng, P.M. and R. Laporte, 2005. Animal welfare: The role and perspectives of the meat and livestock sector. Revue Scientifique et Technique-Office International des Epizooties, 24: 613-623.
5. Mench, J.A., 2003. Assessing animal welfare at the farm and group level: A United States perspective. Anim. Welf., 12: 493-503.
6. Csintalan, C. and L. Visnyei, 1998. The protection of animals during transport in the European Union. Magyar Allatorvosok Lapja, 120: 622-629.
7. Anonymous, 2002c. T.C. Başbakanlık D.I.E., Türkiye Istatistik Yıllığı (2001). Yayın No: 2690, Ankara, Türkiye.
8. Anonymous, 1984. T.C. Başbakanlık D.I.E. Tarımsal Yapı ve Üretim. Yayın No: 1093. Ankara,Türkiye.
9. Anonymous, 2002b. T.C. Başbakanlık D.I.E. Tarımsal Yapı (Üretim-Fiyat-Değer). Yayın No: 2614. Ankara, Türkiye.
10. Anonymous, 2005a. Erzurum Tarım Il Müdürlüğü 2004 Yılı Büyükbaş ve Küçükbaş Hayvan Sevki Kayıtları, Erzurum, Türkiye.
11. Anonymous, 2005c. Erzurum Tarım Il Müdürlüğü. TMMOB, Ziraat Mühendisleri Odası VI. Teknik Kongresi, Cilt: 1, Sayfa: 179-190, 03-07 Ocak 2005, Ankara, Türkiye.
12. Anonymous, 2005d. Koruma Kontrol Genel Müdürlüğü. Çalışma izni alan kırmızı et kombina ve tesisleri. Ankara, Türkiye. http://www.kkgm.gov.tr/Ruhsatlar/RuhsatList.htm
13. Keskin, A., 2003. Türkiye'de et sığırcılığının bölgeler arası yapısal değiþiminin spatial denge modeli ile analizi. Atatürk Üniversitesi Fen Bilimleri Enstitüsü, Doktora Tezi, Erzurum, Türkiye.
14. Griffin, J.F.T., 1989. Stress and immunity: A unifying concept. Vet. Immunol. Immunpathol., 20: 263-312.
15. Murray, K.C., D.H. Davies, S.L. Cullinane, J.C. Eddison and J.A. Kirk, 2000. Taking lambs to the slaughter: Marketing channels, journey structures and possible consequences for welfare. Anim. Welf., 9: 11-122.

16. Kegley, E.B., J.W. Spears and T.T. Brown Jr., 1997. Effect of shipping and chromium supplementation on performance, immune response and disease resistance of steers. J. Anim. Sci., 75: 1956-1964.
17. Moonsie-Shageer, S. and D.N. Mowat, 1993. Levels of supplemental chromium and on performance, serum constituents and immune status of stressed feeder calves. J. Dairy Sci., 71: 232-238.
18. Hayirli, A., 2005. Chromium nutrition of livestock species. Nutr. Abst. Rev. Series, B 75:1N-14N.
19. Anonymous, 2005e. Türkiye Ziraat Odaları Birliği Kırmızı Et Hayvancılığı Raporu. Ankara, Türkiye. http://www.tzob.org.tr/tzob/tzob_basin_bulteni/tzob_basinbulteni_04_04_2005.htm
20. Anonymous, 2005b. 2005 Yılı Hayvan Hastalık ve Zararlıları ile Mücadele Programı. Tarım Köy İşleri Bakanlığı Koruma Kontrol Genel Müdürlüğü, Ankara, Türkiye.
21. Kettlewell, P.J., R.P. Hoxey, C.J. Hampson, N.R. Green, B.M. Veale and M.A. Mitchell, 2001. Design and operation of a prototype mechanical ventilation system for livestock transport vehicles. J. Agric. Eng. Res., 79: 429-439.
22. Anonymous, 2005f. Ulaştırma Bakanlığı. Türkiye Cumhuriyeti Devlet Demir Yolları, Ankara, Türkiye. ttp://www.tcdd.gov.tr/yuk/yurticitasima.htm
23. Cockram, M.S., E.M. Baxter, L.A. Smith, S. Bell, C.M. Howard, R.J. Prescott and M.A. Mitchell, 2004. Effect of driver behaviour, driving events and road type on the stability and resting behaviour of sheep in transit. Anim. Sci., 79: 165-176.
24. Gonyou, H.W. and W.R. Stricklin, 1998. Effects of floor area allowance and group size on the productivity of growing/finishing pigs. J. Anim. Sci., 76: 1326-1330.
25. Hurnik, J.F. and N.J. Lewis, 1991. Body surface area, a reference for space allowance in confinement. Poult. Sci., 70: 412-415.
26. FAWC., 1991. Report on the European Commission Proposals on the Transport of Animals. MAFF Publications, London, U.K.
27. Dawkins, M.S., C.A. Donnelly and T.A. Jones, 2004. Chicken welfare is influenced more by housing conditions than by stocking density. Nature, 427: 342-344.
28. Fisher, A.D., M. Stewart, D.M. Duganzich, J. Tacon and L.R. Matthews, 2005. The effects of stationary periods and external temperature and humidity on thermal stress conditions within sheep transport vehicles. New Zealand Vet. J., 53: 6-9.
29. Gülten, Ş., 1973. Canlı Hayvan Pazarlanmasında Nakliye ve Fire. Et Endütrisi Dergisi. Cilt: 7, Ajans Türk Matbaası, Ankara, Türkiye.
30. Woolverton, W.L., N.A. Ator, P.M. Beardsley and M.E. Carroll, 1989. Effects of environmental conditions on the psychological well-being of primates: A review of the literature. Life Sci., 44: 901-917.
31. Barnett, J.L. and P.H. Hemsworth, 2003. Science and its application in assessing the welfare of laying hens in the egg industry. Aust. Vet. J., 81: 615-624.
32. Renne, U., 1989. The effect of cage type and population density on the body weight development of laboratory mice. Z. Versuchstierkd, 32: 153-156.
33. Restrepo, C. and A. Armario, 1989. Comparison of crowding and food restriction effects on growth, body weight gain and endocrine status in the rat. Reprod. Nutr. Dev., 29: 339-345.
34. Rock, F.M., M.S. Landi, H.C. Hughes and R.C. Gagnon, 1997. Effects of caging type and group size on selected physiologic variables in rats. Contemp. Topics Lab. Anim. Sci., 36: 69-72.
35. Arakawa, H., 2005. Age dependent effects of space limitation and social tension on open-field behavior in male rats. Physiol. Behav., 84: 429-436.
36. Eskola, S. and E. Kaliste-Korhonen, 1999. Nesting material and number of females per cage: Effects on mouse productivity in BALB/c, C57BL/6J, DBA/2 and NIH/S mice. Lab. Anim., 33: 122-128.
37. Binder, R., R. Palme, I. Sommerfeld-Stur, J. Baumgartner, K. Niebuhr, K. Zaludik, H. Bartussek, S. Waiblinger, M. Reifinger, A. Kubber-Heiss, A. Rabitsch, M. Gneist and J. Troxler, 2004. Animal welfare in Austria: Basic concepts of animal ethics, legal framework and animal welfare-related research. Wiener Tierarztliche Monatsschrift, 91: 44-58 (Suppl. 1).
38. Hayirli, A., N. Esenbuğa, M. Macit, E. Laçin, M. Karaoğlu, H. Karaca and L. Yıldız, 2005a. Nutrition practice to alleviate the adverse effects of stress on laying performance, metabolic profile and egg quality in peak producing hens: I. The humate supplementation. Asian-Aust. J. Anim. Sci., 18: 1310-1319.
39. Hayirli, A., N. Esenbuğa, M. Macit, M. A. Yörük, A. Yıldız and H. Karaca, 2005b. Nutrition practice to alleviate the adverse effects of stress on laying performance, metabolic profile and egg quality in peak producing hens: II. The probiotic supplementation. Asian-Aust. J. Anim. Sci., 18: 1752-1760.