P-ISSN: 2305-6622; E-ISSN: 2306-3599
International Journal of Agriculture and Biosciences
www.ijagbio.com; editor@ijagbio.com

Research Article

# Assessment of Public Knowledge and Awareness Level on Antibiotic Residues in Raw Bulk Milk and Public Health Risk

Mulualem Ambaw*, Fekadu Seboka and Mezgeb Workiye

Ethiopian Institute of Agricultural Research Institute Kulumsa Agricultural Research Center, Ethiopia
***Corresponding author:** haamulualem6@gmail.com

**Article History:** Received: March 24, 2020 Revised: August 24, 2020 Accepted: October 06, 2020

**ABSTRACT**

Dairy producers, milk collector and processors and veterinary drug sellers, were interviewed by using structured and semi-structured questionnaire to identify their knowledge and awareness level on antibiotic use, presence of residues in bulk milk and public health risks. The majority 73.3% of the farm owners interviewed was females and most of the producer farmers and milk processors education status were secondary school level. The minimum and maximum level of education status of Veterinary drug sellers was diploma (level four) and Doctor of Veterinary Medicine Degree (DVM) respectively. From 131 interviewed dairy farmers 55(42%) respond mastitis is prevalent in their dairy farms at least one dairy cow infected with mastitis. Producer farmers buy veterinary drugs including antibiotics by themselves without prescription. Based on dairy farmer's response, 94.2% of them use antibiotics for the treatment of mastitis and other infectious diseases. Most commonly used antibiotics in the study dairy farms were Oxyttc and penstrip 35.1 and 26% respectively because of its availability and easy to administer. All most all the dairy farmers did not respect withdrawal time of the antibiotics which means produce milk during the time of treatment and use the milk for home consumption. The knowledge and awareness level of producer farmers, milk processors and veterinary drug sellers on antibiotic residues from milk and milk products were 11.5%, 93% and 100% respectively. The majority 93% milk processors did not test for antibiotic residue during milk collection except Holland dairy located at Bishoftu around Addis Ababa. The awareness level of dairy farmers on antibiotic use, cause of residues development and its impact to public health is very low.

**Key words:** Public awareness, Antibiotic residues in milk.

## INTRODUCTION

Protein-rich foods, mainly of animal origin (milk, meat, and eggs) are important to human beings to fulfill their nutritional requirements, and their health has been associated with the nature and quality of the food consumed (Rokka et al., 2005). Antibiotics have been used in the dairy industry for more than five decades in dairy cattle production to treat or prevent disease and to increase milk production or improve feed efficiency (Beyene, 2016). Residual antibiotics in milk can seriously affect consumer's health causing allergic reactions and developing resistant strains. Antibiotic contamination in milk can also cause significant economic losses for producers and manufacturers of milk and milk products (Riediker *et al*., 2004). Although antimicrobial drugs are useful for treatment of human infections, their occurrence in milk causes adverse public health effects such as drug resistance and hypersensitivity that could be life threatening (Oslon and Sanders, 1975).

The use of antibiotics therapy to treat and prevent udder infections in cows is a key component of mastitis control in many countries. Due to the widespread use of antibiotic for treatment of mastitis in dairy cows, much effort and concerns have been directed towards the proper management and monitoring of antibiotics usage in treatments in order to prevent contamination of raw milk. However, widespread use of antibiotics has created potential residue problems in milk and milk products that are consumed by the general public. Because of the public health significance, milk and milk products contaminated with antibiotics beyond a given residue levels, are considered unfit for human consumption (Hillerton *et al.*, 1999). The good quality of milk must contain no harmful or toxic residues, such as antimicrobial drugs. The extra-label use of these antimicrobial, insufficient withdrawal

**Cite This Article as:** Ambaw M, F Seboka and M Workiye, 2020. Assessment of public knowledge and awareness level on antibiotic residues in raw bulk milk and public health risk. Int J Agri Biosci, 9(4): 172-177. www.ijagbio.com 

period and lack of records are the most common causes of theses residue in milk, which lead to exceed these residues in milk above the acceptable maximum residue limits (MRLs). In addition, the lack of good veterinary practice and illegal use of veterinary drugs by farmers will increase this problem (Oliver *et al.*, 1990; McEwen *et al.*, 1991).

In order to safeguard human health, the World Health Organization (WHO) and the Food Agriculture Organization (FAO) and Codex Alimentarius have set standards for acceptable daily intake and maximum residue limits in foods (FAO and WHO, 1995; codex Alimentarius CAC, 1997) .Regulatory limits for antibiotic residues have been imposed on the dairy industry in many countries (FDA, 1996; Folly and Machado, 2001). European Union Commission Regulation (EU), 1990 and Ethiopian Standards Agency (2012) also set standards for acceptable daily intake and maximum residue limits in foods of animal origin.

In Ethiopia, the research studies that have been conducted on antibiotics residue and knowledge and awareness level of the public on residues in milk is limited because of poor laboratory facility and lack of skilled personnel. Desalegne et al. (2014) reported residues of penicillin G and Oxy tetracycline in Debrezeit and Nazarath around Adiss Ababa. As a result, policy makers remain largely unaware of the extent of the problem for long period of time and poor/no quality and safety assurance programs are in place to prevent sales of animal source foods that may contain antimicrobial residues. Therefore, the objective of this research was to assess knowledge and awareness level of the public on antibiotic residues in milk and public health hazards.

## MATERIALS AND METHODS

**Study areas:** This study was conducted in selected milk shade areas of central Ethiopia. Selected milk shad in Arsi, East shawa Zone and Addis Ababa were included for this study.

**Study design:** Cross sectional types of questionnaire survey was used to collect primary data from dairy producer farmers, milk processors and veterinary drug sellers. Three structured and semi-structured questionnaires were prepared and used to interview producer farmers, milk processors and veterinary drug sellers. Basic information of the respondents, amount of milk produced ,numbers of dairy cows owned, reproductive health problems of the dairy cows, knowledge and awareness level on antibiotic use, presence of residues in milk risk factors for residue development like, withdrawal period of antibiotics, frequency of administration, dose, and consultation to veterinarians during treatment, mastitis control and public health impact of consumption of milk contaminated with antibiotics were asked for producer farmers. Milk processors were asked about the amount of milk collected from producer farmers, quality and safety parameter considered during collection and price of milk per litter during collection and selling raw and processed milk and milk products. Frequently available and soled veterinary antibiotics in their drug shop and types of advice they give for dairy producer farmers were asked.

**Data management and analysis:** The data collected through questionnaire survey was entered in to Micro-Soft Excel and analyzed using SPSS version 20. Descriptive statistics percentage and frequency were used to describe the result.

## RESULTS AND DISCUSSION

**Socio-demographic information:** The majority of interviewed participants involved for this study were from Oromia region. East shewa and Arsi Zones. From a total of 161 respondents; 131 dairy farms, 14 milk collectors and 16 veterinary drug sellers were involved for this study. From 131 dairy producer farmers, the majority 73.3% of them were females. The minimum, maximum and mean age of the dairy farmers were 17, 74, and 40 respectively. Our result indicated that young and old aged people can participate in the dairy sector.

Education level of the dairy farmers and milk processors were categorized as illiterate, primary, secondary, tertiary, whereas the minimum education level of veterinary drug sellers was diploma. The majority 41.2% of the dairy farmers were secondary school and the lower numbers 19.2% were educated up to tertiary level. Considerable number 19.8% of the dairy farmers were illiterate which cannot read and write. The majority 15/16(93.8%) of the drug sellers were diploma (10+4). Only one Doctor of Veterinary Medicine (DVM) Degree holder was involved in veterinary drug sell in the study areas (Table 1).

**Dairy cattle ownership:** Numbers of dairy cattle and breed composition were described under (Table 2). From our result, the dairy farmers keep all breed types (local, cross and exotic). On average one dairy farmer owned 7 dairy cows regardless of breed. The majority of the dairy farmers keep cross breed dairy cows. The mean; maximum cross breed dairy cows ownership were 6 and 180 respectively

**Knowledge and Awareness level of the respondents on antibiotic residues in milk:** Knowledge, perception and awareness level of the respondents can contribute for the development of antibiotic residues in milk. From sixteen (16) vet drug sellers 100%, 131 milk producer farmers 11.5% and 14 milk collectors and processors 93% were aware about the development of veterinary antibiotic residue in raw milk. The awareness level of the dairy producer farmers were very low compared among vet drug sellers and milk collectors.

**Major risk factors of antibiotic residue development in bulk milk:** Antibiotics residues and resistance can be occurring by different activities. The common activities considered as risk factor for drug residues are :-1.over dosage, frequency of administration, rout of administration, types of drug use, withdrawal period of the drug, knowledge and awareness level of the drug sellers and dairy producers, prevalence of diseases of dairy cows particularly mastitis and price of milk and feed. Mastitis is a complex disease and the difference in results could be due to difference in management systems among farms. The high prevalence of mastitis may be attributed to improper milking hygiene, lack of use of post milking teat dipping

**Table 1:** Education level of the respondents in the study areas

| Respondent category | Education level of the respondents | | | | | | |
|---|---|---|---|---|---|---|---|
| | Illiterate | Primary school | Secondary school | Tertiary | Diploma | (DVM) degree | BSc degree |
| Veterinary drug seller | 0(0%) | 0(0%) | 0(0%) | 0(0%) | 15(93.8%) | 1(6.3%) | 0 |
| Milk processors | 0(0%) | 3(21.4%) | 7(50%) | 2(14.3) | 0(0%) | 1(7.14%) | 1(7.14%) |
| Dairy farmers | 26(19.8%) | 39(29.8%) | 54(41.2%) | 12(19.2%) | (0%) | 0(0%) | 0(0%) |
| Total | 19.8% | 51.2% | 91.2% | 26.5% | 93.8% | 13.44% | 7.14 |

**Table 2:** Breeds and numbers of the dairy cows in one farm

| Total number and breed types | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| number of dairy cows in the herd | 131 | 1.00 | 180.00 | 7.1603 | 17.26215 |
| number of local breeds | 131 | .00 | 5.00 | .4351 | .92070 |
| number of exotic breeds of cows | 131 | .00 | 6.00 | .1145 | .71941 |
| number of cross breeds | 131 | .00 | 180.00 | 6.6870 | 17.31610 |
| number of lactating cows | 131 | .00 | 160.00 | 4.5725 | 14.36557 |
| Total | 131 | | | | |

**Table 3:** Knowledge and awareness level of producers on the risk factors of antibiotic residues

| No | Risk factor for antibiotic residues | Frequency | (%) |
|---|---|---|---|
| 1 | Mastitis | | |
| | Yes | 55 | 42.0 |
| | No | 76 | 58.0 |
| | Total | 131 | 100.0 |
| 2 | No of cows infected with mastitis during the study | | |
| | 1 | 21 | 65.6 |
| | >1 | 13 | 34.4 |
| | Total | 34 | 100 |
| 3 | Check for mastitis | | |
| | Yes | 30 | 22.9 |
| | No | 101 | 77.1 |
| 4 | Measures taken on mastitis dairy cows | | |
| | Antibiotic treatment | 52 | 94.2 |
| | Traditional treatment | 1 | 1.8 |
| | Doing nothing | 2 | 3.6 |
| 5 | Source of antibiotics | | |
| | Veterinary pharmacy | 89 | 75.4 |
| | Veterinary clinic | 23 | 19.5 |
| | Human pharmacy | 1 | 0.8 |
| | Others(illegal drug sellers) | 5 | 4.2 |
| 6 | Who treat mastitis | | |
| | Veterinarians | 18 | 32.7 |
| | Assistant veterinarians | 14 | 25.5 |
| | Farm owners | 23 | 41.8 |
| | Total | 55 | 100 |
| 7 | Rout of administration | | |
| | Intra mammary | 38 | 69.1 |
| | Intramuscular | 17 | 30.9 |
| | Total | 55 | 100 |
| 8 | Awareness on withdrawal periods of drugs for milk use | | |
| | Yes | 74 | 56.5 |
| | No | 57 | 43.5 |
| | Total | 131 | 100 |
| 9 | If yes do you milk infected cows separately | | |
| | Yes | 35 | 47.3 |
| | No | 39 | 52.7 |
| | Total | 74 | 100 |
| 10 | Do you consume milk of treated cows during treatment | | |
| | Yes | 57 | 87 |
| | No | 17 | 23 |
| 11 | Waiting time before using of treated cows milk | | |
| | 1-3 days | 16 | 94.1 |
| | 4-8 days | 1 | 5.9 |
| | According to recommended drug withdrawal time | 0 | 0 |
| 12 | Disinfection and teat dipping after milking | | |
| | Yes | 1 | 5.9 |
| | No | 130 | 94.1 |
| 13 | Dry cow therapy | | |
| | Yes | 6 | 6.2 |
| | No | 123 | 93.8 |

and practices of milking by contract laborers with different skills. From 131 interviewed dairy farmers 55(42%) respond mastitis is prevalent in their dairy farms at least one dairy cow infected with mastitis. The majority 94.2% of the dairy farmers use antibiotics for the treatment of mastitis based on their response. See the Table 3 below.

Most commonly used antibiotics in the study dairy farms were Oxyttc and penstrip 35.1 and 26% respectively because of its availability and easy to administer. All most all the dairy farmers did not respect withdrawal time of the antibiotics. The result is in agreement with Birhan and Mulugojjam, (2018) research report conducted at Debretabor and Bahir Dar Northwest Ethiopia.

Commonly used antibiotics, its rout, dose, frequency and withdrawal time are described under (Table 4).

Antibiotics, particularly tetracycline and penicillin G, are extensively used for prevention and treatment of diseases in dairy farms. Similarly, Takele et al. (2018) mentioned Tetracycline as frequently used antibiotics in the livestock production in centeral Ethiopia. The use of antibiotics continues to be a predominant in the treatment and control of mastitis (Owens et al., 1991). But, dry cow therapy was not reported in any farms which could have a great effect in protecting against new intra mammary infections during the dry period of the cows. Regarding hygienic practice, all most all of the dairy farmers were cleaned the teat and udder by using water before milking and only 5/131(3.8%) of the milk producer farmers use dipping of the dairy cows teat after milking. Vaseline, iodine and Jivi were reported as the commonly used dipping chemicals as disinfectant.

**Commonly and frequently sold veterinary antibiotics in veterinary drug shops:** Most commonly available and frequently sold veterinary antibiotics were Penstrip, Oxy ttc10% and 20%, multiject (benzantile penciline), sulpha drugs (intradine). All the drug sellers sold antibiotics without prescription. Half of the drug seller's advice the producer farmers how to use the drugs during selling if the farmer asks question and the rest 50% of the sellers did not advice the dairy farmers. Regarding withdrawal period of the antibiotics; only 18.7% of the drug sellers were advised the farmer not to use the milk during treatment period for at least (3-5 days). I was asking the drug sellers why they did not advice the farmer about the actual withdrawal period of the antibiotics; they respond the farmer may not accept the veterinary advice because of the farmer's perception and tradition not to accept the advice. Milk collectors and processors were also interviewed to identify their knowledge about antibiotic residues in raw milk and

**Table 4:** Common and frequently used veterinary antibiotics for the treatment of mastitis

| No | Common antibiotics used for the treatment of mastitis | Number | Percent (%) | Administration rout | Dose | Frequency | Withdrawal period in milk |
|---|---|---|---|---|---|---|---|
| 1 | Oxyttc | 46 | 35.1 | IM,IV | 1ml/10kgbw | 3-5 days | 6 days |
| 2 | Pens trip | 34 | 26 | IM,IV | 1ml/50kgbw | 3-5 days | 7 days |
| 3 | Multiject | 13 | 9.9 | Intra mammary | 1ml/50kg | 3-5 days | 7 days |
| 4 | Don't know | 37 | 28.2 | | | | |
| | Sulpha drugs | 1 | 0.8 | Subcutaneous, IM | | 3-5days | 15 days |
| | Total | 131 | 100 | | | | |

**Table 5:** Common and frequently soled veterinary antibiotics in the study vet pharmacy

| Common antibiotics available in the study veterinary pharmacy | Number | Percent (%) |
|---|---|---|
| Sell of antibiotics for producer farmers without prescription | | |
| Yes | 16 | 100 |
| No | 0 | 0 |
| Advice of producer farmers about the administration, dose and frequency of using antibiotics | | |
| Yes | 8 | 50 |
| No | 8 | 50 |
| Advice on withdrawal period of antibiotics for food animal treatment | | |
| Yes | 3 | 18.7 |
| No | 13 | 81.3 |
| Common antibiotics frequently soled and used by dairy farmers | | |
| Oxy ttc 20% | 16 | 100 |
| Oxyttc10% | 16 | 100 |
| Pens trip (pencilin+striptomycine) | 16 | 100 |
| Multiject (procan benzyle penciline) | 10 | 62.5 |
| Sulpha drugs | 16 | 100 |

the majorities 93% of the respondents were aware about antibiotic residues in raw milk. Except Holland dairy processing plant all the other milk collectors and processors did not test for antibiotic residues even though most of them set quality parameters. Most of the time; the quality parameters of milk were checked by physical observation of color, smell and by using alcohol test and lactometer. Availability of the instruments used for milk quality testing, preservation and regents used for cleaning of milking equipment's are described under Table 5 below.

**Awareness level of milk processors on residues and other milk quality parameters:** Milk processors collect milk from producer farmers and soled raw and processed milk and milk products to consumers. On average processors collect milk from 42 producer farmers and collect milk from milk a minimum and maximum of 4 and 180 litters and a mean of 43 liters per day. Regarding price of milk per litter, the minimum buying and selling price of one litter of milk was 7 and 11 ETH birr. Milk processors collect milk from producers with a maximum price of 14 birr/litter and sold to consumers with amaximum price 18 birr without processing. Processors soled processed milk products like yoghurt and skimmed milk with 9 birr/litter, chees 35 birr/kg and butter 198 birr/kg.

Regarding their knowledge on milk quality and safety issues; all most all 93% of milk processors were aware about antibiotic residue in milk and set quality and safety parameter with no testing capability. Quality parameters of milk were screened by using lactometer, PH meter, acidometer (alcohol test), and thermometer after physical observation. Only one milk processing plant called Holland dairy located at Bishoftu screen antibiotic residues by using Delvo test SP Assay before processing together with other milk quality parameters. The entire participant 100%, milk processors use lactometer to check (fat content) adulteration of milk by water. The majority 71.4% of milk processors use refrigerator for milk preservation. Plastic containers, stainless steel milk can and both plastic containers and stainless-steel milk cans were used for milk handling. Both Plastic and stainless-steel milk cans were used by the majority of the milk processors. Cleaning of milk handling containers were practiced by using warm water and soup and Omo (powdered and liquid detergents). See the (Table 7) below.

**Conclusion and Recommendations:** The majority of the dairy farmers were not aware a bout antibiotic residue in raw milk, withdrawal period of veterinary drugs particularly antibiotic and public health risk by concerned stockholders and veterinary drug sellers. The majority of milk processors were not able to detect veterinary drug specifically antibiotic residues except Holland dairy and milk processing plant located in Bishoftu which detect antibiotic residues with qualitative test using Delvotest assay. The prevalence of mastitis was high in the study dairy farms inability to completely curing the disease from the farm which is economically important production diseases of dairy cows in the study areas. Even though dairy farmers practice unlimited use of antimicrobials for the treatment, of infectious diseases and as a prophylactic use, and as feed efficiency of dairy cows aggravated with very low awareness level about drug withdrawal period, antibiotic residues in raw milk, the prevalence of the residues of penciline G and oxytetracycline in the study dairy farms was moderate. If the dairy farmers assisted and advised by veterinary professionals during treatment of diseased dairy cows about the drug residues and withdrawal periods, human health impact of consuming of milk with antibiotic residues and record keeping during treatment; the prevalence of antibiotic residues can decrease through time. No recording of treatment history, only they record milk yield and costs associated with feed.

**Table 6:** Awareness of milk processors on antibiotic residues and other milk quality parameters

| Category | Frequency | Percent (%) |
|---|---|---|
| Knowledge on antibiotic residues | | |
| Yes | 13 | 92.9 |
| No | 1 | 7.1 |
| Total | 14 | 100.0 |
| If yes do you test for antibiotic residues | | |
| Yes | 1 | 7.1 |
| No | 13 | 92.9 |
| If yes how can you identify | | |
| No | 13 | 92.9 |
| Delvotest | 1 | 7.1 |
| TOTAL | 14 | 100 |
| Set quality parameter | | |
| Yes | 14 | 100 |
| Types of quality parameters set by processors | | |
| Freshness | 10 | 71.4 |
| Fat content and freshness | 4 | 28.6 |
| Measuring of the quality parameters | | |
| Physical observation | 2 | 14.3 |
| Testing | 1 | 7.1 |
| Physical observation and testing | 11 | 78.6 |
| Use of milk preservatives | | |
| Yes | 10 | 71.4 |
| No | 4 | 28.6 |
| Types of milk preservatives | | |
| Refrigerator | 10 | 71.4 |
| Milk handling containers | | |
| Stainless steel milk can | 1 | 7.1 |
| Plastic container | 6 | 42.9 |
| Both stainless steel milk can and plastic container | 7 | 50 |
| Cleaning of milk containers | | |
| Washing with detergent + warm water | 7 | 50 |
| Washing with detergent + cold water | 7 | 50 |
| Types of detergents used | | |
| Soap | 5 | 35.7 |
| Largo (liquid detergent) | 3 | 21.4 |
| Omo (podered deteragent) | 9 | 64.3 |
| Costic soda | 5 | 35.7 |
| Nitric acid | 1 | 7.1 |
| Availability of Instruments used for milk quality test | | |
| Yes | 12 | 85.7 |
| No | 2 | 14.3 |
| Types of instruments used to measure milk quality | | |
| Lactometer | 14 | 100% |
| Thermometer | 3 | 21.4% |
| PH meter | 7 | 50% |
| Acidometer( alcohol test) | 5 | 35.7 |
| Delvo test | 1 | 7.1% |
| Churner | 1 | 7.1 |
| Cream separator | 3 | 21.4 |

Above all conclusions the following recommendations should be forwarded: -capacity building and awareness on antibiotic residue detection should be provided to be used by dairy producers, milk processors and veterinarians to ensure the production of antibiotic residue-free milk, it is because milk and milk products are essential foodstuffs for children, attention has to be paid to the presence of drug residues in milk. In addition, dairy producer farmers, milk collectors and processors and consumers should be aware about the health impact of consumption of antibiotic residue with milk. Finally, the use of effective enforcement of milk quality and safety standards is essential to provide the public with safe and wholesome animal product particularly milk and milk products.

**Acknowledgements:** Ethiopian Institute of Agricultural Research Institute, Kulumsa Agricultural Research Center is acknowledged for funding the research work. My grate appreciation goes to Veterinary experts in respective study districts, Veterinary drug sellers, dairy farmers and milk processors for their cooperation during data collection.

## REFERENCES

Beyene T ,2016. Veterinary drug residues in food-animal products: Its risk factors and potential effects on public health. J Vet Sci Technol., 7: 1-7.

Birhan Agmas Mulugojjam Adugna, 2018. Antimicrobial residue occurrence and its public health risk of beef meat in Debre Tabor and Bahir Dar, Northwest Ethiopia. Vet World, 11(7): 902–908. doi: 10.14202/vetworld.2018.902-908.

Codex Alimentarius (CAC),1997. General requirements (food hygiene), 21- 30, Rome.Codex Alimentarius Commission. Vol. 1 B. Ethiopian Standards Agency,2012. guideline for standardized description of immunoassay or receptor assay for the detection of antimicrobial residues in the milk and milk products.

Desalegne A, Kelay B, and Girma Z, 2014. Detection and determination of oxytetracycline and penicillin G residue levels in bulk milk of cows in Nazareth dairy farms. Ethiop. Vet. Journal, 18 (1): 1-15.

European Union Commission Regulation (EU) (1990). No. 508/1999. 1999 In. Official Journal of the European Community L 60/16 of 4/03/99.

Folly and Machado S, 2001. Antibiotic residues determination, using microbial inhibition, protein binding and immunoassays methods, in pasteurized milk commercialized in the northern region of Rio de Janeiro State, Brazil. Cienc. Rural., 31: 95-98.

Food and Agriculture Organization (FAO)/World Health Organization (WHO),1995. Application of risk analysis to food standards issues. Report of the Joint FAO/WHO expert consultation. Geneva, Switzerland, WHO/FNU/FOS/95.3, Pp13-17.

Food and Drug Administration (FDA) U.S.A., 1996. Evaluation and use of milk. Antimicrobial drug screening tests report. Centre for food safety and applied nutrition. FDA prime connection. Rockville, M.D., 20855.

Hillerton J E, Halley B I, Neaves P and Rose M D, 1999. Detection of antimicrobial substances in individual cow and quarter milk samples using Delvotest microbial inhibitor tests. J.Dairy Sci., 82: 704-711.

McEwen S A, Meek A H, and Black W D,1991. A dairy farm survey of antibiotic treatment practices, residue control methods and associations with inhibitors in miIk. J. Food Prot. 54454.

Oliver S P, Maki J L, Dowlen H H 1990. "Antibiotic residues in milk following antimicrobial therapy during lactation". Journal of Food Protection, 53: 693-696.

Oslon J C, Sanders A C 1975. Penicillin in milk and milk products. Some regulatory and public health considerations. J Milk Food Techno, 38: 630-633.

Owens W E, Nickerson S C, Washburn P J and Ray C H, 1991. Efficacy of a cephapirin dry cow product for treatment of experimentally induced Staphylococcus aureus mastitis in heifers. J. Dairy Sci., 74: 3376-3382.

Riediker S, Rytz A and Richard S,2004. Cold-temperature stability of five-lactam antibiotics in bovine milk and milk extracts prepared for liquid chromatography-electrospray ionization tandem mass spectrometry analysis. Journal of Chromatography, 1054: 359–363.

Rokka M, Eerola S, Perttila U, Rossow L, Venalainen E, Valkonen E, Peltonen K ,2005. The residue levels of narasin in eggs of laying hens fed with unmedicated and medicated feed. Mol Nutr Food Res., 49:38-42.

Takele Beyene Tufa, Feraol Gurmu, Ashenafi Feyisa Beyi, Henk Hogeveen, Tariku Jibat Beyene, Dinka Ayana, Fanos Tadesse Woldemariyam, Eyerusalem Hailemariam, Fanta Desissa Gutema & J.A, 2018. Stegeman.Veterinary medicinal product usage among food animal producers and its health implications in Central Ethiopia. BMC Veterinary Research, 14: 409.