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# Assessment on Chemicals and Drugs Residue in Dairy and Poultry Products in Bishoftu and Modjo, Central Ethiopia

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## Abstract

Despite the growing of contamination of foods of animal origin with chemicals during production, processing and storage, less attention being paid for the potentially present chemical residues in such foods (meat, milk, eggs and their products). This study was carried out to assess the chemicals and veterinary drugs used, and their possible occurrence as residue in dairy and poultry products in randomly selected dairy and poultry farms, and milk and animal feed processing plants located in Bishoftu and Modjo, central Ethiopia through questionnaire and observation. The result of this study showed that antibiotics, mainly penicillin-streptomycin and ampicillin-cloxacilin combination were used in all dairy farms while oxytetracycline and sulfa drugs were used by 85.7% and 57.1% of dairy farms. Oxytetracycline, amoxicillin, ciprofloxacillin, and sulfa drugs were used in 100%, 71.4%, 28.6%, and 28.6% of poultry farms, respectively. The study also revealed albendazole and ivermectin were commonly used in 96.4% and 71.4% of the dairy farms, respectively while piperazine was a common anthelmintic used in 31.0% of poultry farms. The antiprotozoal drugs commonly used in poultry farm were amprolium (100%) and sulfa drugs (26.3%) while the commonly used drug in dairy farms was sulfa drugs (50.0%). Antiseptics, namely, savlon (82.2%), iodine tincture (53.3%) and denatured alcohol (53.3%) were commonly used in dairy farm whereas disinfectants, such as, hydrogen peroxide (83.3%), sodium hydroxide (66.7%), and formalin (19.0%) were commonly used in poultry farms though small number of dairy farms also used formalin (17.8%) and hydrogen peroxide (10.7%). Among the rodenticides used in farms, zinc phosphide was used more in poultry farms (33.3%) than dairy farms (14.3%). Different chemicals were also used in the milk and feed processing plants. We conclude that there are high possibility of drug and chemical residues occurrence in poultry and dairy products in the area.

**Keywords:** Chemical; Drugs; Dairy products; Poultry; Residue; Central Ethiopia

## Introduction

Human beings consume protein-rich foods to supply their nutritional requirements, mainly of animal origin. In several countries the safety of such food has been focused on avoiding the transmission of zoonotic diseases, however, less attention has been paid to potentially present chemical residues [1]. Now days, increased awareness of consumers about a growing chemicalization of animal origin foods (meat, milk, eggs and their products) present a challenge to the dairy, meat and poultry industry. A great number of chemical compounds are used either directly or indirectly during the production, processing and storage of it. Environmental pollution due to increased urbanization and industrialization in conjunction with the inappropriate use of veterinary drugs, on the other hand, may induce the presence of residues in food products [2].

A chemical contaminant is a potentially harmful chemical substance of anthropogenic or natural origin, which may be present in food following deliberate treatment or accidental contamination during the production, transformation or preservation of foodstuffs [3]. Contamination of these foods with pathogenic microbes and chemical residues can result during production at the farm level, transportation, storage, distribution and preparation for consumption [4].

Foods from animals can potentially be contaminated with one or more of the thousands of manufactured chemicals, which are used in society. Relatively few of these occur with any regularity in foods from animals, and the most contentious residues (in terms of probability of occurrence and impact on human health, trade or consumer confidence) are antibacterial drugs, hormonal growth promoters or production adjuncts, polyhalogenated hydrocarbon pesticides, industrial chemicals and heavy metals [2,5]. Among the manufactured chemicals, which occur in foods, are a large number of additives used intentionally for production, processing or preservation purposes. A few of these, for example, nitrites, are of concern if toxic metabolites (e.g., nitrosamines) are allowed to form in foods prior to ingestion. Chemical residues (such as iodine, chlorine or bromine) are also contaminants of sanitation procedures, and others that occasionally migrate from packaging materials [5].

In many cases, the long-term effects of antibiotics on human health are not known, but they can, for example, provoke strong allergic reactions in a previously sensitized individual. Despite their generally non-toxic nature, β-lactams appear to be responsible for most of the reported human allergic reactions to antimicrobials. Aminoglycosides, sulfonamides and tetracyclines may also cause allergic reactions. In exceptional cases, certain macrolides may be responsible for liver

injury caused by a specific allergic response to macrolide metabolite-modified hepatic cells. Anaphylactic reactions to penicillin and streptomycin residues have been also reported [6].

Antibiotics can encourage the spread of antibiotic resistance in bacteria, making treatment of human infection more difficult. Widespread use of antimicrobials for disease control and health maintenance in animals has been paralleled by an increase in bacterial resistance in those animals [7,8]. Antibiotic residues in milk that is used to produce fermented products can interfere with the fermentation process by affecting desired lactic acid bacteria [9]. Disruption of normal human flora in the intestine is another harmful effect of antibiotic residues in human food [10].

The general types of chemicals which have been or possibly found in milk are chlorinated pesticides, organophosphates, herbicides, fungicides, anthelminthic drugs, antibiotics and sulfonamides drugs, detergents and disinfectants, Poly Chlorinated (PCBs), Poly Brominated Biphenyles (PBBs), dioxins, mycotoxins, heavy metals and somatotropin hormone. Any of these compounds may persist at collection, preparation processes of dairy products [11].

The objectives of this study were to assess commonly used chemicals and drugs in dairy and poultry farms; and to estimate the possibility of occurrence of assessed chemical residue in food products from such farms found in Bishoftu and Modjo towns, central Ethiopia.

## Materials and Methods

### Study areas

This study was conducted in Bishoftu and Modjo towns of East Shoa zone of Oromia regional state from October 2013 to June 2014. Bishoftu is located at 47 km Southeast of Addis Ababa and at latitude and longitude of **8°45′N 38°59′E** and elevation of 1885 meters above sea level. The mean annual rainfall of the town is 866 mm with a bimodal pattern. The mean annual minimum and maximum temperatures are 14°C and 26°C, respectively and a relative humidity of 61.3% [12]. Modjo town is located at 66 km Southeast of Addis Ababa and lies at 8°35'N and 39°7'E at an altitude 1790 meters above sea level [13].

### Study methods

This cross-sectional study was conducted by collecting data through structured questionnaire format by interviewing farm owners, attendants and managers of dairy processing plants. Close observation were made to farms and animal feed during visits. The questionnaire was with a target of assessing the chemicals and drugs used for biosecurity and treatment in farms and the awareness level of the farmers about drug withdrawal period, chemical and drug residues. The chemicals included in this study were insecticides, rodenticides, feed treating chemicals, disinfectants and antiseptics, antimicrobials and other chemicals. The commonly used antibiotics, anthelmintics and antiprotozoal drugs were also considered. Similarly, during the visit of the processing plants and farms, keen observation was made to their sites, presence of nearby industries, way of waste disposal, feed and chemical stores and storages, and other possible conditions that were thought to be risk of chemical contamination.

In the present study poultry and dairy farms, and animal feed and milk processing plants were randomly selected. Twenty-eight dairy farms, 42 poultry farms (26 layers and 16 broilers), seven animals feed processing plants and five milk-processing plants in Bishoftu and Modjo were included in the study.

### Data analysis

The collected data were coded and entered to Microsoft Excel Spread Sheet. Descriptive analysis and Chi-square test were done using SPSS (version 20). The significance level was set at $\alpha=0.05$.

## Results

### Commonly used drugs and chemicals in dairy and poultry farms

A total of 28 dairy farms and 42 poultry (layer and broiler) farms were visited during the study period. The assessment revealed that all dairy farms use three or more antibacterial drugs. Among these, penicillin-streptomycin combination (penstrep) injection (100%), oxytetracycline (85.7%) and sulfa drugs (57.1%) and ampicillin-cloxacilin combination (intramammary infusion) are the most frequently used. These drugs are mainly used for treatment of septicemic cases and mastitis. The dairy farms also use different anthelmintic drugs (albendazole, ivermectin, tetramisole/levamisole and oxyclozanide) to control helminths and antiprotozoal drugs (diaminazine aceturate and sulphamethoxazole-trimethoprim) to treat protozoal infections (Table 1). The study also showed that dairy farms in the study area use diazinon (46.5%) as acaricides; formalin (17.8%) and Hydrogen peroxide (H2O2) (10.7%) as a disinfectant; zinc phosphide (14.3%) as the sole rodenticide; savlon (a composition of cetrimide and chlorhexidine gluconate) (82.2%), iodine tincture (53.3%) and denatured alcohol (53.3%) used as antiseptics (Table 1). Feeding and watering trough made of metallic substance were used by 10.3% and 19.7% of dairy farms, respectively. 57.1%, 28.6% and 14.3% of the dairy farms are using metallic, plastic and both metallic and plastic made containers for milk collection and storage.

In the study poultry farms, oxytetracycline (100%), amoxicillin (71.4%), ciprofloxacillin (28.6%) and sulfa drugs (28.6%) are used as prophylaxis and/or control of bacterial infections. Also, the farms use amprolium (100%) and sulfa drugs (26.3%) for the treatment of coccidiosis and piperazine (31.0%), albendazole (9.1%) and tetramisole (7.1%) to control endoparasites. Zinc phosphide and aluminum phosphide are used in 33.3% and 12.0% of the farms as rodenticides; and malathion and diazinon by 26.2% and 19.0% of poultry farms as acaricides, respectively (Table 1). The poultry farms also use soap (solid, powder or liquid forms) (100%), hydrogen peroxide (83.33%), sodium hydroxide (66.67%) and formalin (19.04%) as disinfectant (footbaths, house disinfection and other biosecurity activities). 66.7% of the poultry farms use feeding troughs made of metallic substance which is periodically treated with antirust chemicals. The water sources are pipeline (64.3%) and well (35.7%).

Fifty nine percent of poultry farms reported that they were aware of the possible occurrence of chemical contaminants in animal feed ($x^2=3.86$, $p=0.049$ between aware and non-aware farms in asking their seller about prior chemical usage). Among these, only 20% of respondents asked the poultry feed suppliers about chemicals used as preservative. However; there is no statistically significant difference in asking the feed seller between aware and non-aware farmers about the chemical residues ($x^2=0.243$, $p=0.622$).

| Name of chemical and/or drug used | Type of the farms using the chemical/drug | | | |
|---|---|---|---|---|
| | Dairy farms (N=28) using | | Poultry farms (N=42) using | |
| Antibacterial agents | n | % | n | % |
| Amoxicillin | 0 | 0 | 30 | 71 |
| Ampicillin | 28 | 100 | 0 | 0 |
| Ciprofloxacillin | 0 | 0 | 12 | 29 |
| Cloxacillin | 28 | 100 | 0 | 0 |
| Oxytetracycline | 24 | 86 | 42 | 100 |
| Penstrep | 28 | 100 | 0 | 0 |
| Sulfa drugs | 16 | 57 | 12 | 29 |
| Antiprotozoal agents | | | | |
| Amprolium | 0 | 0 | 42 | 100 |
| diaminazine aceturate | 1 | 3.6 | 0 | 0 |
| Sulfa drugs | 14* | 50 | 11# | 26 |
| Anthelmintic agents | | | | |
| Albendazole | 27 | 96 | 4 | 9.5 |
| Ivermectin | 20 | 71 | 0 | 0 |
| Oxyclozanide | 9 | 32 | 0 | 0 |
| Piperzazine | 0 | 0 | 13 | 31 |
| Tetramisole | 9 | 32 | 3 | 7.1 |
| Acaricides | | | | |
| Diazinon | 13 | 47 | 8 | 19 |
| Malathion | 1 | 3.6 | 11 | 26 |
| Rodenticides | | | | |
| Aluminium phosphide | 0 | 0 | 5 | 12 |
| Zinc phosphide | 4 | 14 | 14 | 33 |
| Antiseptics | | | | |
| Alcohol denatured | 15 | 53 | 0 | 0 |
| Iodine tincture | 15 | 53 | 0 | 0 |
| Savlon | 23 | 82 | 0 | 0 |
| Disinfectants | | | | |
| Hydrogen peroxide | 3 | 11 | 35 | 83 |
| sodium hydroxide (for foot bath) | 0 | 0 | 28 | 67 |
| Soap | 0 | 0 | 42 | 100 |
| Formalin | 5 | 18 | 8 | 19 |

**Table 1:** Summary of the assessments of chemicals, anthelmintics and antibiotics used in dairy and poultry farms in Bishoftu and Modjo, central Ethiopia. n=number of using farms; *Sulphamethoxazole-trimitoprim and sulfadimidine; #Sulfonamides

## Animal farm owners' perception and role of health professionals on animal products use during withdrawal period

All of the farms were not asked or challenged by their customers about prior use of chemicals or drugs. Among 40 farms that preferred doctor of veterinary medicine (DVM) and above professionals for the health care of their animals, 40% of them were not told about the drug withdrawal period while it was 65% for the 20 farms, which preferred animal health assistants (Table 2). From all studied poultry and dairy farms, 58.6% of them sell animal product while their animals are under treatment and 70.0% of farms sell their product after the end of the treatment but before the withdrawal period (Table 3).

## Results of drug/chemical residue possibilities in milk from milk processing plants

Five milk-processing plants were visited during the study period. Among these, only one of them conducted chemical residue testing by using bacterial inhibition test (starter culture addition). Additionally, the assessment revealed that three of the processing plants accepted milk from cows under treatment. These plants have an established agreement with the raw milk suppliers to control whether the cows are in treatment or not. However, two (40%) of processing plants asked their customers whether their cows are under drug therapy or not. The milk received from cows under treatment was offered to their calves after boiling, used for local cheese making or processed into different dairy products depending on the processing plant.

All of the milk processing plants used different chemicals as cleaning, additives, testing and stabilizing agents. Among these chemicals, sodium hydroxide, hydrogen peroxide, nitric acid, sodium hypochlorite and formaslin were used in all plants for different purposes and none of the plants used chemicals to preserve processed milk products.

## Results of drug/chemical residue possibilities in animal products from feed processing plants

The production capacity of the 7 animal feed processing plants showed 2 (28.6%), 2 (28.6%), and 3 (42.9%) of the plants produced less than 1000 kg, between 1000 and 5000 kg and more than 5000 kg of feed per day, respectively. Six (85.7%) of them do not ask who supply them with grain and other animal feed raw materials whether they have recently used preservatives/chemicals or not. Three (42.9%) of the plants do not store raw materials. Five (71.4%) of the feed processing plants get their raw materials from local traders while the other two plants (28.6%) get from farmers and their own farms.

Five (71.4%) of the feed processing plants use aluminum phosphide, and one (14.3%) plant uses both aluminum phosphide and malathion to preserve raw materials. Additionally, alcohol and grease are used in six (85.7%) plants for instrument cleansing and lubricating, respectively. One plant uses formalin, hydrogen peroxide, sodium hydroxide and sodium hypochlorite as a cleansing agent.

## Discussion

### Chemicals and drugs used in dairy and poultry farms and their possible occurrence as residues

In order to investigate the presence of chemicals, drugs and/or heavy metals residue in the foods of animal origin, mainly where misuse of chemicals are growing, knowing the commonly used chemicals by food of animal origin producers and assessing their insight about chemical or drug residue are very essential. Therefore, this study was conducted with the objectives of assessing the commonly used chemicals and/or drugs in dairy and poultry farms, and in milk and animal feed processing plants and the possible occurrence of these chemicals and drugs as residues in dairy and poultry products. The results of this assessment indicated that both of the dairy and poultry farms use different antibacterial, antiprotozoals, anthelmintics, acaricides, rodenticides, antiseptics and disinfectants.

| Animal products sold (offered) to the public | | | | | | | |
|---|---|---|---|---|---|---|---|
| Variables | Proportions | During treatment | | | From the end of Rx to end of WDP | | |
| | | No-(%) of farms | P=value | ($X_2$) | No-(%) of farms | P=value | ($X_2$) |
| Who treats your animal | | | | | | | |
| Vet | 40 (57.1) | 21 (52.5) | 0.429 | 1.69 | 26 (65) | 0.304 | 2.38 |
| AHA | 20 (28.1) | 14 (70) | | | 14 (70) | | |
| NP | 10 (14.3) | 6 (60) | | | 9 (90) | | |
| Did he/she told you not to use | | | | | | | |
| Yes | 32 (45.7) | 12 (37.5) | 0.001 | 10.79 | 16 (50) | 0 | 11.23 |
| No | 38 (54.3) | 29 (76.3) | | | 33 (88) | | |
| Awareness about drug withdrawal times | | | | | | | |
| Non aware | 34 (48.6) | 23 (67.6) | 0.134 | 2.24 | 30 (88.2) | 0.001 | 10.47 |
| Aware | 36 (51.4) | 18 (50) | | | 19 (52.8) | | |

**Table 2:** Role of awareness of farms and animal health workers on the products sold during drug withdrawal pseriod. Rx-treatment, WDP-withdrawal period, Vet-veterinarian, AHA-animal health assistant, NP-non-professional.

| Variables | | Product usage (sell) to public | | | | | |
|---|---|---|---|---|---|---|---|
| | | During treatment | | | Until end of withdrawal | | |
| Type of farms | Proportion | N(%) | $X^2$ | p-value | N(%) | $X^2$ | P-value |
| Dairy | 28 | 10(35.7) | 24 | 0 | 13(46.4) | 19 | 0 |
| Poultry (layers) | 26 | 25(96.2) | | | 26(100) | | |
| Poultry (broilers) | 16 | 6(37.5) | | | 10(62.5) | | |
| Total | 70 | 41(58.6) | | | 49(70.0) | | |
| Type of production system in dairy | | | | | | | |
| Intensive | 16 | 3(18.8) | 4.7 | 0.031 | 5(31.2) | 3.46 | 0.063 |
| SH and SI | 12 | 7(58.3) | | | 8(66.7) | | |

**Table 3:** Comparison of products used or sold to the public in different type of farms and production systems during drug withdrawal period, N- Number, SH- small holder, SI- semi intensive.

The most commonly used antibacterial agents for treatment of septicemic diseases in the dairy farms were penstrep injection, which is used in 100% of dairy farms. Ampicillin+cloxacillin combination intramammary infusion was used to treat both clinical and subclinical mastitis in all dairy farms included in this study, as mastitis is highly prevalent in central Ethiopia [14,15]. These show that the possible occurrence of residues of penicillin, streptomycin, cloxacillin and ampicillin and their metabolites in milk is high and more common than other antibacterial drugs which agree with Chirag et al. [2] who stated that the dominating residues in most countries are β-lactam antibiotics and sulfa drugs, if appropriate milk discard and strict refusal of milk processing plants and customers to buy such milk is not done. Oxytetracycline injection is used in 85.7% of farms and its possible occurrence in residue form in milk should not be also neglected. Sulfonamides was used to treat both protozoal and bacterial infections and used in 57.1% and 50.0% of dairy farms as antibacterial and antiprotozoal agent, respectively. However, the use of other antiprotozoal drugs for blood parasites is very low. This may be due the low prevalence of blood parasites (protozoans) in Bishoftu intensive dairy farms [16]. So, these drugs can also be a possible residue which can be investigated while undergoing investigation of chemical residues from dairy products possibly due to, failure to observe the withdrawal periods of each drug, extra-label dosages for animals and contamination of animal feed with the excreta of treated animals [8].

In the present study, the antimicrobials used in the poultry farms were tetracyclines, beta-lactams, quinolones and sulfonamides are in line with the study conducted by Stolker and Brinkman [17]. Oxytetracycline was used in all farms, which agree with Smith et al.

[18] who stated that the tetracyclines are the most widely used antimicrobials in poultry industry. This is largely due to their affordability, a wide margin of safety and broad-spectrum (Mycoplasma, Gram-positive and Gram-negative bacteria) and intracellular activity. It is also easily administered in mass in either feed or water. Amoxicillin is also used in 71.4% of farms and ciprofloxacin and sulfa drugs were also used in 28.6% of farms. Residues of oxytetracycline, amoxicillin, ciprofloxacin and sulfonamides can occur in egg and poultry meat if they are used before the end of withdrawal period in Bishoftu and Modjo which is in line with commonly used drugs in food animals in Kenya [19]. Anticoccidials and other antiprotozoals are most commonly used in poultry farms. There is high prevalence of coccidiosis in Bishoftu [20] thus all farms were used amprolium and 26.3% of poultry farms uses sulfa drugs. Hence, the possible occurrence of amprolium residue in egg and poultry meat is high and sulfonamide can also be possible residue from egg and poultry meat which agree with the assessment result done in Sudan for sulfonamides in eggs and poultry meat [21].

Different antiparasitic drugs were used by dairy and poultry farms in the study area. The most commonly used anthelmintic in the dairy farm was albendazole, ivermectin and levamisole/oxyclozanide which are used in 96.4%, 71.4% and 32.1% of farms, respectively whereas in the poultry farm was piperazine and albendazole which are used in 30.9% and 9.5% of farms, respectively. The high albendazole usage by dairy farms may be because it is well known by farms and relatively available at low price. The probability of getting milk containing albendazole and its metabolite residue is far more common than other anthelmintics. This is in agreement with other studies [22,23] who stated that albendazole is a widely used benzimidazole anthelmintic and rapidly transform to various metabolites, the major metabolites being albendazole sulfoxide, albendazole sulfone and albendazole 2-amino sulfone. These metabolites can account for all residues found in milk and dairy products at any time point that are both bioavailable and of toxicological significance. Residues of benzimidazole compounds can occur in milk and dairy products and it is necessary to observe withdrawal periods for milk after therapy. Despite its contraindication ivermectin is used in 71.4% of farms and the probability of getting ivermectin residue from milk can be more probable than any other anthelmintic because of its long withdrawal time and its whole secretion with milk [24]. The survey showed that the use of anthelmintics in poultry farms in the study area was not common since intensive management systems may avoid exposure of chickens to these parasites. Therefore, the possibility of occurrence of anthelmintic residues in egg was very low due to less use of anthelmintic drugs use in poultry farms and lack of accidental exposure to these drugs. The most probable anthelmintic residue in egg from poultry farms in the study area might be piperazine due to failure to observe the withdrawal period and extra-label dosages [8].

The assessments done on dairy and poultry farms showed different chemicals were used as disinfectants, acaricides, rodenticides, and antiseptics. The result showed that the probability of occurrence of residues from chemicals used as disinfectant in dairy farm is low except for hydrogen peroxide and formalin, which was used by some farms. Unlike the dairy farms, 88.33% of poultry farms were used H2O2, 66.67% of farms were used sodium hydroxide and none of the farms were used only one type of chemical. So, there is a possibility for the occurrence of residues for H2O2, sodium hydroxide and formalin in egg and poultry meat if there is improper handling and mixing of them with poultry feed as written by Saegerman et al. [3] residues in animal products can result from disinfectants. Among the common acaricides, diazinon was used by 46.5% in dairy farms and 19.04% in poultry farms, had the highest probability to be as a chemical residue in milk if appropriate milk discarding times are not done following diazinon spray. It may be also present as a residue in eggs and poultry meat if eggs and poultry meat are used for human consumption in withdrawal period and lack of awareness about chemical contamination. Moreover, the probability of occurrence of malathion as a residue in eggs and poultry meat is high and less in dairy products. The possibility of occurrence of rodenticide residue might be high in poultry products as zinc phosphide and aluminium phosphide were used in 33.3% and 12.0% of poultry farms. Thus, the risk of contamination of poultry feed with chemicals while using them or by rodents, which in turn occur in poultry product as a chemical itself or its metabolite of heavy metals. However, residue of zinc phosphide, the only used in the dairy farms, might be relatively low because as only 14.3% of farms use it as rodenticide. The assessment result revealed that all dairy farms use one or more antiseptics (savlon, iodine tincture and denatured alcohol). Among the antiseptics, the highest probability to be residue in milk was savlon, which used in 82.2% of farms. Besides savlon, iodine also had the possibility to occur as residue in milk since it was used in 53.3% of the farms for teat dipping.

During this survey and assessment, no herbicide use was found in all farms that agree with McEwan and McNab [5] who said herbicide residues are more common in vegetables and fruits than animal products. However, there are possibility of occurrence of heavy metals residues in milk, milk products, egg and poultry meat which is in line with Chirag et al. and Swarup et al. [2,25] who stated that heavy metals (lead, mercury, cadimium, zinc and others) accumulate in edible tissues (in milk and its products, and egg and poultry meat) and these residues can pass to the public. Out of 28 dairy and 42 poultry farms assessed and surveyed, 10.7% of dairy and 66.7% of poultry farms have a feeding trough made of metallic materials. All dairy cows from all farms are tied in a metallic pole in which cows lick both the poles and the trough. Metallic feeding trough was periodically treated with antirust chemicals. Hence, these may expose cows and chicken to heavy metal residues accumulation through time and may get access to the public via milk, eggs and chicken meat. Additionally, metallic milk containers, which are used in 57.1% of farms, may lead to accumulation of detectable heavy metals in milk [25].

The present assessment done on awareness of the farm owners about the possible occurrence of chemical contaminants showed 50% of respondents from dairy farms and 59% from poultry farms have awareness and information about chemical contamination of animal feed. However, only 20% of poultry farms ask or check the seller whether he or she have used chemicals recently and there is significant difference ($p<0.05$) between aware and non-aware farms in asking their seller, but in dairy farms there is no statistical difference ($p>0.05$). This shows that farm owners having awareness about chemical contamination of dairy feed do not give attention to check or ask the prior use of chemicals unlike poultry farms.

The assessment on use of dairy and poultry product by the public also revealed that about 35.7%, 96.2% and 37.5% and 46.4%, 100% and 62.5% of the dairy and poultry (layers and broilers) farms offer milk, eggs and meat for public consumption while their animals are under treatment, and before the commence of animal product discard time after the end of treatment, respectively. The type of farms is significantly associated with public use of animal products while their animals are on therapy ($x2 = 24.1$, $p=0.00$) and before the end of withdrawal time but after treatment ($x2 = 18.98$, $p=0.00$). Additionally,

type of production system in dairy farms has significant association with offering milk of cows under treatment for public use, as there is significant difference ($p<0.05$) between large and small farms. 18.8% and 58.3% of large and smallholder intensive dairy farms, and 31.2% and 66.7% of large and smallholder dairy farms were offer their products for public use during treatment. This might be due to large intensive farms may have awareness and knowledge or because of fear of market loss to a huge amount of milk produced if their sell of milk during treatment is known by their customer. However, from end of treatment to end of milk discard time the above figure were increased to 31.2% and 66.7% for large intensive farms and small intensive and semi intensive farms, respectively and there is no statistical difference ($p>0.05$) between them. This may be because most customers and processing plants do not give focus after the end of treatment for the possibility of presence or absence of chemical residues and farmers also sell their milk. In general, around 58.6% of farms sell their animal products (milk, poultry meat and egg) while their animals were under treatment and the figure were increased to 70.0% from end of treatment to withdrawal period. This may be associated to lack of awareness and regulation on drug and chemicals residues, lack of clear regulation on controlling antibiotic contamination of feedstuffs in many African countries and clear lack of available information about antibiotic residues in animal-derived foods in Africa [8].

## Role of animal health workers in drug/chemical withdrawal period

Out of 70 farms assessed and surveyed, 57.1% of them prefer professionals that have doctor of veterinary medicine (DVM) and above to treat sick animals. Among these, 40% of the farms were not informed to discard dairy and poultry products during treatment and in the withdrawal period, even if this was the responsibility of veterinarian [4]. Among 20 farms where animal health assistants treated sick animals, 65% of farms were not informed to discard products from animal under treatment until the withdrawal period. Non-professionals managed about 14.3% of the farms' sick animals. Among these farms, 90% of them used the products of treated animals within the withdrawal period that may be due to lack of awareness about chemical residue and its effects on public health. Most of the public were lack awareness about the chemical and drug residues [1]. Thus, in this study, none of the poultry and dairy products customers asks the seller prior use of the products about treatment of animals with drugs or chemicals.

The use of animal products contaminated with drugs by the public while in drug withdrawal periods, there is no significant difference ($p>0.05$) between farm preferences among veterinarian, assistant veterinarian and non-professional personnel. This might be due to the lack of offering appropriate information about drug withdrawal time to farms by the animal health professionals, which contradicts the role of veterinarians to ensure residue free animal product [26]. However, selling the contaminated product to the public while the product is within the withdrawal period had significant difference ($x^2=11.23$, $p=0.000$) between informed and non-informed farms about the drug withdrawal period by animal health workers. There were also significant difference between aware and non-aware farms in using the animal products during the withdrawal period ($x^2= 10.47$, $p=0.001$). This shows that if awareness of the farms and farmers is increased the possible occurrence of chemical residues in animal products that brought to public use can be minimized.

## Chemicals used and chemical contamination possibilities in milk and animal feed processing plants

Chemical residues in poultry and dairy products can result from offering of chemical treated feed to the animals [27]. The feed processing plants (85.7%) in the study area have not checked whether feed raw materials were treated with preservative chemicals or not before they buy from farmers and traders. However, farmers or traders use different pesticides to preserve their crops from insects and rodents. These pesticides can transfer from animal feed to food of animal origin after they accumulated in fat tissues of the animal [28]. Besides their failure to ask and check the prior used chemicals by their sellers, 85.7% of them use aluminium phosphide and one plant used marathon to preserve their crops. So, aluminium phosphide is a possible chemical residue which can transfer from animal feed to foods of animal origin and should not be neglected while investigating chemical residues from animal feed and from animal products (eggs, poultry meat, and milk). The possibility of offering recently treated animal feeds with chemicals to food producing animals is high in Bishoftu and Modjo due to absence of any checking measure to avoid such exposure by farms and processing plants before they buy.

Chemical residues in milk can also result from milk processing plants through sanitation and packaging materials [5]. In Bishoftu and Modjo, out of five milk-processing plants assessed and surveyed, 60% of plants did not check whether the milk has possibility to contain chemicals. Despite the presence of various screening tests which used to detect chemical residues specially drugs from raw milk like microbial inhibition test, Penzyme test, Charm II test, LacTec test, SNAP test, beta star test and charm safe level test which are used in different countries, none of the plants in the study areas used appropriate routine tests. However, one plant uses bacterial inhibition test (starter culture addition test) without regular programs. This might be due to less attention is given to chemical residue effect [1] or lack of awareness about the health hazard of residues. Three of surveyed plants confirmed that they received milk from cows under treatment with different drugs during milk discard time. Two of these plants received milk in separate container and also used it for public consumption. Although receiving this milk in separate container encourages farm owners not to mix treated cows' milk and normal cow milk, the purpose of using this milk in processing plants and ways used to control mixing should regularly be evaluated by the responsible health sector to safeguard the public from drug residues.

During this survey, different chemicals were also used in the milk processing plants, such as: sodium hydroxide, hydrogen peroxide, nitric acid, sodium hypochlorite, alcohol and formalin were used in all plants as sanitation, test reagents, additives and disinfection. Dairy products containing these chemical residues may be investigated from the study area since it is possible for milk to contain these chemical residues if careless handling is done [5].

## Conclusion and Recommendations

Assessment result showed different drugs and chemicals are being used for different purposes in farms and processing plants. Different antibiotics, antiprotozoals and anthelmintics are being used in poultry and dairy farms. Different chemicals are also being used in farms and processing plants in the study areas. Thus, there is possibility of finding these chemicals, drugs or their metabolite residues from milk and milk products, egg and poultry meat that brought to market for public use. This is due to lack of awareness in farms, failure of animal

health professionals to respect the drug withdrawal times after treatment, lack of awareness of animal products' consumers, lack of commitment in well aware farms about chemical residue and its public health effects, and possibly due to lack of legal control on farms and processing plants about chemical and drug use. Therefore, laboratory investigation should be done to confirm the presence of drugs and/or chemicals in foods of animal origin (milk and its products, poultry meat, and eggs). Collaborative work on awareness creation about possible occurrence of chemical residues should also be made among animal health workers, poultry and dairy farm owners, animal feed and milk processing plants, and agricultural and health offices.

## Ethical Considerations

The study was granted an exemption from requiring ethics approval from the College of Veterinary Medicine and Agriculture Institutional Research and Review Committee. Then the participants after reading the written consent form, and when agree upon, and sign, involved in the study. Confidentiality of the participants and the farm were maintained by using unique code.

## Competing Interests

The authors declare that they have no competing interests.

## Authors' Contributions

TB, AF, TJ and FT developed the research idea. TB and AK contributed to collecting the materials and drafted the manuscript. TB, AK, DA and AF provided valuable information on the subject of data analysis and the design of the study. TB led the project. TB, DA and AF coordinated and supervised the study. TB and AF revised the manuscript. All authors agreed with the results and conclusions; and read and approved the final manuscript.

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## References

1. Maria CL, Mary T (2012) Chemical residues in animal food products: An issue of public health, public health- methodology, environmental and systems issues. pp: 163.
2. Chirag MM, Hitesh BP, Shailesh KM (2013) Animal husbandry practice to contaminants and residues of chemical in animal origin foods and health hazard. Inter J Mole Vet Res 3: 55-61.
3. Saegerman C, Pussemier L, Huyghebaert A, Scippo ML, Berkvens D (2006) On-farm contamination of animals with chemical contaminants. Rev Sci Tech 25: 655-673.
4. Karshima NS (2013) The roles of veterinarians in the safety of foods of animal origin in Nigeria: A review. J Anim Prod Adv 3: 57-68.
5. McEwen SA, McNab WB (1997) Contaminants of non-biological origin in foods from animals. Rev Sci Tech 16: 684-693.
6. Fein SB, Lin J, Levy AS (1995) Food borne illness: perception, experience, and preventive behavior in the United States. J Food Prot 58: 1405-1411.
7. Beyene T, Tesega B (2014) Rational veterinary drug use: Its significance in public health. J Vet Med Anim Health 6: 302-308.
8. Darwish WS, Eldaly EA, El-Abbasy MT, Ikenaka Y, Nakayama S, et al. (2013) Antibiotic residues in food: the African scenario. Jpn J Vet Res 61 Suppl: S13-22.
9. Myllyniemi AL, Rannikko R, Lindfors E, Niemi A, Backman C (2000) Microbiological and chemical detection of incurred penicillin G, oxytetracycline, enrofloxacin and ciprofloxacin residues in bovine and porcine tissues. F Addit Contam 17: 991-1000.
10. Nisha AR (2008) Antibiotics residues-A global health hazard. Vet World 1: 375-377.
11. Khaniki JG (2007) Chemical contaminants in milk and public health concerns: A review. Inter J D Sci 2: 104-115.
12. NMSA (2003) National meteorology service agency report. Addis Ababa, Ethiopia.
13. Mekibib B, Furgasa M, Abunna F, Megersa B, Regassa A (2010) Bovine mastitis: prevalence, risk factors and major pathogens in dairy farms of Holeta town, central Ethiopia. Vet World 3: 397-403.
14. Mekonen H, Tesfaye A (2010) Prevalence and etiology of mastitis and related management factors in market oriented smallholder dairy farms in Adama, Central Ethiopia. Revenue Med Vet 161: 574-579.
15. Sitotaw T, Regassa F, Zeru F, Kahsay AG (2014) Epidemiological significance of major hemoparasites of ruminants in and around Debre-Zeit, Central Ethiopia. J Parasitol Vector Biol 6: 16-22.
16. Stolker AA, Brinkman UA (2005) Analytical strategies for residue analysis of veterinary drugs and growth-promoting agents in food-producing animals--a review. J Chromatogr A 1067: 15-53.
17. Smith JL, Drum DJ, Dai Y, Kim JM, Sanchez S, et al. (2007) Impact of antimicrobial usage on antimicrobial resistance in commensal Escherichia coli strains colonizing broiler chickens. Appl Environ Microbiol 73: 1404-1414.
18. Muriuki FK, Ogara WO, Njeruh FM, Mitema ES (2001) Tetracycline residue levels in cattle meat from Nairobi salughter house in Kenya. J Vet Sci 2: 97-101.
19. Dinka A, Tolossa YH (2012) Coccidiosis in Fayoumi Chickens at Debre Zeit Agricultural Research Center Poultry Farm, Ethiopia. Europ J Appl Sci 4: 191-195.
20. Mehtabuddin AA, Mian T, Ahmad S, Nadeem Z, Tanveer I, et al. (2012) Sulfonamide residues determination in commercial poultry meat and eggs. The J of An & Pl Sci 22: 473-478.
21. [No authors listed] (1990) Residues of some veterinary drugs in animals and foods. Joint FAO/WHO Expert Committee on Food Additives. FAO Food Nutr Pap 41: 1-106.
22. Schenck FJ, Callery PS (1998) Chromatographic methods of analysis of antibiotics in milk. J Chromatogr A 812: 99-109.
23. Susan EA (1998) The Merck Veterinary Manual. (8thedn) MERCK and CO., INC., Whitehouse Station, N.J., USA.
24. Swarup D, Patra RC, Naresh R, Kumar P, Shekhar P (2005) Blood lead levels in lactating cows reared around polluted localities; transfer of lead into milk. Sci Tot Envi 349: 67-71.
25. Muhammad F, Akhtar1 M, Zia-Ur-Rahman JI, Irfan AM (2009) Role of veterinarians: in providing residue-free animal food: Pak Vet J 29: 42-46.
26. Leeman WR, Van Den Berg KJ, Houben GF (2007) Transfer of chemicals from feed to animal products: The use of transfer factors in risk assessment. Food Addit Contam 24: 1-13.
27. Bushra I, Samina S, Shafiqur R (2014) Assessment of the dietary transfer of pesticides to dairy milk and its effect on human health. Afr J Biotech 13: 476-485.
28. Pavlina N (2011) Screening methods used for the detection of veterinary drug residues in raw cow milk-a review. Czech J Food Sci 26: 393-401.

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