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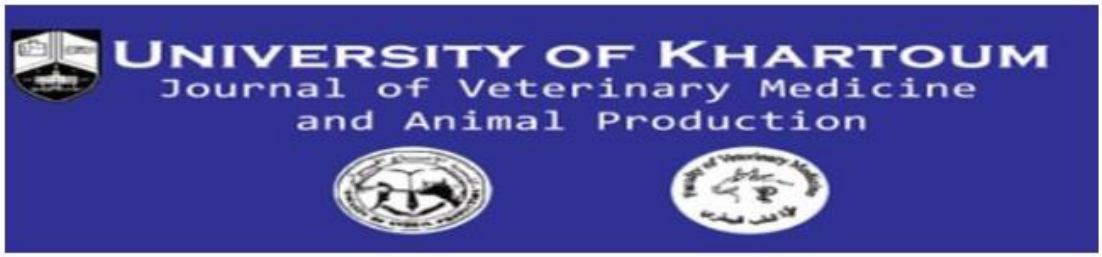

Risk Factors Associated with antimicrobial Residues in the Milk Consumed in Nyala, South Darfur State, Sudan

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Abstract

This study aimed to assess the contamination of milk by antimicrobial residues consumed in Nyala, South Darfur State, Sudan. A questionnaire and direct interviews with veterinarians at the veterinary pharmacies (n= 30) as well as with dairy farmers (n= 30) were carried out to determine the various risk factors associated with the presence of antimicrobial residues in milk. In addition, hundred milk samples were collected from dairy farms and sale points (n= 50, each) and were analyzed for antimicrobial residues by using Trisensor kit. The results revealed that 73.3% of the veterinarians believe that prescriptions are not necessary for drug dispensing, and that 43.3% of the veterinarians practice whole sale of antibiotics to dairy farm owners ($P<0.001$). However, 60% of the veterinarians guide the dairy farmers to be strict to antibiotic dose and 73.3% advise them about the way of administration. Moreover, only 56.7% of the veterinarians advise the dairy farmers about the importance of the withdrawal period, and 93.3% stated that most of the saleable drugs are broad spectrum antibiotics. On the other hand, 16.7% of the dairy farmers add antibacterial drugs to animal feed, with significant difference ($P>0.01$) between south and north Nyala. Fifty percent of dairy farmers administer antibiotics to healthy animal as prophylactic therapy, only 26.7% of them consult the veterinarians, 70% keep drug in the cattle yard and treat the animals by themselves, 73.3% do not apply the withdrawal period and non of them have balances to measure animal weight for suitable drug dosage. Furthermore, one hundred raw and heated milk samples (50 from dairy farms and 50 from sale points) collected by non-probability sampling method were screening for contamination with drugs residues using the Trisensor kit (detects simultaneously beta-lactams, tetracyclines and sulfonamides, in addition to the Triaminosensor kit (detects simultaneously gentamicin, streptomycin and neomycin). In both raw and heated milk, high contamination rates with tetracyclines (34% and 31%, respectively) and sulfonamides (31% and 29%, respectively) were detected, but with no significant difference ($P>0.05$). Contamination with beta-lactams was higher in milk samples collected from the sale points (37%) than in the samples from dairy farms (32%), but also the difference was not significant ($P>0.05$). While, neomycin was not detected, gentamicin was detected in 25% and 32% and streptomycin was found in 19% and 26% of raw and heated milk, respectively.

In conclusion, contamination of milk by antimicrobial in Nyala indicates lack of proper and direct veterinary supervision in implementation of the legislations on the presence of veterinary drugs residues in milk in addition to the ignorance of withdrawal period of drugs.

المستخلص

هدَفُت هذه الدراسةِ إلى تَقييم تلوّثِ اللبن ببقايا المضادات الميكروبية في اللبن المستهلك في نيالا (السودان). صمم استبان واجريت مقابلات مع الاطباء البيطريين بالصيدلياتِ البيطريةِ (n= 30) وملاك مزارع الألبان (n= 30)، بغرض تحديد عواملِ الخطرِ المُخْتَلِفةِ المتعلقة بوجود بقايا المضادات الميكروبية فى اللبن. بالإضافة الى ذلك، جُمِعتْ مائةَ عينة لبن من مزارع الألبان ونقاط البيع (خمسون عينة لكل) وحللت لبقايا المضادات الحيوية باستعمال Trisensor antibiotic test. أظهرت النتائج ان 73.3% مِنْ الأطباء البيطريين يعتقدون ان الرشتة ليست ضرورية لصرف الدواء وان 43.3% ($P<0.001$) يمارسون بيع المضادات الحيوية بالجملة لملاك مزارع الالبان. بالرغم من ان 60% منهم يرشدون مربي ابقار اللبن عن جرعة المضاد الحيوي و73.3% ينصحون ملاك مزارع الالبان بطرق اعطاء الادوية. علاوة على ذلك فان 56.7% فقط من الاطباء البيطريين ينصحون ملاك ابقار اللبن بأهمية التقييد بفترةِ الامتناع وذكر 93.3% ان معظم الادوية المباعة هي مضادات حيوية واسعةِ الطيفِ. دلت النتائج علي ان 16.7% مِنْ ملاك مزارع الألبان يُضيفُون المضادات الحيوية إلى العليقة والذى اظهر فرقا معنويا ($P<0.01$) بين شمال وجنوب نيالا. كما ان 50% من ملاك مزارع الالبان يعطون المضادات الحيوية للحيوانات السليمة بغرض الوقاية من الامراض. فقط 26.7% مِنْ ملاك مزارع الألبان يَستشيرونَ الاطباء البيطريين و 70% لديهم مضادات حيوية بالمزارع يعطونها للحيوانات

بأنفسهم و 73.3% لا يتقيدون بفترة الامتناع 100% و جميهم ليست لديهم موازين بالمزارع لقياس اوزان الحيوانات لإعطاء الجرعات المناسبة من الادوية. جمعت مائة عينة لبن خام ولبن معامل حراريا (خمسون من مزارع الالبان وخمسون من نقاط البيع) باستخدام الطريقة الاحتمالية لأخذ العينات، وفحصت للتلوث باستخدام ترايسنسر للكشف عن البتالاكتام والتتراسيكلين والسلفانومايد، وأستخدم ترايامينوسنسرللكشف عن الجنتاميسين و استربتومايسين والنيومايسين. ترايسنسر وترايامينوسنسر هما مقياس العمق متعدد الارسال والتي تحتوي علي مستقبلات متخصصة واجسام مضادة عامة احادية النسيلة في كل من عينات اللبن الخام واللبن المعامل حراريا. اظهرت النتائج انتشار عاليا للتتراسيكلين (34 % و31 % علي التوالي) والسلفانومايد (31 % و 29 % علي التوالي) ولكن الفرق لم يكن معنويا (P>0.05). و كان انتشار البيتالاكتام عاليا في نقاط البيع (37%) مما هو عليه في مزارع الالبان (32 %) ولكن الفرق لم يكن معنويا. لم تحتوي كُلّ عينات اللبن التى فُحُصت على النيومايسين، بينما بلغ انتشار الجنتاميسين 25% و32% والاستربتومايسين 19 % و26 % فى كل من عينات اللبن الخام وعينات اللبن المعامل حراريا، علي التوالي. خلصت الدراسة إلى أن اللبن الملوث ببقايا المضادات الحيوية في نيالا قد يدل الافتقار الى الاشراف البيطري الصحيح و المباشر بتطبيق القوانين على تواجد بقايا الادوية البيطريه في اللبن وعدم التقيد بفترة الامتناع سحب الادوية.

Introduction

Veterinary drugs have been used in livestock farming for several decades for the purpose of therapy and prophylaxis against infectious diseases and are used as growth promoters administered at low doses for extended periods (Movassagh, 2011). Antibiotic residues in foodstuffs are currently a problem of some magnitude in different parts of the world, particularly due to associated public health concerns that include hypersensitivity reactions, antibiotic resistance, toxicity, teratogenicity, and carcinogenicity (Darwish *et al*., 2013). The extensive use of these antimicrobials, insufficient withdrawal period and lack of records are the most common reasons of residues in milk above the acceptable Maximum Residue Limits (Kaneene and Ahl, 1987). As infections caused by antibiotic resistant pathogens do not respond well to therapy by ordinary antibiotics and hence new antibiotics must be developed (Stolker and Brinkman, 2005).

Many of the antimicrobials used in animals are also used in human medicine; the use of antimicrobials in animals is part of the global problem of antimicrobial resistance (Aryal, 2001). Improper application of the veterinary medicinal products (VMP) for disease therapy and growth promotion may result in presence of antimicrobial residues in milk and dairy products, and can contribute to the development and spread of drug resistant bacteria (Kirbis, 2006 and Stolker *et al*., 2007). Komolafe, 2003 and Katakweba, *et al.* (2012) reported that lack of proper application and handling lead to occurrence of residues in foods from animal origin; particularly meat, milk and eggs. Farm animals treated with antimicrobials are required to be held for specific withdrawal periods until all residues are depleted to safe levels before the animal products can be used as food for human consumption (Kukanich *et al*., 2005).

The abuse of antimicrobials has led to development of multi-drug resistant animal and human pathogens (Alanis, 2005 and El Zubeir *et al*., 2012)**.** Methods for determination of antimicrobial residues include high performance liquid chromatography (Abbasi *et al*., 2011) and competitive immunoassay format (Adrian *et al*., 2009). Most of the studies carried out were based on microbiological screening techniques that do not specifically, classify and quantify the antimicrobial. Hence, the degree of risks to the consumers could not be ascertained due to low specificity and sensitivity of techniques (Barrow and Feltham, 1993).

In the Sudan, the milk samples from sales points had the highest percent of the antibiotic residues compared to those detected in the farms (Said Ahmad *et al*., 2008). The detection of higher contamination with antimicrobials reported in the milk samples collected from venders might suggest the addition of antibiotics to the milk in order to prolong its shelf life (Said Ahmad *et al*., 2008 and El Zubeir and El Owni, 2009). The objectives of the present study were to investigate the occurrence of drug residues in milk (raw and heated) sold in Nyala, South Darfur State, Sudan. It was also aimed to correlate the application and practices of using veterinary drugs with the occurrences of residues in milk.

Materials and Methods

Study area

This study was carried out in Nyala, South Darfur State, Sudan (8º 30 and 13º 30 North and 22º and 28º East), Nyala is the capital city and Jabal Mara Street divided the city to South and North. It is densely populated and is an active trading center of livestock in the region. Dairy farms are located in South and North parts of the city, with dairy farms in the South more than in the North. Milk and milk products play an important role in the livelihood and in some of the social aspects in the town.

Data collection

A questionnaire was designed in order to obtain basic information about the manner of using antimicrobials in dairy farms. Information was collected from thirty veterinary pharmacies and thirty dairy farms owners (fifteen from each part) using Non Probability Sampling Method and closed questions as described by Thrusfield (2007).

Milk samples collection

A total of 100 milk samples were collected in sterile plain tubes from dairy farms (raw) and sales points (heated) (fifty samples for each). Milk samples collected were kept in insulated ice box at 2-8º C and transferred to the lab.

Detection of the antimicrobial residues

Two antimicrobial detection kits from Unisensor (Ougrée, Liège, Belgium): (1) the trisensor kit, which detects betalactams, tetracyclines and sulphonamides simultaneously and (2) the unisensor kit, which detects the aminoglycosides group (specifically, gentamicinm, streptomycin and neomycin).The test procedures and interpretation of the results were carried out according the manufacturer's protocol as described by Reybroeck and Ooghe (2012),

Data analysis

The data collected through questionnaire survey and that obtained for the milk samples examination were analyzed using Statistical Package foe Social Science (SPSS version 20, 2011) programme. Descriptive statistic was used for variables. Differences between the groups were assessed by Chi-square (χ^2) test.

Results and discussion

A survey questionnaire include direct interviews with veterinarians at veterinary pharmacies and dairy farm owners to identify various risks factors associated with drugs residues in milk between South and North Nyala was conducted to determine the occurrence of antibiotic residue in the milk. The result showed that 73.3% from all interviewed veterinarians believe that prescriptions are not necessary for drugs dispensing and the difference was not significant ($P>0.05$) between South and North Nyala (Table 1). This might create some potential risks factors to the development of antimicrobials residues and resistance. In Tanzania, it was found that only 54 % of respondents obtained their antibiotics through prescription by veterinarians (Katakweba *et al*., 2012).

As seen from the results, 43.3% of the veterinarians at veterinary pharmacies practice whole sale of antibiotics to the dairy farms' owners, 60% guide them to restrict dose and 73.3% advice the owners about the routes of administration (Table 1). However, only 56.7% from all interviewed veterinarians advice the dairy farms' owners for the withdrawal period and 93.3% stated that the most saleable drug were broad spectrum antibiotics. Komolafe (2003) and El Zuber *et al*. (2012) reported that he antibiotic abuse is one or perhaps the most important cause of the high prevalence of drugs residues and resistance among bacteria.

Regarding the knowledge of the dairy farm owners on the antimicrobials application, It was found that 16.7% from the interviewed dairy farmers add antimicrobial agents to the animal feed as prophylactic, with significant differences ($P<0.05$), and 50% administrated antibiotics to the healthy animal for prophylactic measures (Table 2). Similarly Sawant *et al*. (2005) reported that antibiotics are used extensively on dairy herds for both therapeutic and prophylactic purposes. In the present study, from all interviewed dairy farm owners, only 26.7% consult the veterinarians to advice them about antimicrobial application. El Zubeir and Mahala, (2011) reported that dairy farmers themselves always decide the drugs they administer according to their experience or to the advices of their colleagues whose cows have shown the same symptoms. They attributed that to the high financial cost of the veterinarian personnel as well as the easiness in dispensing veterinary medicinal products. Moreover, high degree of antimicrobial abuse by livestock keepers through failure in observing the recommended therapeutic doses, use of wrong routes of administration, and non-observance of withdrawal periods, were known as causes of developing and promoting spread of resistance to antibiotics (Okeke and Ojo, 2010).The results confirmed the previous report in Khartoum State that found 58% of the farmers lack to the necessary information about antibiotic residues appearance in food material, and the absence of veterinary supervision (72.3%) in the visited farms (Salman *et al*., 2012). Furthermore, in Khartoum State, it was found that the disease control was not satisfactory as most of the labors give the treatment without consultation of veterinarians (El Zubeir and Mahala, 2011).

About 70% of dairy farm owners give the drugs to their animal. Sawant *et al* (2005) reported that in 93% of the farms, antibiotics were administered by the owners and untrained personnel (Katakweba, *et al*., 2012). In the present study, only 23.3% from all interviewed dairy farmers were found to consider the withdrawal period (Table 2). Therefore, this might lead to presence of drugs residues in food derived from animal origin. The dairy farmers do not consider proper drug dosage, duration of treatment as well as the withdrawal period. Also Salman *et al.* (2012) found that antibiotic treated cows were milked together with the healthy ones. In Cameroon, regularly monitoring of cow health by the veterinarians is not common and the waiting time between cow treatment with antibiotic and milking is rarely respected (Edima *et al*., 2012). The most common cause of the presence of antibiotic residues in milk is non-compliance with the withdrawal period of antimicrobial excretion from animal body (Kirbis, 2006). It was found in Tanzania that the very high proportion of milk containing antibiotic residues was due to the lack of adherence to the withdrawal period of veterinary antimicrobial which poses a risk to public health and the dairy industry (Ryoba *et al., 2007*). Moreover, in Kenya, a questionnaire was constructed and the results suggested that lack of understanding of risks related to antibiotic

contamination of food, poor or no treatment records and lack of a monitoring system are major risks for drug residues in food derived from animal origin (Shitandi and Sternesjö, 2004). The results also confirm previous report from a rural district in China on lack of knowledge on prudent use of antibiotics and antibiotic resistance in developing countries (Chenggang *et al.*, 2011).

Beta-lactams were the predominant antibiotics residues in milk in south and north Nyala (35% and 34%, respectively) followed by tetracyclines (35% and 30%, respectively) and sulfonamides (26% and 34%, respectively). However, no significant difference (P>0.05) was found between the residues of these antimicrobial between the two parts of the city (Table 3). The presence of tetracyclines, sulfonamides and beta-lactams residues in milk in Nyala depended on the milk type. The tetracyclines residues were found in 34% of the raw milk samples and in 31% of the heated milk samples. The sulfonamides was detected in 31% of the raw milk and 29% of the heated milk, but the difference was not significant (P>0.05). High rate of tetracycline resistance bacteria obtained may be due to the wide spread use of tetracycline among dairy farms in Sudan (El Zubeir *et al*., 2012). In Cameroon, it was found that 27% of the milk samples collected in farms were contaminated with antibiotic residues, with beta-lactams and/or tetracycline families may be the source of the contamination as it found in 53.85% of milk samples (Edima *et al*., 2012). In Tanzania, 42.7% of screened milk samples were found positive for antibiotic residues (*Ryoba et al., 2007*). Moreover it was found in Palestine that 18.7% milk samples tested for tetracyclines were above maximum residues limits (Al Zubeir, 2012).

In the present study, beta-lactams were found to be high in the sale points (37%) compared to those collected from dairy farms (32%) as shown in Table 3. This might suggest the addition of antibiotics to milk as chemical preservative in order to prolong its shelf life as was stated previously by Said Ahmed *et al.*(2008). Similarly a study carried out in Khartoum State, showed that 12.55% and 6.66% of the milk samples were contaminated with antibiotic and sulphonamides respectively, with the highest prevalence in the milk samples collected from collection points compared to farms (El Zubeir and El Owni, 2009).

In Ghana, 35.5% of the milk samples collected contaminated with antimicrobial residues levels ranged from 16.6% for wholesalers or milk assemblers to 54.2% for milk processors (Aning *et al*., 2007). In Palestine, 22.2% of milk samples that were tested for beta-lactams residues were above maximum residues limits (Al Zuheir, 2012).

Gentamicin residues were the highest among aminoglycosides that contaminated milk samples in Nyala. Streptomycin (Dihydrostreptomycin) residues were higher in milk samples collected from north Nyala compared to those from south Nyala. However, all the examined milk samples without neomycin (Figure 1), which could be due to unavailability in Nyala.

Gentamicin residues were higher in the heated milk (32%) compared to the raw milk samples (25%), but the difference was not significant (P>0.05). The heated milk was highly contaminated by the streptomycin compared to the raw milk samples (26% and 19%, respectively) (Table 5). In Cameroon, aminoglycosides antibiotics group streptomycin as antimicrobial residues; in milk was detected in 15.38% of the samples (Edima *et al*., 2012).

Visual results on dipsticks to compare the intensity of the line colour of the test line with the intensity of the line colour of the control line were illustrated in Figure 2 and 3

Conclusion

In the present study, higher prevalence of drugs residues in milk was obtained using trisensor and triaminosensor. In addition many risk factors associated with drugs residues in milk were identified. They include veterinarians's practices and the unawareness of dairy farms' owners mismanagement and unawareness. Hence this situation necessitate the initiation of strict legislation should be implemented in order to minimize the abuse of antibiotics, and comprehensive program should be developed through collaboration with governmental authorities, farmers, veterinarian and researchers to ensure the quality of milk in term of chemical contamination. Monitoring programs should be initiated and implemented using screening tests to ensure that safe food and wholesome milk and dairy products are available for consumption in this country.

Table 1: The opinions and practices of veterinarians in veterinary pharmacies in Nyala in dispensing antimicrobials

Unit	south Nyala	north Nyala	Total	Chi-square	P- value
Importance of prescription					
Yes	0%	0%	0%		
No	12 (40%)	10 (33.3%)	22(73.3%)	**0.682**	**0.409**
Sometimes	3 (10%)	5 (16.7%)	8 (26.7%)		
Total	**15 (50%)**	**15 (50%)**	**30 (100%)**		
Whole saleable antibiotics to the owners					
Yes	12 (40%)	1 (3.3%)	13(43.3%)	**20.308**	**0.001****
No	3 (10%)	3 (10%)	6 (20%)		
Sometimes	0 (0%)	11(36.7%)	11(36.7%)		
Total	**15 (50%)**	**15 (50%)**	**30 (100%)**		
Dose restriction & administration to owners					
Yes	3 (10%)	3 (10%)	6 (20%)	**3.556 0.169**	
No	11(36.7%)	7 (23.3%)	18 (60%)		
Sometimes	1 (3.3%)	5 (16.7%)	6 (20%)		
Total	**15 (50%)**	**15 (50%)**	**30 (100%)**		
Yes	11(36.7%)	11(36.7%)	22(73.3%)	**1.143**	**0.565**
No	4 (13.3%)	3 (10%)	7 (23.3%)		
Sometimes	0 (0%)	1 (3.3%)	1 (3.3%)		
Total	**15 (50%)**	**15(50%)**	**30 (100%)**		
Advice owners for withdrawal period					
Yes	8 (26.7%)	9 (30%)	17(56.7%)	**0.136**	**0.713**
No	7 (23.3%)	6 (20%)	13(43.3%)		
Sometimes	0 (0%)	0 (0%)	0 (0%)		
Total	**15 (50%)**	**15(50%)**	**30 (100%)**		
The most saleable broad spectrum antibiotics					
Yes	14(46.7%)	14(46.7%)	28(93.3%)	**0.000**	**1.00**
No	0 (0%)	0 (0%)	0 (0%)		
Sometimes	1 (3.3%)	1 (3.3%)	2 (6.7%)		
Total	**15 (50%)**	**15(50%)**	**30 (100%)**		

P-value < 0.01 highly significant while P-value >0.05 not significant

Table 2: The knowledge and of the dairy farm owners on the application of antimicrobial drugs in Nyala

Unit	South Nyala	North Nyala	Total	Chi-square	P-value
Antimicrobials add to animal feed					
Yes	1 (3.3%)	4(13.3%)	5(16.7%)	8.927	**0.012***
No	13(43.3%)	5(16.7%)	18(60%)		
Sometimes	1 (3.3%)	6(20%)	7(23.3%)		
Total	**15 (50%)**	**15 (50%)**	**30(100%)**		
Administration of antibiotics as prophylactics					
Yes	9 (30%)	6 (20%)	15(50%)	**4.671**	**0.097ns**
No	5 (16.7%)	3 (10%)	8 (26.7)		
Sometimes	1 (3.3%)	6 (20%)	7(23.3%)		
Total	**15 (50%)**	**15 (50%)**	**30(100%)**		
Consultation of Veterinarians					
Yes	5 (16.7%)	3 (10%)	8 (26.7)	**0.833**	**0.659**
No	5 (16.7%)	5(16.7%)	10(33.3)		
Sometimes	5 (16.7%)	7(23.3%)	12 (40%)		
Total	**15 (50%)**	**15 (50%)**	**30(100%)**		
Availability of drugs in cattle yard					
Yes	13(43.3%)	8(26.7%)	21 (70%)		
No	2 (6.7%)	5(16.7%)	7(23.3%)		
Sometimes	0 (0.0%)	2 (6.7%)	2 (6.7%)		
Total	**15 (50%)**	**15 (50%)**	**30(100)**		
Consideration of withdrawal period					
Yes	4 (13.3%)	3 (10%)	7(23.3%)	**1.143**	**0.565**
No	11(36.7%)	11(36.7%)	22(73.3)		
Sometimes	0 (0.0%)	1 (3.3%)	1 (3.3%)		
Total	**15 (50%)**	**15 (50%)**	**30(100)**		
Using balance for measurement of animals weight					
Yes	0 (0%)	0 (0%)	0 (0%)	**No estimate**	
No	15 (50%)	15 (50%)	30(100)		
Sometimes	-	-	-		
Total	**15 (50%)**	**15 (50%)**	**30(100%)**		

ns P-value >0.05 not significant * P-value = significant difference ($P < 0.05$)

Table 3: Prevalence of beta-lactams, tetracyclines and sulfonamides residues in milk in south and north Nyala Prevalence of beta-lactams, tetracyclines and sulfonamides residues in milk in south and north Nyala

Antibiotics	South Nyala	North Nyala	Total	Chi-square	P-value
Beta-lactams					
Positive result	35 (35%	34 (34%)	69 (69%)	**0.047**	**0.829**
Negative result	15 (15%)	16 (16%)	31 (31%)		
Total	**50 (50%)**	**50 (50%)**	**100 (100%)**		
Teteracyclines					
Positive result	35 (35%)	30 (30%)	65 (6%)	**1.099**	**0.295**
Negative result	15 (15%)	20 (20%)	35 (35%)		
Total	**50 (50%)**	**50 (50%)**	**100 (100%)**		
Sulfonamides					
Positive result	26 (26%)	34 (34%)	60 (60%)	**2.667**	**0.102**
Negative result	24 (24%)	16 (16%)	40 (40%)		
Total	**50 (50%)**	**50 (50%)**	**100 (100%)**		

P-value > 0.05 not significant

Table 4: Prevalence of beta-lactams, tetracyclines and sulfonamides residues in raw and heated milk in Nyala

Antibiotics	Raw milk	Heated milk	Total	Chi-square	P-value
Beta-lactams					**0.28**
Positive	32 (32%)	37 (37%)	69	**1.169**	
Negative	18 (18%)	13 (13%)	31		
Total	**50 (50%)**	**50 (50%)**	**100**		
Teteracyclines				**0.396**	**0.529**
Positive	34 (34%)	31 (31%)	65		
Negative	16 (16%)	19 (19%)	35		
Total	**50 (50%)**	**50 (50%)**	**100**		
Sulfonamides				**0.167**	**0.683**
Positive	31 (31%)	29 (29%)	60		
Negative	19 (19%)	21 (21%)	40		
Total	**50 (50%)**	**50 (50%)**	**100**		

P-value > 0.05 not significant

Table 5: Prevalence of aminglycosides residues in raw and heated milk samples in Nyala

Antibiotics	Raw milk	Heated milk	Total	Chi-square	P- value
Gentamicin					
Positive	25 (25%)	32 (32%)	57	**1.999**	**0.157**
Negative	25 (23%)	18 (18%)	43		
Total	**50 (50%)**	**50 (50%)**	**100**		
Streptomycin					
Positive	19 (19%)	26 (26%)	45	**1.980**	**0.159**
Negative	31 (31%)	24 (24%)	55		
Total	**50 (50%)**	**50 (50%)**	**100**		
Neomycin					
Positive	0 (0%)	0 (0%)	0		
Negative	50 (50%)	50 (50%)	100	**No estimate**	
Total	**50 (50%)**	**50 (50%)**	**100**		

P-value > 0.05 not significant

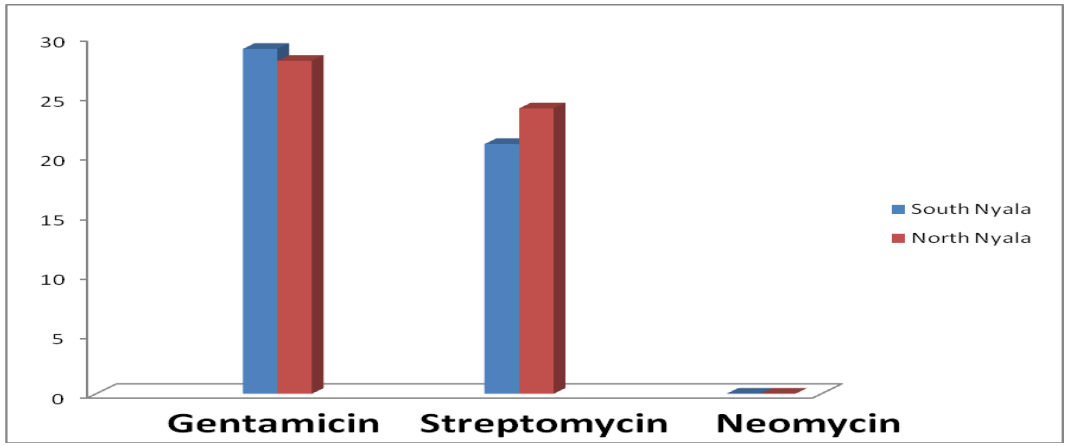

Figure 1: Occurrence of aminoglycoside residues in milk in both south and north Nyala

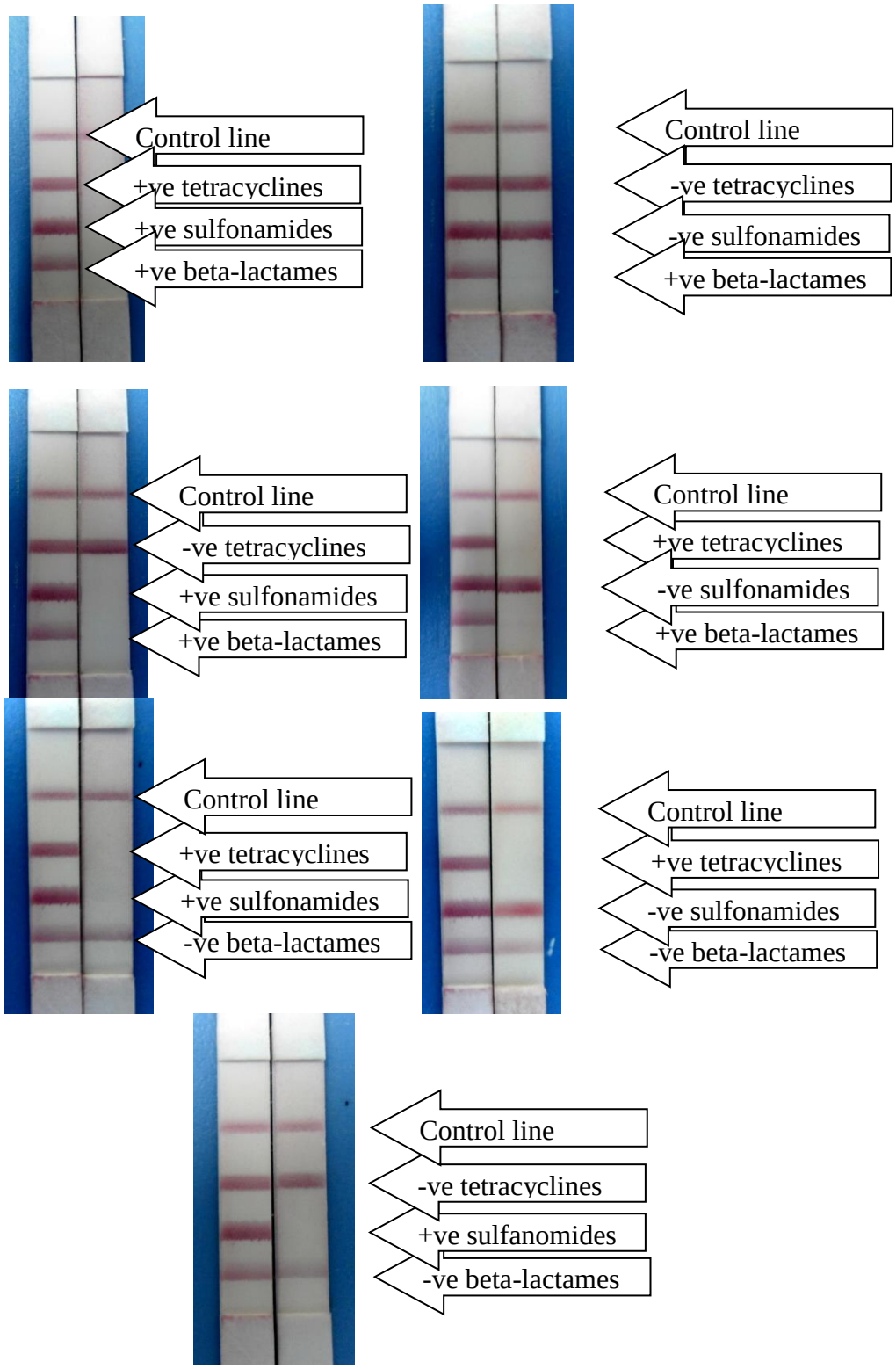

Figure 2: Comparison of the intensity of the line colour of the test line with the intensity of the line colour of the control line of the trisensor dipsticks

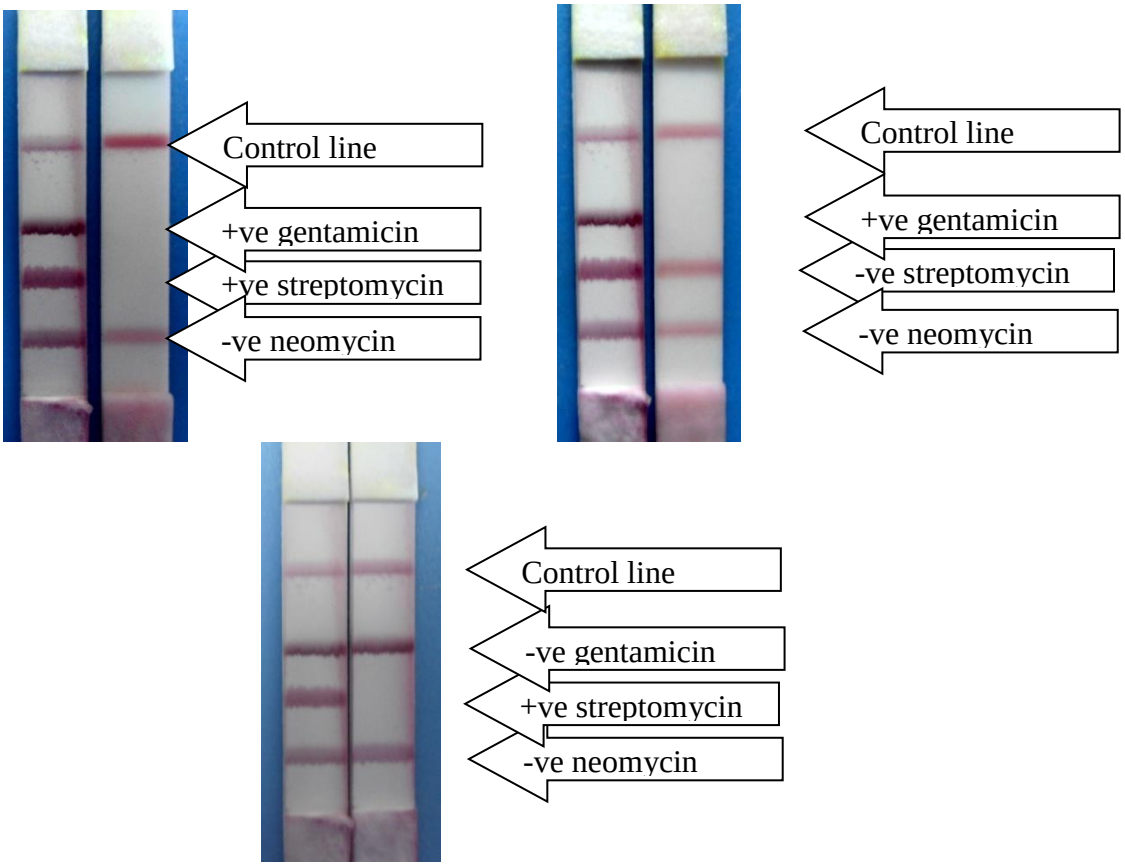

Figure 3: Comparison of the intensity of the line colour of the test line with the intensity of the line colour of the control line of triaminosensor dipsticks

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