CONSUMERS' AWARENESS REGARDING THE EFFECT OF ANTIBIOTIC USED IN ANIMAL FEED ON HUMAN HEALTH

ABSTRACT

The main objectives of the study were to determine the consumers' awareness regarding the effect of antibiotics used in animal feed on human health and to explore relationship between the selected characteristics of the respondent consumers and their awareness. The study was conducted at Mohammad Nagar residential area under Batiaghata upazila of Khulna district and Nirala residential area of Khulna City Corporation, Khulna, Bangladesh following descriptive and diagnostic type of research design. Forty respondents from each of the residential areas were interviewed as the sample of the study and data were collected through personal interview method using an interview schedule by the researcher between January–February, 2019. Most (80%) of the respondents were highly aware while only one fifth (20%) of the respondents had medium awareness about the effect of antibiotics used in animal feed on human health. Consumers were highly aware that resistance is grown in pathogenic organisms causing diseases in human body against antibiotics that were used in patient treatment; thus, resulting in treatment failure. However, consumers were less aware about allergic reaction and painful rash, which are possible with many antibiotics. The mean awareness score of the consumers residing at Nirala was higher than that of Mohammad Nagar residential area but it did not differ significantly. This might be due to proximity of the two residential areas. Among ten selected characteristics of the respondents; education, family education, annual family income, exposure to communication media, nutritional knowledge, animal protein consumption behavior and attitude showed positive significant relationship with their awareness regarding the effect of antibiotic used in animal feed on human health. Consumers in the study area are concerned about the effect of antibiotics used in animal feed on human health.

Key Words: Consumers' awareness, antibiotic, animal feed, human health.

1. INTRODUCTION

This is an established truth that human health is directly related to the surrounding environment and in particular to the nature and quality of food. Quality of food from animal products is gaining concern from public health agencies around the world since antibiotics and veterinary drugs have played an important role in the field of animal husbandry and agro-industry. At present, the occurrences of veterinary drug residues are increasing and resistance of pathogens against the drugs have become burning issues [1].

1

Antibiotics and veterinary medicinal products (VMPs) are crucial to meet the challenges of supplying sufficient quantity of food for the vast and fast-growing world population as drugs improve the rate of weight gain, improve feed efficiency, prevent and treat diseases in food producing animals [2]. The safe and effective use of antibiotics in animal production has received considerable attention in most of the countries in the world [3].Human health can either be affected by the residues of drugs in food of animal origin, which may cause direct side effects or indirectly through selection of antibiotic resistance bacteria that may spread to human [4,5,6]. Resistant microorganism can get access to human either by direct contact or indirectly through milk, meat, and egg. It is documented that drug resistant bacteria such as *Salmonella*, *Campylobacter* and *Staphylococcus* from food of animal origin were developed by human beings [5, 6].

In general, antibiotics and drugs residues have harmful effects on human health, which may be mutagenic, carcinogenic, reduction in reproductive performance, drug allergy and acute toxicity or poisoning. [1, 7, 8]. Low-level contamination of drug generally may not generate a violating problem on human health. However, extensive use of drugs may increase the risk of an adverse effect of residues on the consumer including the occurrence of antibiotic resistance. In this study an attempt has been made to find out the effects of antibiotics used in animal feed on human health and how far the consumers are aware of this issue in the selected areas of Khulna district.

The study was conducted to fulfill the following specific objectives:
  i.   To analyze the selected characteristics of the consumers.
 ii.   To determine consumers' awareness regarding the effect of antibiotics used in animal feed on human health.
iii.   To explore relationships between the selected characteristics of the consumers and their extent of awareness regarding the effect of antibiotics used in animal feed on human health.

2. METHODOLOGY

2.1 Design and Locale of the Study

The present study was a descriptive and diagnostic type of research. It was designed to study consumers' awareness regarding the effect of antibiotics used in animal feed on human health. The study was conducted at Mohammad Nagar residential area under Batiaghata upazila of Khulna district and Nirala residential area of Khulna City Corporation, Khulna, Bangladesh.

2.2 Population and Sampling

All the household heads of Mohammed Nagar and Nirala residential areas of Khulna were considered as the population of the study. Forty family heads from each of the residential areas were interviewed purposively as the sample of the study. Thus, the sampling technique was purposive and sample size stood 80.

2.3 Data Collection and Processing

The primary data were collected through face-to-face interview between January-February, 2019. Reviewing related studies, the authors considered some of the selected characters of the respondents as independent variables for the study. The characteristics were age, educational qualification, family size, family education, annual income, exposure to communication media,

81 nutritional knowledge, animal protein consumption behavior, training exposure and attitude
82 towards antibiotics used in animal feed. Consumers' awareness regarding the effect of antibiotics
83 used in animal feed on human health was considered as dependent variable in this study.

84 All qualitative data were converted into quantitative form by means of applying some
85 appropriate scoring technique (Table 1). In several instances, indices and scales were constructed
86 through the simple accumulation of score assigned to individual or pattern of attributes.
87
88 **2.3.1 Measurement of Selected Characteristics (Independent Variables)**

89 The measurement of selected characteristics (independent variables) is shown in Table 1.

90 **Table 1. Measurement of selected characteristics (independent variables)**
91

Selected characteristics (independent variables)	Measuring Unit
Age	Actual year
Educational qualification	Score 1 was given for a complete schooling year
Family size	Number
Family education	As above
Annual income	'000'BDT
Exposure to communication media	Score
Nutritional knowledge	Score
Animal protein consumption behavior	Score
Training exposure	Score
Attitude	Score (following Likert scale)

92
93 **2.3.2 Measurement of Consumers' Awareness (dependent variable)**
94 To determine consumers' awareness, five statements related to the effects of antibiotics used in
95 animal feed on human health were incorporated in the interview schedule. To determine the
96 awareness score of the respondents a five-point rating scale such as strongly agree, agree,
97 undecided, disagree and strongly disagree were employed against the five statements and a score
98 of 5, 4, 3, 2 and 1 was employed against the scales respectively. The awareness score of a
99 respondent would range from 5 to 25, where '5' indicate low awareness and '25' indicate high
100 awareness. Based on awareness score, the respondents were categorized into three groups as low
101 awareness (≤ 8), medium awareness (9-16) and high awareness (>16). To compare among
102 statements, an awareness index (AI) was calculated using following formula:

103 $AI = N_{sag} \times 5 + N_{ag} \times 4 + N_{ud} \times 3 + N_{da} \times 2 + N_{sda} \times 1$
104 Where,
105   AI = Awareness Index
106   N_{sag} = Number of respondents rated the impact as strongly agree
107   N_{ag} = Number of respondents rated the impact as agree
108   N_{ud} = Number of respondents rated the impact as undecided
109   N_{da} = Number of respondents rated the impact as disagree
110   N_{sda} = Number of respondents rated the impact as strongly disagree

The awareness index (AI) score would range from 80-400 where 80 indicates low awareness and 400 indicates high awareness on a particular statement regarding the effect of antibiotics used in animal feed on human health.

For better understanding of the relative position of the statement, the AI score was converted to percentage using following formula:

$$\% \text{ AI} = \frac{\text{Observed AI Score}}{\text{Highest Possible AI Score}} \times 100$$

2.4 Data Analysis

Data were compiled, tabulated and analyzed based on the objectives of the study. Different statistical treatments such as number, mean, standard deviation, range, minimum, maximum, rank order and percentage were used to describe the variables. To explore relationship between variables, Pearson Product and Spearman Rank Correlation Coefficients were used. Data analysis was done using the Statistical Package for Social Science (SPSS) 20.

3. RESULTS AND DISCUSSION

3.1 Facts on the Selected Characteristics of the Consumers (Respondents)

Data presented in Table 2 indicate that majority (51.3%) of the respondents was young and highest proportion (41.3%) of the respondents had secondary level of education. Highest proportion (45%) of the respondents' family had secondary level of education followed by higher secondary (27.5%) and graduate (25%). Majority (70%) of the respondents had small sized family, belonged to high income group (57.5%), had medium exposure to communication media (72.5%), had medium nutritional knowledge(61.3%) and consumed high amount of animal protein (62.5%). Most (90%) of the respondents did not receive any training on human health especially the effects of antibiotics used in animal feed on human health and had moderately favorable attitude(80%).

Table 2. Distribution of the respondents according to their selected characteristics (N=80)

Selected Characteristics	Categories	Score	Number	Percentage	Mean	SD	Min.	Max.
			Respondents (N=80)		Mean	SD	Range	
Age (Years)	Young aged	≤ 35	41	51.3	38.08	12.85	16	70
	Middle aged	36-50	24	30				
	Old aged	>50	15	18.8				
Education (Years of schooling)	Illiterate	0	0	0	12.34	3.61	1	17
	Primary	1-5	3	3.8				
	Secondary	6-10	33	41.3				
	Higher Secondary	11-12	10	12.5				
	Graduate	13-16	18	22.5				
	Post graduate	>16	16	20				
Family size (No. of	Small	1-4	56	70	4.2	0.97	2	7
	Medium	5-6	22	27.5				

(members)	Large	≥7	2	2.5				
Family education (Years of schooling)	Illiterate	0	0	0	10.21	2.69	3	15.5
	Primary	1-5	2	2.5				
	Secondary	6-10	36	45				
	Higher secondary	11-12	22	27.5				
	Graduate	13-16	20	25				
	Post graduate	>16						
Annual family income (BDT "000")	Low income	≤200	3	3.8	422.93	185.07	180	960
	Medium income	201-350	31	38.8				
	High income	>350	46	57.5				
Exposure to communication media (score)	No Exposure	0	0	0	14.63	3.94	6	23
	Low exposure	1-9	10	12.5				
	Medium exposure	10-18	58	72.5				
	High exposure	>18	12	15				
Nutritional knowledge (score)	No knowledge	0	0	0	8.84	3.05	2.5	16
	Poor knowledge	Up to 6	20	25				
	Medium knowledge	7-12	49	61.3				
	High knowledge	13-18	11	13.8				
Animal protein consumption behavior (score)	Low consumption	1-5	2	2.5	10.61	2.07	4	14
	Medium consumption	6-10	28	35				
	High consumption	>10	50	62.5				
Training exposure	Yes		8	10				
	No		72	90				
Attitude (score)	Less favorable	≤ 10	1	1.3	17.7	3.31	10	28
	Moderately favorable	11-20	64	80				
	High favorable	21-30	15	18.8				

137

Table 3. Rank order of sources of animal protein based on animal protein consumption index

Source of animal protein	APCI		Rank order
	Score	Percentage	
Egg	204	85%	2nd
Milk	195	81.25%	3rd
Chicken	210	87.5%	1st
Beef	143	59.58%	4th
Mutton	96	40%	5th

**APCI= Animal protein consumption index

Among the sources of animal protein, chicken ranked 1st (APCI= 210, percentage= 87.5%) compared to other sources of animal protein and mutton ranked last (APCI=96, percentage=40%). This might be due to the low and high market price of chicken and mutton, respectively (Table 3).

3.2 Consumers' Awareness regarding the Effect of Antibiotics Used in Animal Feed on Human Health

The computed scores of awareness of the respondents ranged from 14 to 24 with mean and standard deviation of 18.93 and 2.63 respectively. According to the scores on awareness, the respondents were distributed into three groups as shown in Table 4.

Table 4. Distribution of the respondents according to their awareness

| Categories | Score | Respondents (N=80) | | Mean | Standard Deviation | Range | |
		Number	Percentage			Min.	Max.
Low awareness	≤ 8	0	0				
Medium awareness	9-16	16	20.0	18.93	2.63	14	24
High awareness	> 16	64	80.0				

Most (80%) of the respondents were highly aware about the effect of antibiotics used in animal feed on human health. Only one-fifth (20%) of the respondents had medium awareness about the effect of antibiotics used in animal feed on human health (Table 4). Therefore, it is clear that, all the respondents were more or less aware about the effect of antibiotics used in animal feed on human health. The findings of the present study have harmony with the findings of Mallick and Mondol [9]. They conducted a study on farmers' awareness regarding deforestation at Jalma union of Batiaghata upazila under Khulna district of Bangladesh. Human health is directly related to the surrounding environment and in particular to the nature and quality of food [16]. Thus, the human being must remain aware of the consumed foods regarding high antibiotic contamination and so on.

Table 5. Rank order of the statements related to antibiotics used in animal feed and their effect on human health based on Awareness Index (AI)

| Sl. No. | Statements | AI* | | Rank Order |
		Score	Percentage	
1.	Resistance grow against the antibiotics which are used in patient treatment	327	81.75%	1st
2.	Some antibiotics can cause stomach upset and other gastrointestinal side effect	286	71.5%	4th
3.	Allergic reaction and painful rash are possible with many antibiotics	271	67.75%	5th
4.	Some antibiotics may cause cancer.	320	80.00%	2nd
5.	Many antibiotics may adversely affect human fertility	307	76.75%	3rd

** AI= Awareness Index

Data presented in Table 5 indicate that consumers were highly aware about the resistance that is grown against antibiotics which are used in patient treatment (AI=327, rank= 1st). However,

6

consumers were less aware that allergic reaction and painful rash are possible with many antibiotics (AI=271, rank= 5th).

The mean awareness score of the consumers residing at Nirala residential area (x=19.65) was higher than that of the Mohammad Nagar residential area (x=18.2). Nevertheless, it did not differ significantly (t=1.99). This might be due to proximity of the two residential areas.

3.3 Relationship between the Selected Characteristics of the Respondents and Their Awareness Regarding the Effect of Antibiotic Used in Animal Feed on Human Health

The purpose of this section is to determine the relationships of the selected characteristics of the respondents with their awareness regarding the effect of antibiotics used in animal feed on human health. The selected characteristics of the farmers included: age, educational qualification, family size, family education, exposure to communication media, nutritional knowledge, animal protein consumption behavior and attitude towards antibiotic used in animal feed. Each of the above characteristics constituted an independent variable while consumers' awareness regarding the effect of antibiotic used in animal feed on human health was the only dependent variable in this study. Relationships of the nine selected characteristics of the respondents with their awareness have been presented in the Table 6.

Table 6. Correlation between the selected characteristics of the respondents and their awareness regarding the effect of antibiotic used in animal feed on human health

Independent variable (selected characteristics)	Dependent variable (focus variable)	Correlation coefficient	Remark
Age		0.055 NS	PPCC
Education		0.520**	PPCC
Family size	Consumers' awareness regarding the effect of antibiotic used in animal feed on human health	-0.147 NS	PPCC
Family education		0.419**	PPCC
Annual family income		0.426**	PPCC
Communication media exposure		0.619**	SRCC
Nutritional knowledge		0.725**	PPCC
Animal protein consumption behavior		0.310**	SRCC
Attitude		0.663**	SRCC

NS= Non-significant, **Correlation highly significant at 1% level of probability and *Correlation highly significant at 5% level of probability, PPCC = Pearson's Product Moment co-efficient of correlation, SRCC = Spearman Rank Correlation Coefficient.

Among the selected characteristics of the respondents; education, family education, annual family income, exposure to communication media, nutritional knowledge, animal protein consumption behavior and attitude showed positive significant relationship with their awareness regarding the effect of antibiotics used in animal feed on human health. It means that education,

family education, annual family income, exposure to communication media, nutritional knowledge, animal protein consumption behavior and attitude increase awareness of consumers. Sultana et al. [10] also found similar results regarding age. The findings of the studies conducted by Hasan, Shanto and Khatun [11,12,13] have harmony with the present study regarding educational qualification. Similar result was described by Mallick and Mondol, Hasan and Hoque [9,11,14] regarding family size. The findings of the studies conducted by Hasan, Shanto and Khatun [11,12,13] have similarity with the present study regarding annual family income. Hasan, Shanto [11,12] observed similar result regarding exposure to communication media. The findings of the studies conducted by Hasan, Hoque and Jalal [11,14,15] have harmony with the present study regarding knowledge.

4. DISCUSSION

According to [17], in Bangladesh, various types of antimicrobial drugs are available in the market. Only a few companies mention the withdrawal period of their product in packet. Our farmers are not so much literate that they can think about the residual effect of antibiotics which have been developed due to continuous use of these antimicrobial drugs. Livestock producers in all parts of the world will increasingly face legislative and consumer pressures to reduce the use of antimicrobial drugs which are chemically related to antibiotics used to treat human disease.

According to [18], a cross-sectional study on the use of antibiotics in pig and poultry production as well as the farmer's knowledge on the danger of the antibiotic use in three different animal production systems (farm household, semi-industrial and industrial) on 270 entities, in 3 representative localities of the Red River Delta (RRD) region was conducted in Vietnam. The researchers found that a large volume of antibiotics was used in all animal production systems. Animals were not only treated for acute diseases, but also for disease prevention and for growth promotion. At least 45 antibiotics of more than 10 classes were used. Fifteen antibiotics were used in pig and poultry feed. For diseases treatment and prevention, antibiotics were used abusively and even illegally (e.g. chloramphenicol) by both farmers and veterinarians.

[19] carried out a study to investigate antibiotic usage in livestock management by farmers in northeast Nigeria and found that majority of the farmers administered antibiotics on their animals yearly (21%) and monthly (16%), and tetracycline (25%) and penicillin (19.5%) appeared to be the most commonly patronized antibiotics by farmers in this region. Majority of the farmers indicated sourcing their antibiotics from veterinary pharmacy shops (31%) and veterinary clinics (27.5%), and most of the farmers indicated relying on veterinary doctors for recommendation for antibiotic use (29.7%), dosage (27%) and withdrawal time (29.7%).The pattern of antibiotics use and administration observed in this survey revealed potential misuse of antimicrobials, despite the fact that more farmers relied on antibiotic prescriptions.

[20] reported that among seven countries Norway, Belgium, Sweden, Denmark, Switzerland, Austria and The Netherlands, Belgium ranked first (86%) for antimicrobial use in animals. National mechanism for data collection on antibiotic use is lacking amongst many countries, as pharmaceutical industries seem to treat production and sales figures as confidential business information. [21] found that the maximum veterinary residue limits for tetracycline, oxytetracycline, streptomycin, gentamicin, sulphonamides, quinolones, among others, to be 100, 100, 200, 200, 100 and 75 µg/kg respectively. Antibiotics used in livestock and poultry are similar in mechanism to antibiotics used in humans and have the substantial potential to trigger cross-resistance [22].

239 Commonly used antibiotics in animal feed arestreptopenicillin, benzyl penicillin, enroflaxocin,
240 amoxicillin, ampicillin, sulfa-trimethoprim, tylosin, sulfamethoxazole, oxytetracycline,
241 doxycycline, colistin sulfate, neomycin,tetracycline, tylosin, enrofloxacin, ciprofloxacin,
242 amikacin and tilmicosin Infectious zoonotic agents, as well as non-zoonotic diseases that are
243 affecting livestock, are commonly treated with antibiotics. The most used and commonly
244 reported antibiotics were tetracycline, sulphadimidines and penicillin-streptomycin [23].

245 [24] reported that the use of antimicrobial drugs in large amounts and consistently could result in
246 deposition of antimicrobial residues in muscle and organs of animal. Consumption of these
247 residues in animal products (especially through meat and meat products) may cause health risk to
248 consumers including development of antibiotic resistance and hypersensitivity reaction.
249 Approximately 4-11% of the human population are believed to be allergic to penicillin and
250 related drugs [25], therefore exposure to this drug class via food animal residues puts them at
251 risk for developing allergic reactions that may range from minor reactions such as a skin rash to
252 severe anaphylaxis. Although the true incidence/prevalence and mortality associated with drug
253 induced anaphylaxis is unknown in western countries, several epidemiological studies
254 investigating penicillin and anesthetic agents given during the perioperative period showed these
255 drugs were associated with allergic anaphylaxis [25].

256 **5. CONCLUSION**

257 Based on the finding of the study and its scientific interpretation it can be concluded that most of
258 the respondents were highly aware about the effect of antibiotic used in animal feed on human
259 health. Only one-fifth of the respondents had medium awareness about the effect of antibiotic
260 used in animal feed on human health. Consumers were highly aware about that resistance is
261 grown in pathogenic organisms causing diseases in human body against antibiotics which are
262 used in patient treatment resulting in treatment failure. But consumers were less aware about
263 allergic reaction and painful rash which are possible with many antibiotics. The mean awareness
264 score of the consumers resided at Nirala residential area was higher than that of the Mohammad
265 Nagar residential area but it did not differ significantly. This might be due to proximity of the
266 two residential areas. Among the selected characteristics of the respondents; education, family
267 education, annual family income, exposure to communication media, nutritional knowledge,
268 animal protein consumption behavior and attitude showed positive significant relationship with
269 their awareness regarding the effect of antibiotic used in animal feed on human health.

270 In pursuit of the findings and observations, it is clear that the consumers in the study area are
271 concerned about the effect of antibiotic used in animal feed on human health. Government and
272 the producer should develop new strategies for a prudent use of antibiotics in food producing
273 animals to ensure food safety.

274 **REFERENCES**

275 1. Beyene T. Veterinary drug residues in food-animal products: its risk factors and potential
276 effects on public health. Journal of Veterinary Science & Technology. 2016;7:285.
277 DOI:10.4172/2157-7579.1000285.

278 2. Jayalakshmi K,Paramasivam M, Sasikala M, Tamilam TV, Sumithra A. Review on antibiotic
279 residues in animal products and its impact on environments and human health. Journal of
280 Entomology and Zoology Studies. 2017;5(3):1446-1451.

281 3. Swatantra S, Shukla, Tandia N, Nitesh K, Paliwal R. Antibiotic Residues: A global
282   challenge. Pharma Science Monitor. 2014;5(3):184-197.

283 4. Hassali MA, Ho RY, Verma AK, Hussain R, Sivaraman S. Antibiotic use in food animals:
284   Malaysia overview. School of Pharmaceutical Sciences, University Sains Malaysia, 11800
285   Minden, Penang, Malaysia; 2018. ISBN 978-967-13914-8-8;https://www.reactgroup.org/wp-
286   content/uploads/2018/11/Antibiotic_Use_in_Food_Animals_Malaysia_Overview_2018web.
287   pdf.

288 5. Chang Q, Wang W, Regev-Yochay G, Lipsitch M, Hanage W P. Antibiotics in agriculture
289   and the risk to human health: how worried should we be? Evolutionary Applications.
290   2014;8:240-247.

291 6. Landers TF, Cohen B, Wittum TE, Larson EL. A review of antibiotic use in food animals:
292   perspective, policy, and potential. Public Health Report. 2012;127:4-22.

293 7. Prajwal S, Vasudevan VN, Sathu T, Irshad A, Nayankumar SR, Pame K. Antibiotic residues
294   in food animals: Causes and health effects. The Pharma Innovation Journal. 2017;6(12):01-
295   04.

296 8. Falowo AB, Akimoladun OF. Veterinary drug residues in meat and meat products:
297   occurrence, detection and implications; 2019. DOI: org/10.5772/intechopen.83616.
298   https://www.intechopen.com/online-first/veterinary-drug-residues-in-meat-and-meat-
299   products-occurrence-detection-and-implications.

300 9. Mallick A, Mondol S. Farmers' awareness regarding deforestation at Jalma union of
301   Batiaghata upazilla under Khulna district of Bangladesh. B.Sc. Ag. (Hons.) Thesis,
302   Agrotechnology Discipline, Life Science School, Khulna University, Khulna; 2017.

303 10. Sultana H, Sultana N, Ahmed DMB, Islam MR. Farmers' awareness about Bangladesh
304   agricultural research institute (BARI) innovated agricultural machineries: a case study of
305   Meherpur district. The journal of rural development.2012;37(2):91-105.

306 11. Hasan MM. Use of organic manure: farmers' awareness and environmental consideration.
307   M.S. Thesis, Department of Environmental Science, Bangladesh Agricultural University,
308   Mymensingh; 2008.

309 12. Shanto HH. Awareness of the farmers on environmental pollution due to use of pesticides in
310   vegetable cultivation. M.S. (Ag. Ext. Ed.) Thesis, Department of Agricultural Extension
311   Education, Bangladesh Agricultural University, Mymensingh; 2011.

312 13. Khatun H. Farmers' awareness about the impact of using pesticide on environment at
313   Iswaripur union under Shyamnagar upazilla of Satkhira district. B.Sc. Ag. (Hons.) Thesis,
314   Agrotechnology Discipline, Life Science School, Khulna University, Khulna; 2017.

315 14. Hoque MK. Environmental awareness and problem confrontation of the FFS farmers in
316   practicing IPM. M.S. (Ag. Ext. Ed.) Thesis, Department of Agricultural Extension Education,
317   Bangladesh Agricultural University, Mymensingh; 2001.

318 15. Jalal MS. Farmers' awareness of the use of indigenous technical knowledge (ITK) for
319   sustainable agricultural development. M.S. (Ag. Ext. Ed.) Thesis, Department of Agricultural
320   Extension Education, Bangladesh Agricultural University, Mymensingh; 2009.

16. Segneanu A, Grozescu I, Cepan C and Velciov S. Significance of food quality on human health. Applied Food Science Journal. 2018; 2(2): 17.

17. Chowdhury R, Haque MN, Islam KMS, Khaleduzzaman ABM. A review on antibiotics in an animal feed. Bangladesh Journal of Animal Science. 2009;38(1&2): 22 – 32.

18. Kim DP, Saegerman C, Douny C, Dinh TV, Xuan BH, Vu BD, Hong NP, Scippo ML. First survey on the use of antibiotics in pig and poultry production in the Red River Delta region of Vietnam. Food and Public Health. 2013; 3(5): 247-256. DOI: 10.5923/j.fph.20130305.03.

19. Mamza SA, Geidam YA, Mshelia GD, Egwu GO. Antimicrobial usage in livestock management in North-eastern Nigeria: A survey of livestock farmers. International Journal of Science and Research Methodology. 2017;8(2): 149-172.

20. Chantziaras I, Boyen F, Callens B, Dewulf J. Correlation between veterinary antimicrobial use and antimicrobial resistance in food-producing animals: a report on seven countries. Journal of Antimicrobial Chemotherapy. 2014; 69: 827 – 834. DOI: 10.1093/jac/dkt443.

21. Nisha AR. Antibiotic residues—A global health hazard. Veterinary World. 2008;1(12):375-377.

22. Marshall BM, Levy SB. Food animals and antimicrobials: Impacts on human health. Clinical Microbiology Reviews. 2011;24(4): 718–733.

23. Prajwal S, Vasudevan VN, Sathu T, Irshad A, Nayankumar SR, Pame K. Antibiotic residues in food animals: Causes and health effects. The Pharma Innovation Journal. 2017;6(12): 01-04.

24. Vragovic N, Bazulic D, Njari B. Risk assessment of streptomycin and tetracycline residues in meat and milk on Croatian market. Food and Chemical Toxicology. 2011;49:352-355.

25. Dayan AD. Allergy to antimicrobial residues in food: assessment of the risk to man. Veterinary Microbiology. 1993;35 (3-4): 213-326.

26. Thong BY, Tan TC. Epidemiology and risk factors for drug allergy. British Journal of Clinical Pharmacology. 2011; 71(5): 684-700.