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Effect of Antibiotics Overuse in Animal Food and its Link with Public Health Risk

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ABSTRACT

Antibiotics are a group of antimicrobial substances that are used in treatment of bacterial infections and prevent diseases. Use of antibiotics in poultry have been observed since 1940, the purpose of the usage was initially for treatment of infection but gradually taking this drug increased dramatically in animal husbandries especially in poultry in the second half of the twentieth century for increasing economic benefits because these antibiotics have ability to work as hormone growths. Meanwhile at the end of the century, more than 70 percent of all produced antibiotics consumed in animal husbandries.. Overuse and abuse of these medications in poultry have dangerous effect on human health as consumers of these products because of strong relationship between use of antibiotic in animal food and it's resistance in human's body. In this paper we focused on different types of antibiotics used in poultry and discussed possible overuse of antibiotics in animal husbandries which result in threatening human health in order to encourage establishing organizations Supporting Restrictions on the Use of antibiotics in animal husbandries to save human health in this order.

Keywords: Antibiotics, Overuse, Animal Husbandries, Antibiotic Resistance, Human Health

I. INTRODUCTION

An antibiotic is a substance that erase or slows the bacteria growth. There are various types of antibiotics that are playing role in destroying bacteria in different ways. The antibiotics belonging to the same class generally possess similar mechanism of action, effectiveness, resistance and the same target (bacteria 's type).Antibiotics are classified into two groups base on their spectrum for treating range of infections : broad – spectrum antibiotics and narrow-spectrum antibiotics which treat inclusive range of infection and limited range of infection respectively.[1-3] Antibiotics used in animal food are classified in to following major groups:

Aminoglycosides: Aminoglycosides are derivation of different species of Streptomyces bacteria. Their mechanism of action is blocking the proteins vital synthesis to bacterial growth. These antibiotics persist in digestive tract so are active and useful in enteric infections treatmnet. Examples include spectinomycin, and streptomycin, neomycin, gentamycin [1-3]

Bambermycins : Bambermycins are derivation of Streptomyces bambergiensis. Their mechanism of action is inhibition of bacterial cell wall synthesis. Examples are bambermycin and flavophospholipol,

Beta-Lactams: This class include Pencillins and cephalosporins as two major classes.

Penicillins : This antibiotics was the first one to be discovered and derived from the mod Penicillium notatum. Their mechanism of action is inhibition of bacterial cell wall formation. Examples are Amoxicillin and ampicillin. Penicillins are useful in the treatment of sinusitis and chronic respiratory disease in poultry.

Cephalosporins : This group are structurally close to penicillins. This class is classified into three generations which possess a large spectrum of action than the one before (first, second and third generation).

Glycopeptides: Activity of this class is done by interrupting with protein synthesis as well as cell-wall formation. The only member of this class which is available in US is Vancocin which is effective for MRSA infections in humans. FDA-CVM issued an

order regarding prohibiting extra lable use of this class in food animals in 1997.

Ionophores : This class of antibiotics are effective for treatment of coccidiosis which is a disease in poultry and caused by Eimeria(Protozoan Parasite) invading poultry intestine's cells. This class are not used in human medicine and are used as antimicrobial in poultry.

Lincosamides : Lincosamides are derived from Streptomyces lincolnensis. This class shows the same antimicrobial activity (effect) with Macrolides, although they are structurally different. Lincomycin has effective activity against bone and joint infections, as well as necrotic enteritis caused by Clostridium perfringens.

Macrolides: Macrolides are derivation of the Streptomyces bacteria and their mechanism of action is interrupting in protein synthesis.

Polypeptides : Polypeptides are effective against bacilli..

Quinolones : Fluoroquinolones are not derived from bacteria or fungi but are synthetic antibiotics. Their mechanism of action is prevention of DNA replication of bacteria.Examples include enrofloxacin, danofloxacin, flumequine, norfloxacin, and difloxacin. Fluorquinolones are effective against colibacillosis, fowl cholera, salmonellosis,, and Pseudomonas aeruginosa infections. Baytril (enrofloxacin; This drug is prohibited for animal use in the United States.)

Streptogramins : Streptogramins are derived from Streptomyces species and made of two structurally unrelated molecules. One inhibits protein synthesis, and the other, cell-wall formation.. The drug virginiamycin is a streptogramin that has effective activity against necrotic enteritis.

Sulfonamides (sulfa drugs): Sulfonamides are developed by chemical synthesis.. Their mechanism of action is interfering with RNA and DNA, which are essential for cell growth and replication. Sulfonamides, such as trimethoprim, are effective against Salmonella, Staphylococcus species, Pasteurella,, E coli and. Streptococcus species,

Tetracyclines : Tetracyclines are produced by the bacteria Streptomyces. Their mechanism of action is prevention of bacteria from multiplication while the host animal's immune system copes with the original infection. Examples are chlortetracycline (Aureomycin) and oxytetracycline (Terramycin).[1-4]

II. METHODS AND MATERIAL

The Overuse of Antibiotics in Food Animals and its effect on public health

The use of antibiotics has been observed since 1940s which resulted in a broad reduction in diseases and death from infections. But from other aspect, according to the federal Interagency Task Force on Antimicrobial Resistance, overuse of these antibiotics has led to drug(antibiotic) resistance that threatens public health. So since antibiotic use has been observed widely and for so long. Antibiotics resistance has become a major public health risk. [5-6]. As a feedback, there has been a united effort by the Centers for Disease Control and Prevention(CDC) and other organization to excite doctors and patients to use antibiotics more carefully. Unfortunately less progress has been observed for reduction of antibiotics use on farms, where most of these antibiotics are used. Approximately 80 %of the antibiotics sold in the United States are administrated in meat and poultry production. The broad mass is used on healthy (not ill) animal for promotion of growth or prevention of disease in unsanitary or crowded conditions. The main question raised from above note is that can antibiotic abuse in animals stimulate the evolution of hardened-to-cure antibiotic-resistant superbugs that cause people sick? And if it can, are the diseases rare existences and the risk theoretical, or could current use of antibiotics in animal cause a serious threat to human health. Consumers Union has concluded that overuse of antibiotics in animal food and its link with public health threat is evident and growing. [7-8].Human's health is at the risk due to potential occurrence of strong viruses in meat and poultry and to the general transfer of strong viruses (superbugs) into the environment, where they are able for transmitting their genetic immunity to antibiotics to other bacteria, including bacteria that make people infected. Diverse health organizations like the American Public Health Association, American Medical Association,, Infectious Disease Society of America, and the World Health Organization comply and have alarmed for serious reductions in antibiotics use in animal. Conclusion of scientific qualified organizations for more than two decades showed that there is a link between use of antibiotics in animals and less effectiveness of these antibiotics in human medicine. In 1988, one conclusion

by the institute of Medicine has been shown that according to the obtained data, there is a flow of distinct salmonella clones from farm animals treated with antibiotics, through food products, to humans, who gain clinical salmonellosis. After ten years, the National Research Council showed a conclusion that there is a relationship between antibiotic use in animal food, evolution of resistant bacteria in those animals and zoontic spread of pathogenic microorganisms to human. In 2003, the World Health Organization in association with FDA and OIE demonstrated one conclusion that there is a clear documentation of adverse human health consequences including infections due to resistant microorganisms developing from non-human use of antibiotics. In 2010, the U.S. FDA,U.S. Department of Agriculture, and the CDC all announced before Congress that there is a link between the general use of antibiotics for production of meat and the reducing effectiveness of antibiotics for human.[9-11]. In 2012, the FDA announced that abuse and overuse of antibiotics cause selective evolutionary pressure that lead to increasing ability in number rapidly of antimicrobial resistant bacteria than antimicrobial susceptible bacteria thus increases the opportunity for people to become infected by resistant microorganisms.[12].Nevertheless, the argument of the livestock industry continues that it is not an important issue for human health and little change in present practices are required. In addition to above expert attitudes about effect of antibiotics on human health, different studies also supported this opinion. For example. *When superbugs enter the farm, they mostly move from farm to the kitchen via uncooked poultry and meat. Some reports on chickens in 2006 and 2010 showed widespread occurrence of antibiotic resistant microorganisms in retail poultry products, in both years, contamination with Salmonella* and/or *Campylobacter was found about more than two thirds of the samples* in which about 60% of those pathogens were resistant to one or more antibiotics. Although there was an argument by industry that there is no any concern on it because people have knowledge of cooking poultry carefully. Although they do it well but dripping packages in the refrigerator or contamination of cutting boards and other problems support previous opinion of antibiotic effect on human health. Also scientists showed that 20 % of examined chicken breast samples contained -resistant *Camplobacter* in 1999(this bacteria cause a disease). Finally after along arguments in the courts, FDA blocked use of the ciprofloxacin in 2005 and after this action in 2010, the resistance to this antibiotic decreased to 13.5 percent while it was nearly 30 percent in 2005. Generally during feeding antibiotics to animals, bacteria (Pathogenic Microorganisms) in and around them are exposed to the antibiotic, and most of them killed by it. But there are always some bacteria that do not kill by the drug and survive and multiply.Voila, superbugs. [13-17]Some of these survived microorganism infect people some not but generally there are two ways through which infection is done one is direct way, in meat and poultry products and the other one is an indirect way through the environment.One another report for supporting this issue is that a strain of *Salmonella* resistant to four different antibiotics, ampicillin, streptomycin, tetracycline and gentamicin caused about 136 illness and one death in turkey in 2011. Another report was occurred in New England in 2011 linked to 19 infections and seven hospitalization at least due to by a strain of *Salmonella* resistant to multiple antibiotics, including sulfisoxazole, ampicillin, cefoxitin, ceftriaxone,, kanamycin, streptomycin, and amoxicillin/clavulanic acid found in ground beef from the Hannaford grocery store chain.Via environmental transmission, spread of superbugs beyond farm is possible which threaten public health. This transmission and infection can occur in different routes, especially via farm runoff or workers. Farm born superbugs can transfer their genetic material to other bacteria and make them resistant too. This event can occur in many places like in human digestive tract, wild animal or lakes. In comparison to other colony members, the workers are more likely to transfer resistant bacteria from animal to elsewhere. For example one study demonstrated that poultry workers in the Delmarva peninsula were 32 times more likely for carrying gentamicin-resistant Escherichia coli *and more than 5 times more likely for carrying multi antibiotic resistant* E.Coli *in comparison with other colony member*s. One more case in Midwest demonstrated that there is possibility for resistant bacteria like methicillin-resistant *Staphylococcus aureus* (MRSA) in which the resistant *Staphylococcus aureus* evolved in human and jumped into pigs where it obtained resistance to the

antibiotics like methicillin and tetracycline and then gone back to human where it called livestock-associated MRSA (LA-MRSA).Additionally, escaping of resistant bacteria can also happen from a large livestock operation (CAFO) via various ways like fertilizers, flies attracted to the fertilizer, wind leaving hog facilities and trunks transporting animals. Exchange of genetic material for antibiotic resistance is possible between bacteria and their neighboring bacteria. Some times in some cases gene coding for antibiotics resistance are available on mobile genetic elements like plasmids, transposons and integrons which can do easily movement between bacteria of the same or different class or species which in turn do facilitation of spreading antibiotic resistance by multiple species of bacteria.[18-23]

III. RESULT AND DISCUSSION

Use of antibiotics in animal food poses a risk to human health. Antibiotic use causes promotion of superbugs development and proliferation which result in contamination of meat and poultry and in turn lead in hard to treat illness in human which make human health at risk. Although poultry industry argues that antibiotics are used in poultry they are not used in human medicine and not harmful for human but various health organizations supported this opinion and examined different studies in support of use of antibiotics lead in human health risk. This infection can appear in direct or indirect routes and superbugs can exit via wildlife. Farm workers. Wind and run off. May be they do not immediately cause infection and disease but they are able to exchange their genetic material via plasmids with other bacteria and make them antibiotic resistance. This knowledge and awareness of ability of superbugs to threat human health via exchanging genetic material and make other become resistance to multiply antibiotics help poultry industries and other related industries to be careful in management antibiotic use in their production which is very important to save human health. For this reason that FDA and public health community proposed limitation on use of antibiotics in animal food for more than three decades. Of course we should pay attention and make action on decreasing antibiotic use in animal foods to prevent disease in both animal and human and prevent from antibiotic resistance problems to treat emerging diseases easily and do not face hard to cure diseases in human.

IV. CONCLUSION

Overuse and abuse of antibiotics pose a risk to human health. Promotion of development of superbugs which cause contamination of meat and poultry and hard to treat disease in human evolved by abuse of antibiotics. Hence public health community and FDA and other organizations proposing limit use and correct use of antibiotics in poultry and meat production in order to control harmful effect of this abusing to save human health. In addition to it, for reduction of hard cure disease in human which arise from animal food, knowledge of correct use and limit use of antibiotic help people to have a safe and healthy life both for themselves and animal too.

V. REFERENCES

[1] The Merck Manual of Medical Information. Mark H. Beers et al., eds. 2nd Home Edition. Whitehouse Station, NJ: Merck; 2003.

[2] Antibiotics: MedlinePlus. U.S. National Library of Medicine

[3] Physicians' Desk Reference. 59th ed. Montvale, N.J.: Thomson PDR, 2005.

[4] Waksman SA. Mycologia Vol. 39, No. 5 (Sept.-Oct. 1947): 565-569.

[5] Timothy F. Landers, Bevin Cohen, Thomas E. Wittum, Elaine L. Larson, A Review of Antibiotic Use in Food Animals: Perspective, Policy, and Potential Public Health Rep. 2012 Jan-Feb; 127(1): 4–22.

[6] Pg 5 in Interagency Task Force on Antimicrobial Resistance, 2012. A Public Health Action Plan toCombat Antimicrobial Resistance. Washington, D.C

[7] Pg 5 in American Farm Bureau Federation et al June 12, 2012 letter to Congressperson Slaughter

[8] Pg. 2 in Institute of Medicine (IOM). 1988. Human Health Risks with the Subtherapeutic Use of Penicillin or Tetracyclines in Animal Feed. National Academies Press. Washington, D.C.

[9] Pg. 6 in IOM. 1998. The Use of Drugs in Food Animals: Benefits and Risks. National Academies Press. Washington, D.C.

[10] Pg. 1 in WHO/FAO/OIE. 2003. Joint FAO/OIE/WHO Expert Workshop on Non-Human Antimicrobial Usage and Antimicrobial Resistance: Scientific assessment, Geneva, December 1-5, 2003.

[11] Hearing: Antiobiotic Resistance and the Use of Antibiotics in Animal Agriculture, Subcommittee on
[12] Health, Energy and Commerce Committee, U.S. House of Representatives, July 12, 2010
[13] Pg. 738 in FDA. 2012. New Animal Drugs; Cephalosporin Drugs; Extralabel Animal Drug Use; Order of Prohibition. Federal Register, Vol. 77(4)
[14] Consumer Reports, 2010. How safe is That Chicken. January 2010, pp. 19-23. Consumers Union.
[15] Centers for Disease Control (CDC). 2011. Investigation Update: Multistate Outbreak of Human Salmonella Heidelberg Infections Linked to Ground Turkey.
[16] Food and Water Watch. 2012. Antibiotic Resistance 101: How Antibiotic Misuse on Factory Farms Can Make You Sick. 21pp.
[17] Consumer Reports, 2007. Dirty Birds. January 2007, pp. 20-23. Consumers Union.
[18] CDC. 2012. Investigation Update: Multistate Outbreak of Human Salmonella Typhimurium infections Linked to Ground Beef.
[19] Price LB, Graham JP, Lackey LG, Roess A, Vailers R and E Silbergeld. 2007. Elevated risk of carrying gentamicin-resistant Escherichia coli among U.S. poultry workers. Environmental Health Perspectives, 115(12): 1738-1742.
[20] Van Loo I, Huijsdens X, Tiemersma E, de Neeling A, van de Sande-Bruinsma N, Beaujean D, Voss A and J Kluytmans. 2007. Emergence of methicillin-resistant Staphylococcus aureus of animal origin in humans. Emerging Infectious Diseases, 13(12): 1834-1839.
[21] Price LB, Stegger M, Hasman H, Aziz M, Larsen J, Andersen PS, Pearson T, Waters AE, Foster JT et al. 2012. Staphylococcus aureus CC398: Host adaptation and emergence of methicillin resistance in livestock. mBio, 3(1): e00305-11 At
[22] Smith TC, Male MJ, Harper AL, Kroeger JS, Tinkler GP, Moritz ED, Capuano AW, Herwalt LA and DJ Diekema. 2009. Methicillin-resistantStaphylococcus aureus (MRSA) strain ST398 is present in midwestern U.S. swine and swine workers. PLoS One, 4(1): e4258.
[23] Rule AM, Evans SL and EK Silbergeld. 2008. Food and animal transport a potential source of community exposure to health hazards from industrial farming (CAFOs). Journal of Infection and Public Health, 1(1): 33-39.
[24] Chee-Sanford JC, Mackie RI, Koike S, Krapac IG, Lin Y-F, Yannarell AC, Maxwell S and RI Aminov. 2009. Fate and transport of antibiotic residues and antibiotic resistance genes following land application of manure waste. Journal of Environmental Quality, 38(3): 1086-1108.