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Continuing Education Article

Rational Use of Drugs in Broiler Meat Production

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ABSTRACT

Poultry play a pivotal role in bridging the protein gap of animal origin in most countries of the world. Besides, prophylactic vaccination programmes, poultry production in Pakistan largely depends upon the use of antibiotics, coccidiostats and arsenicals. Due to indiscriminate use and unawareness of the withdrawal periods of drugs, the treated birds (broilers) are known to possess their residues in meat. Such meat is undoubtedly unfit for human consumption and poses serious threats to consumers' health. This paper describes the antibiotics/drugs commonly used in broiler production, factors leading to the occurrence of residues, potential hazards to human health, and their possible solutions.

Key Words: Drug residues; Broiler meat production; Rational use of drugs

INTRODUCTION

Of the many foods obtained from land and sea, man tends to have a preference for animal products such as meat, milk, eggs and fish. Meat holds an important position in our daily diet. It provides palatability and is a good source of essential amino acids, vitamins and minerals. Being an Islamic country, meat of only 'halal' animals is consumed in Pakistan. Among the most preferred are chicken, mutton and beef. Others are camel, fish, game animals and birds. The present discourse overviews the antibiotics/drugs used in broiler production, factors leading to the occurrence of drug residues, potential hazards to human health, and their possible solutions.

MEAT PRODUCTION

It is estimated that in the year 1998–99, 963,000 tons of beef, 633,000 tons of mutton, 297,000 tons of poultry and 539,000 metric tons of total marine inland fish were produced in the country and poultry sector has grown by 2.7% over the previous year (Anonymous, 1998–99). Moreover, the demand and consumption of poultry meat (broiler meat) has also increased over the last few years. In 1990, broiler meat was 12% of the total meat produced, while in the year 2,000, it is expected to be 25% of the total meat produced in the country (Ajmal, 1990). The increase in broiler meat demand and consumption is attributed to rapid production rate, availability all around the year and white meat concept.

BROILER MEAT PRODUCTION

Broilers are available from the hatcheries in the form of day-old chicks. These are grown on special feed during their life span. Of the feed ingredients, macro-feeding stuffs include cereals, pulses, poultry by-products, oilseeds, fish and fish by-products, whereas micro-feeding stuffs comprise antibiotics, coccidiostats, arsenicals, vitamins, and minerals. (Tables I & II)

USE OF POULTRY OFFALS IN POULTRY FEEDS

In the poultry rations, waste products from poultry slaughter are added as a cheap source of proteins. These include blood, feathers and offals. Their proportion in the feed varies from 5 to 10% (Feltwell & Fox, 1979). The basic purpose is to enhance the protein content and to reduce environmental pollution as well as cost of production. These offals may contain certain unknown and unidentified toxic substances. These may find their way into the meat through recycling and thus become responsible for serious health hazards to human beings.

Table I. Specimen formulation for broiler diet
(Feltwell & Fox, 1979)

Ingredients	Broiler Starter (%)	Broiler Finisher (%)
Maize	25.0	12.5
Wheat	46.3	55.0
Barley	–	5.2
Fish meal	10.0	7.5
Soybean meal	12.5	13.7
Meat and bone meal	2.5	2.5
Dried distiller solubles	1.2	2.2
Fat	1.0	2.2
Methionine	0.064	0.056
Lime stone	1.0	0.9
Salt & Vitamin. Supplement	0.5	0.5
Feed additives (Antibiotics & Coccidiostats)	+	+

In UK, recently bovine spongiform encephalopathy (BSE) or mad cow disease has emerged as a serious

problem. It has been related to the use of bovine offals, which contain the disease transmissible agent (TSE), in the cattle feed. The scientists have been trying to correlate BSE with CJD (Creutzfeldt–Jakob disease) in human beings (Muhammad, 1996).

COMMONLY USED DRUGS/ANTIBIOTICS IN BROILER PRODUCTION

Arsenicals, chloramphenicol, chlortetracycline, danofloxacin, enrofloxacin, erythromycin, flumequine, furazolidone, gentamicin, kanamycin, monensin, norfloxacin, oxolonic acid, oxytetracycline, penicillin, sulphaquinoxaline, and trimethoprim are to name a few of the drugs commonly used in poultry production (Athar & Ahmad, 1996).

Table II. Macro-feeding stuffs in alphabetical order (Feltwell & Fox, 1979)

Ingredients	Quantity (%)	Ingredients	Quantity (%)
Barley feed or bran	4.0 – 5.0	Beans	2.5 – 10.0
Blood meal	1.0 – 2.0	Coconut meal	2.5 – 30.0
Chickpeas	5.0 – 20.0	Feather meal	2.0 – 10.0
Liver meal	1.0 – 5.0	Maize	10.0 – 70.0
Meat meal	2.5 – 10.0	Oats	25.0 – 30.0
Offals	2.0 – 10.0	Poultry waste	5.0 – 10.0
Rice meal	5.0 – 40.0	Soybean	10.0 – 40.0
Sunflower meal	5.0 – 10.0	Wheat	20.0 – 60.0

USE OF ANTIBIOTICS IN THE BROILER FEED

Antibiotics are used in the poultry feed:

1. to protect the birds from different diseases;
2. to promote growth of the birds;
3. to improve feed conversion ratio (FCR);
4. to increase weight gain; and
5. to maximise economic returns from the individual bird.

However, these are also being misused. According to Khan (1975), the antibiotic abuse occurs when these are:

1. used unnecessarily;
2. over prescribed;
3. employed in wrong combination;
4. changed quickly over to the other drugs;
5. used persistently;
6. given in inadequate dosage;
7. given in self-medication;
8. used for preventive purposes; and
9. employed as unauthorised.

Due to above-mentioned practices, antibiotic residues accumulate in various body tissues like muscles, liver and kidney (Ayres & Kraft, 1969) and eggs (Blom, 1975) of birds. The main sources of antibiotic residues in broiler meat are the therapeutic and growth promoting antibiotic drugs (Coulson, 1984). The residue may remain in the tissues if proper withdrawal period is not provided before slaughtering the bird, hence will reach the consumer (Table III).

Table III. Drug residues and withdrawal periods of some commonly used antibiotics

Antibiotics	Residue	Withdrawal period
	mg/kg	Days
Penicillin	0.06	5
Streptomycin	0.30	–
Bacitracin	0.05	–
Oxytetracycline	0.05	7
Trimethoprim	–	10

FACTORS LEADING TO THE OCCURRENCE OF ANTIBIOTICS RESIDUES IN ANIMAL PRODUCTS

Muhammad *et al.* (1997) has enumerated the following factors leading to the occurrence of antibiotic residues in animal products:

1. Failure to observe drug withdrawal period
2. Extended usage or excessive dosages of antibiotics
3. Non-existence of restrictive legislation or their inadequate enforcement (this is single most important reason for the apparent widespread violated levels of antibiotic residues in milk and meat in Pakistan)
4. Poor records of treatment
5. Failure to identify treated animals
6. Lack of advice on withdrawal periods
7. Off-label use of antibiotics
8. Availability of antibiotics to lay persons as over-the-counter drugs in the developing countries
9. The addition of antibiotics as milk preservatives during hauling from the centre of production (villages) to the centres of consumption (cities or factories)
10. Lack of consumer awareness about the magnitude and human health hazards associated with antibiotic residues in the food of animal origin

The most important of these factors, from the tissue residue's point of view, is strict adherence to the prescribed withdrawal period of the drug before the bird is sent to market for human consumption. Under the prevailing conditions in Pakistan, it is very much possible for birds to be sent for slaughter with residues of antibiotics in their tissues. Cooking and or cold storage will act as minimal safeguards in destroying the antibiotic residues that are present in edible tissues. When the antibiotic residues enter the human body through consumption of meat, these cause resistance in some enteric bacteria such as *Salmonella* and *E. coli* (Ladefoged, 1996). The resistance development in these enteric bacteria may result in serious problems in human beings like stomach pain, diarrhoea, pyrexia, vomiting, enteric fever, food poisoning, hypersensitivity, super-infections, abnormal development of teeth and bones,

bone marrow depression and aplastic anaemia.

In order to counteract these problems a concept of clean agriculture is developing. A number of countries e.g., Sweden, Denmark, Finland and Germany have taken steps forward to prohibit the use of antibiotics in the broiler feed (Best, 1996).

ANTICOCCIDIALS/COCCIDIOSTATS IN BROILER PRODUCTION

These drugs are used to control coccidial (*Eimeria*) infection called coccidiosis in poultry. The most important group of drugs employed for this purpose is sulphonamide that has been used prophylactically for many years to prevent coccidiosis. As a consequence, the enteric bacteria in poultry have been exposed to selective pressures. The application of sulphonamide group of anticoccidials in the broiler feed has led to the emergence of resistant *E. coli*. Moreover, this resistance has caused development of *E. coli* strains resistant to tetracycline and streptomycin (Fenlon, 1984). The development of *E. coli* resistance in the broilers may lead to the development of resistant *E. coli* in human gut through handling the chicken carcass and via food chain. The residues of sulpha drugs in the broiler tissues and organs have been studied at the Department of Physiology and Pharmacology, University of Agriculture, Faisalabad as shown in Table IV and V.

Table IV: Residual period of various drugs in tissues/organs after medication within tissues and organs

Anticoccidial Drugs	Residual Periods (in days)				
	Breast	Thigh	Heart	Liver	Kidney
Sulphadimethoxine (Nawaz & Ahmad, 1996)	2	1	2	3	5
Sulphachloropyrazine (Maqbool, 1988)	7	7	9	15	–
Sulphaquinoxaline (Rana, 1988)	8	8	10	12	16

ARSENICALS IN POULTRY FEED

These are being used as feed additives in broiler rations to promote growth and to improve the yellow colour of the skin and shanks. Any dietary source of arsenic should be withdrawn from the feed at least 5 days prior to slaughtering. Otherwise the residues may remain in the tissues which may cause problems to human beings (Ensminger, 1980).

POTENTIAL HAZARDS TO HUMAN BEINGS THROUGH DRUG RESIDUES IN BROILER MEAT

Of the many, followings are the commonly encountered and alarming human health hazards:

Table V. Withdrawal periods of some anticoccidials/antibacterials (Calnek *et al.,* 1991)

Drugs	Withdrawal period (Days)	Drugs	Withdrawal period (Days)
Arsalinic acid	5	Amprolium	3
Biocin	4	Carbomycin	1
Decoquinate	3	Furazolidone	5
Halofuginone	5	Lasalocid	3
Madurimicine	5	Monensin	3–5
Nicarbazine	4	Nitrofurazone	5
Oxytetracycline	3	Penicillin	1
Robenidine	5	Spectinomycin	5
Salinomycin	5	Sulphadimethoxine	5
Sulphachloropyrazine	4	Sulphanitrone	5
Sulphamethazine	10	Sulphaquinapyramine	4
Sulphaquinoxaline	10	Zoaline (DOT)	3

1) The emergence of resistant strains of bacteria in birds and passage of these or other resistant factors via food chain from birds to human beings. Use of antibiotics at sub-therapeutic levels in broiler feeds may lead to the development of resistant strains of bacteria in the bird. While consuming the meat containing residues of antibiotics over protracted period of time may lead to emergence of resistant gut flora and pathogens in human beings such as *E. coli* and *Salmonella* sp. (Ladefoged, 1996).
2) Production of harmful effects from direct toxicity or from the allergic reactions (hypersensitivity reactions) in persons already sensitized to them (O'Brien & Campbell, 1984)
3) Some drugs and/or their metabolites possess carcinogenic potential e.g. sulphamethazine residues containing meat preserved with sodium nitrate may develop a triazine complex that has a considerable carcinogenic potential (Maqbool, 1988; Ladefoged, 1996)
4) Prolonged ingestion of tetracycline present in the broiler meat has detrimental effects on teeth and bones in growing children. It is pertinent to mention that except for some tetracyclines, most therapeutic antibiotics are relatively heat stable and resist both pasteurization and cooking process (Booth & McDonald, 1986).
5) Adverse effects on the cartilage development in children may result if the broiler meat contains quinolone residues (Booth & McDonald, 1986).
6) Drug residues may destroy the useful microflora of gastrointestinal tract, especially in children and hence lead to enteritis (diarrhoea/dysentery) like problems (Ladefoged, 1996).
7) Superinfections that refer to as fresh invasion or re-infection added to an already existing

infection. Candidiasis caused by *Candida albicans* is a classical example of the untoward consequence of the use of antibiotics (Booth & McDonald, 1986).

8) Residues of chloramphenicol are known to cause bone marrow depression and problems like aplastic anaemia in consumers (Booth & McDonald, 1986).

CONCLUSIONS

1) The meat from birds contains drug residues for a few days after treatment.
2) The contamination of broiler meat with the drugs may pose a serious health hazard.
3) Exposure of birds to low levels of some antibiotics may lead to the development of resistant bacterial strains, allergic manifestations or may destroy the useful microflora in the human digestive tract.

POSSIBLE SOLUTIONS

1) Research should be conducted about the residues in the broiler meat.
2) Poultry industry and the public should be enlightened of the side effects of feed additives.
3) Control the illegal and misuse of drugs.
4) Non antibiotic additives should be utilised in broiler feed.
5) Feed enzymes should be employed.
6) Proper withdrawal period should be given to the feed additives, so that the bird should not contain any residues after slaughtering.
7) Proper legislation must be proposed and implemented.
8) Antibiotics used for human therapy should not be used for growth promotion purpose of poultry birds.
9) Contaminated meat, if suspected, should always be tested in laboratory for the presence of antibiotic residues (Muhammad *et al.,* 1997*)*.
10) The drugs should be used only when unavoidable.

All in all, it is the responsibility of every veterinarian who administers drugs, to have in mind, that the drugs are handled in a proper way to avoid any harmful exposure to humans.

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