FEATHER – A POTENTIAL SOURCE FOR REENTRY OF ENROFLOXACIN AND ITS METABOLITE CIPROFLOXACIN RESIDUES IN FOOD CHAIN

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ABSTRACT

Antimicrobials used in poultry production have the potential to bioaccumulate in poultry feathers but available data are scarce. Although feathers were processed and introduced as a protein source in animal feed, withdrawal periods were not established. Hence, an experimental trial was conducted to evaluate the residuol profile of enrofloxacin and its primary metabolite ciprofloxacin in feather of broiler chicken. Thirty six one-day old broiler chicks were randomly divided into control (6 nos) and treatment group (30 nos). Treatment group was administered with enrofloxacin at recommended therapeutic dose 10 mg Kg^{-1}, through drinking water for five consecutive days from 43rd to 47th day of age, whereas control group received non-medicated water. Six birds from treatment group were sacrificed ethically and feather samples were collected at different time points during the withdrawal period at 48 hours interval on day 1, 3, 5, 7 and 9 post treatment. Control birds were sacrificed on day 9 post treatment. Enrofloxacin and ciprofloxacin residues in feather were analysed by a validated High Performance Thin Layer Chromatography-Fluorescent Densitometry method.The present study revealed that enrofloxacin persisted in feather throughout the study period, where as its metabolite ciprofloxacin could be detected until 7th day post treatment and on 9th day post treatment it was below detection limit. The interesting finding is the high level of enrofloxacin achieved in feathers during the withdrawal period. Drug withdrawal times, based on the concentrations of antimicrobial residues in edible chicken meat, were not adequate to reduce antimicrobial residues in chicken feathers. As the feathers are used as a protein source to supplement feed for different food animal species (bovines, pigs, salmons, trouts) they must be considered potential reservoirs of chemical residues that can reach man through the food chain; hence, the present study warrants establishment of withdrawal period for feather similar to that of edible tissues.

Key words: Feather, broiler chicken, enrofloxacin, ciprofloxacin, residues, food chain.

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INTRODUCTION

Feather meal is a potential source of drug residues that can pass through the food chain when contaminated meal is fed to food animals. Following poultry slaughter, feathers are converted by rendering into feather meal (Nachman et al., 2012). Feather meal is sold as a fertilizer (Hadas and Kautsky, 1994), a raw material in biodiesel (Kondamudi et al., 2009) as ingredient in bioplastics (Ahn et al., 2011) and as animal feed ingredient. Feather meal is often incorporated as a protein source into the diets of other food animals, such as cattle, swine, rainbow trout, shrimp and salmon (Cheng et al., 2002; Ssu et al., 2004; Bertsch and Coello, 2005; Divakala et al., 2009).

Considering the pharmacokinetic characteristics of enrofloxacin and ciprofloxacin (Reyes-Herrera et al., 2005; Dimitrova et al., 2006), drug accumulation in non edible tissues such as feathers is highly probable. Although feathers were processed and introduced in the food chain as a protein source in animal feed, withdrawal periods were not established. Data concerning drug residues in feathers from treated birds are scarce (Malucelli et al., 1994) and tests of antimicrobials in feather meal products have not been described in the literature (Love et al., 2012). Hence, the present study has been conducted to evaluate the residue profile of enrofloxacin and its primary metabolite ciprofloxacin in feather of broiler chicken.

MATERIALS AND METHODS

Thirty six one-day old broiler chicks (Broiler strain B1) were obtained from Institute of Poultry Production and Management, Madhavaram Milk Colony, Chennai-600 051. Necessary approval was obtained from Institutional Animal Ethics Committee (IAEC), Madras Veterinary College, Tamil Nadu Veterinary and Animal Sciences University (TANUVAS), for conducting the experiment. The birds were randomly divided into control (6 nos) and treatment group (30 nos). Treatment group was administered with enrofloxacin at recommended therapeutic dose 10 mg Kg-1, through drinking water for five consecutive days from 43rd to 47th day of age, whereas control group received non-medicated water. Six birds from treatment group were sacrificed ethically and feather samples were collected at different time points during the withdrawal period at 48 hours interval on day 1, 3, 5, 7 and 9 post treatment. Control birds were sacrificed on day 9 post treatment. Enrofloxacin and ciprofloxacin residues in feather were analysed by a validated High Performance Thin Layer Chromatography-Fluorescent Densitometry method as described by us earlier (Sureshkumar et al., 2012; Sureshkumar et al., 2013).

RESULTS AND DISCUSSION

Enrofloxacin and its metabolite ciprofloxacin residues in feather of broiler chicken at different sampling period are shown in Table 1. Enrofloxacin and its metabolite ciprofloxacin residues in feather were higher than in other tissues during withdrawal time (days after treatment). Highest concentration of both the compounds was observed on 1st day post treatment i.e. after 5th dose. Enrofloxacin persisted throughout the study period, where as its metabolite ciprofloxacin could be detected until 7th day post treatment and on 9th day post treatment it was below detection limit. The ciprofloxacin to enrofloxacin ratio was found to be 0.03 to 0.07.

The interesting finding is the high level of enrofloxacin achieved in feathers, even at concentrations far higher than those measured in edible tissues (liver, kidney, muscle and skin) at all sampling periods. These findings are in agreement with the earlier report of San Martin et al., (2007) and Cornejo et al., (2011), which showed that enrofloxacin and flumequine, two antimicrobials in the fluoroquinolone class, accumulate in higher concentrations and persist longer in chicken feathers than in muscle.

Feather generation and molting can play an important role in drug disposition kinetics in feathers of treated animals. As the birds grow from chicks to adult birds, they undergo a series of molts, in which four generations of feathers develop and grow from the same follicle. All these follicles are formed during embryo development; once the bird has hatched, the follicle number is fixed. Both the follicle and the emerging feathers are derived from the epidermis of the skin (Leeson and Walsh, 2004). The slow elimination of enrofloxacin residues from feathers could be explained by the reabsorption of the vascularized pulp that fills the shaft of the feather throughout the maturation process. This process is discontinued and terminates in a pulp cap, in which the drug can be retained (Leeson and Walsh, 2004).

It is also important to mention that as the feathers are used as a protein source to supplement food for different food producing species (bovines, pigs, salmons, trouts) they must be considered potential reservoirs of chemical residues that can reach man through the food chain; so it would be advisable to establish a withdrawal period similar to that of edible tissues, as suggested by earlier studies (San Martin et al., 2007; Cornejo et al., 2011; Love et al., 2012).

Table 1: Enrofloxacin and its metabolite ciprofloxacin residues (µg/Kg) in feather of broiler chicken (Mean ±SE, n=6)

Days after treatment	Enrofloxacin	Ciprofloxacin	Enrofloxacin + Ciprofloxacin	Cipro/Enro
1	1297.29±33.08	56.13±3.14	1353.42±32.91	0.04
3	943.17±18.89	42.9±2.07	986.077±19.62	0.05
5	571.63±26.43	34.2±1.43	605.82±27.16	0.06
7	90.41±5.1	6.22±0.42	102.27±9.01	0.07
9	27.91±3.83	ND	27.91±3.83	-

ND – Not Detected

Limit of detection - 2ng/band for enrofloxacin; 3ng/band for ciprofloxacin

Limit of quantification - 5ng/band for both the compounds Analysis carried out in triplicate

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