BEEF

TIME FOR A FEVER-REDUCING, BACTERIA-KILLING[1], FAST-ACTING[2], ONE-DOSE BRD TREATMENT

Resflor GOLD®
Florfenicol and Flunixin Meglumine

MERCK Animal Health

YOU CAN'T AFFORD TO WAIT WITH BRD

Most cattle suffering from bovine respiratory disease (BRD) have been ill for several days before they are detected. Lungs may already have been damaged.

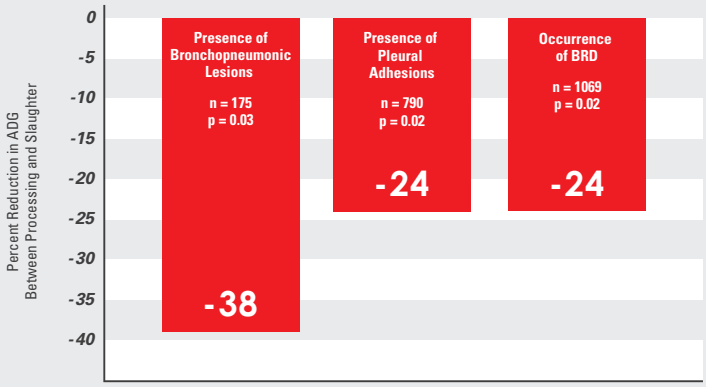
Irreversible damage can be avoided by simultaneous control of the bacterial infection and local inflammation[3] that can cause permanent performance losses, as illustrated in a study of 2,036 feedlot calves.[4]

- These calves were weighed at processing (five days after arrival), Day 35 and at harvest, after a mean of 137 days on feed.

Early treatment with a broad-spectrum antibiotic and a non-steroidal anti-inflammatory (NSAID) can:

- Reduce fever[3] that can cause clinical depression and appetite loss.
- Control bacterial growth[3] that leads to the release of bacterial toxins that cause lung damage.
- Reduce the severity of disease events that lead to irreversible lung lesions[5] and lost profits.

Association Between Lung Lesions and Reduction in ADG

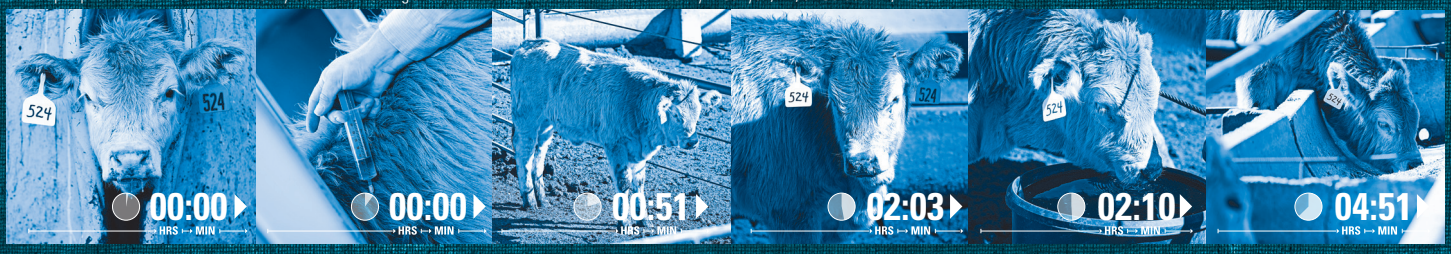


THE FUTURE OF BRD THERAPY

Resflor Gold® (florfenicol and flunixin meglumine) Injectable Solution: See a Difference in One Dose

- Resflor Gold combines the powerful antibiotic florfenicol with the fast-acting NSAID flunixin meglumine.
- A single subcutaneous (SQ) injection of 6 cc per 100 pounds promotes rapid recovery.
- Resflor Gold is effective for the treatment of BRD associated with the economically important bacterial pathogens *Mannheimia haemolytica, Pasteurella multocida* and *Histophilus somni*.
- The unique formulation of Resflor Gold is better than individual doses of florfeniol and flunixin meglumine because it saves time and animal handling with the convenience of one-dose SQ administration.
- You can see improvement in just six hours.

Time-lapse photos were taken of a randomly chosen calf during an actual trial conducted at a research facility in Canyon, TX, on October 14, 2009.



Symptoms of Disease are Apparent

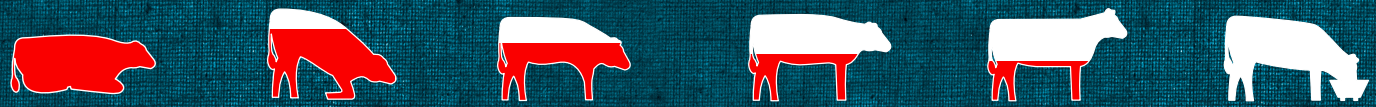
One Dose of Resflor Gold is Administered

Respiration Rate is Improved

Activity Level is Restored

Begins to Drink

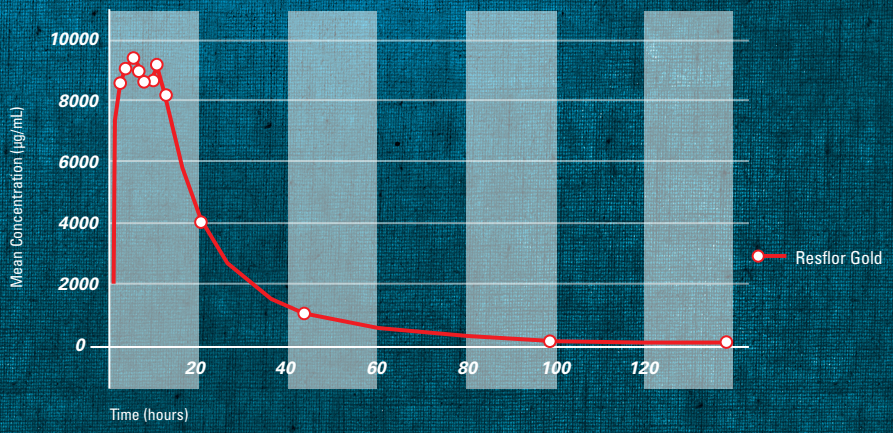
A VISIBLE IMPROVEMENT IN 6 HOURS



TIME FOR A BACTERIA-KILLING, DUAL-ACTION THERAPY

- Mean plasma florfenicol concentrations are above 1 µg/mL within 30 minutes in cattle treated with Resflor Gold SQ injection.[6]
- The result is a fast and powerful bacteria-killing response from florfenicol treatment.[2]
- Fast-acting, long-lasting BRD therapy.

Mean Plasma Concentrations of Florfenicol Versus Time in Cattle



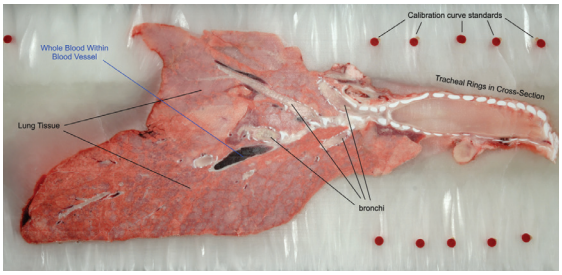
TISSUE PENETRATION THAT IS FAST AND EXTENSIVE

With Florfenicol:

- Concentrations of antibiotic in lung tissue were similar to those observed in whole blood.[5]
- The penetration of florfenicol was seen in all other areas of the respiratory tract, including the trachea, bronchi, nasal sinuses, nares and tracheal cartilage rings.[5]

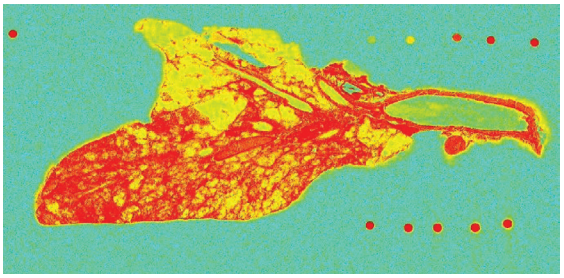
CALF LUNG

Lung of calf treated with ^{14}C-florfenicol (containing radiolabelled florfenicol) embedded within a frozen carboxymethylcellulose block



CALF LUNG AUTORADIOGRAPH

Autoradiograph of a 30-micron section of lung from the block on the left

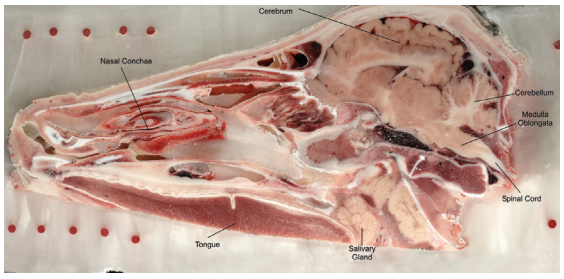


KEY:

- No florfenicol
- Some florfenicol
- High concentration of florfenicol
- Highest concentration of florfenicol

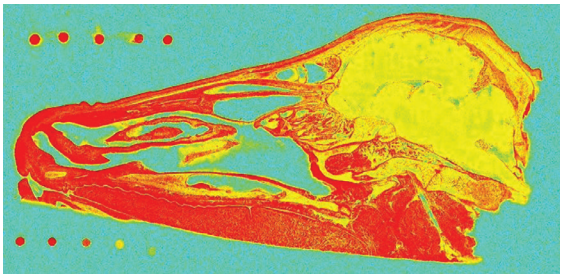
CALF HEAD

Cross-section of the head of a calf treated with ^{14}C-florfenicol



CALF HEAD AUTORADIOGRAPH

Autoradiograph of a 30-micron section of lung from the block on the left



Comparisons of Florfenicol-Flunixin Meglumine versus Tulathromycin or Enrofloxacin in Reducing Fever in Calves with Naturally Occurring BRD

Overview

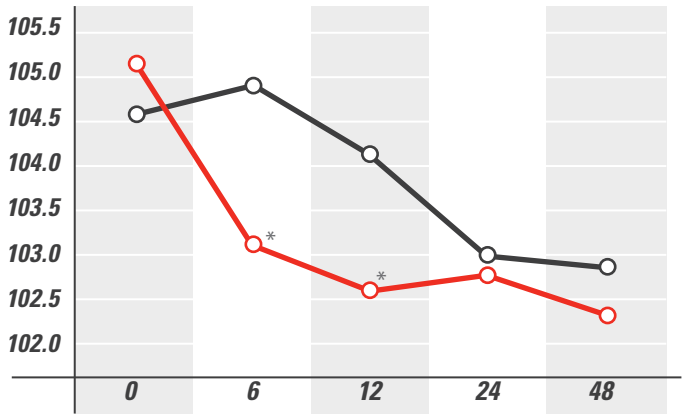
In these studies, sick calves were treated with Resflor Gold or Draxxin®, or Resflor Gold or Baytril®. Calves' rectal temperatures were monitored for two days after treatment.

Resflor Gold vs Draxxin[7]

A total of 40 animals with naturally occurring BRD were treated with either Resflor Gold (n=20) or Draxxin (n=20). Rectal temperatures were taken at Time 0, 6, 12, 24, and 48 hours after treatment. Results are shown in the graph at the right.

Resflor Gold
Draxxin

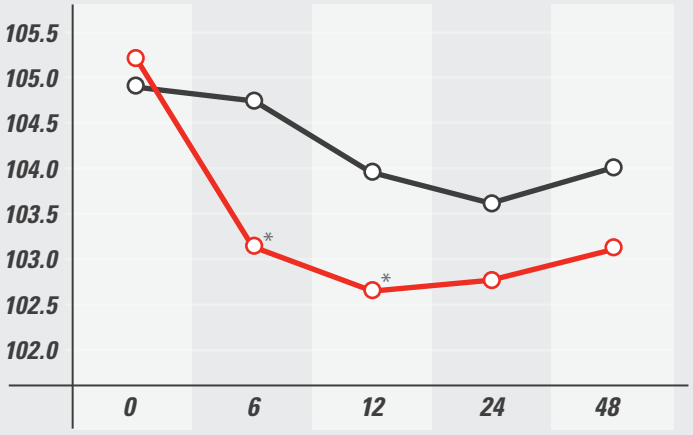
Resflor Gold vs Draxxin[7]



Hours Post Treatment

*Group differs $p<0.05$

Resflor Gold vs Baytril[7]



Hours Post Treatment

*Group differs $p<0.05$

Resflor Gold vs Baytril[7]

A total of 40 animals with naturally occurring BRD were treated with either Resflor Gold (n=20) or Baytril (n=20). Rectal temperatures were taken at Time 0, 6, 12, 24, and 48 hours after treatment. Results are shown in the graph at the left.

Resflor Gold
Baytril

Whether compared to Draxxin or Baytril, Resflor Gold was the superior (consistently $p<0.05$) product for fever reduction in these studies.

The Resflor Gold-treated animals had significantly lower ($p<0.001$) rectal temperatures than the other treatment groups at 6, 12, 24, and 48 hours after enrollment in treatment at 0 hours.

A Comparison of Florfenicol-Flunixin Meglumine versus Tulathromycin for the Treatment of Undifferentiated Fever in Fall-placed Feedlot Calves

Highlights of a Controlled Study* Published in *Veterinary Therapeutics* Vol. 10, No. 1-2, Spring-Summer 2009

Overview

The purpose of this study was to compare the efficacy of a combination drug, florfenicol-flunixin meglumine [Resflor Gold], with tulathromycin [Draxxin] for initial treatment of undifferentiated fever (UF) in fall-placed calves that received metaphylactic tilmicosin [Micotil®] on arrival at the feedlot.

Results

There were no statistically significant differences between florfenicol-flunixin and tulathromycin in first, second, or third UF relapse rates.

Calves treated with florfenicol-flunixin had a lower crude case fatality rate ($p=0.0447$) than calves treated with tulathromycin.

Investigators:
Joyce Van Donkersgoed, DVM, MVS; Janice Berg, DVM; Steven Hendrick, DVM, DVSc

THE FUTURE OF BRD THERAPY IN A SINGLE SQ DOSE

Fast-acting
Long-lasting
Kills bacteria
Reduces fever
Visible improvement in six hours
Helps preserve profits

Ask your veterinarian about Resflor Gold or visit resflorgold.com.

IMPORTANT SAFETY INFORMATION NOT FOR HUMAN USE. KEEP OUT OF REACH OF CHILDREN. This product contains material that can be irritating to skin and eyes. Animals intended for human consumption must not be slaughtered within 38 days of treatment. This product is not approved for use in female dairy cattle 20 months of age or older, including dry dairy cows. Use in these cattle may cause drug residues in milk and/or in calves born to these cows. A withdrawal period has not been established in pre-ruminating calves. Do not use in calves to be processed for veal. Do not use in animals that have shown hypersensitivity to florfenicol or flunixin. Not for use in animals intended for breeding purposes. The effects of florfenicol and flunixin on bovine reproductive performance, pregnancy, and lactation have not been determined. When administered according to the label directions, Resflor Gold may induce a transient local reaction in the subcutaneous and underlying muscle tissue.

REFERENCES

[1]Exhibits bactericidal activity against some strains of *Mannheimia haemolytica* and *Histophilus somni*.

[2]The correlation between *in vitro* susceptibility data and clinical effectiveness is unknown.

[3]Lekeux P. Bovine respiratory disease complex: an European perspective. *Bovine Practitioner* 1995: vol 29, 71-75.

[4]Thompson PN et al. *J. Anim Sci* 2006;84:488-498.

[5]Weingarten A. Simmons RD, de Haas V et al.: The Efficacy of Resflor, A New Therapeutic Agent for the Treatment of Bovine Respiratory Disease. Presentation at The XXIV World Buiatrics Congress, Nice, France 2006 (proceedings published by the Gloyd Group, Wilmington, Delaware).

[6]Wrzesinski, Chris. Comparison of Florfenicol-Flunixin/2-Pyrrolidone/Triacetin Formulation to Resflor/n-methyl-2-Pyrrolidone Formulation in a Single-Dose Bioequivalence, Crossover Study of Florfenicol and Flunixin in Cattle. SPRI Study No. 06244.

[7]Data on file: I/SP study # MS-Resflor Gold 01-09.

PRODUCT INFORMATION
NADA 141-299, Approved by FDA.

122996 R3

(Florfenicol and Flunixin Meglumine)

Antimicrobial/Non-Steroidal Anti-Inflammatory Drug

For subcutaneous use in beef and non-lactating dairy cattle only. Not for use in female dairy cattle 20 months of age or older or in calves to be processed for veal.

CAUTION: Federal law restricts this drug to use by or on the order of a licensed veterinarian.

DESCRIPTION: RESFLOR GOLD® is an injectable solution of the synthetic antibiotic florfenicol and the non-steroidal anti-inflammatory drug (NSAID) flunixin. Each milliliter of sterile RESFLOR GOLD® contains 300 mg florfenicol, 16.5 mg flunixin as flunixin meglumine, 300 mg 2-pyrrolidone, 35 mg malic acid, and triacetin qs.

INDICATION: RESFLOR GOLD® is indicated for treatment of bovine respiratory disease (BRD) associated with *Mannheimia haemolytica, Pasteurella multocida, Histophilus somni,* and *Mycoplasma bovis,* and control of BRD-associated pyrexia in beef and non-lactating dairy cattle.

DOSAGE AND ADMINISTRATION: RESFLOR GOLD® should be administered once by subcutaneous injection at a dose rate of 40 mg florfenicol/kg body weight and 2.2 mg flunixin/kg body weight (6 mL/100 lb). Do not administer more than 10 mL at each site. The injection should be given only in the neck. Injection sites other than the neck have not been evaluated. For the 500 mL vial, do not puncture the stopper more than 20 times.

RESFLOR GOLD® Dosage Guide*	
ANIMAL WEIGHT (lbs)	**DOSAGE (mL)**
100	6.0
200	12.0
300	18.0
400	24.0
500	30.0
600	36.0
700	42.0
800	48.0
900	54.0
1000	60.0

* Do not administer more than 10 mL at each site.

Recommended Injection Location

CONTRAINDICATIONS: Do not use in animals that have shown hypersensitivity to florfenicol or flunixin.

WARNINGS: NOT FOR HUMAN USE. KEEP OUT OF REACH OF CHILDREN. This product contains material that can be irritating to skin and eyes. Avoid direct contact with skin, eyes, and clothing. In case of accidental eye exposure, flush with water for 15 minutes. In case of accidental skin exposure, wash with soap and water. Remove contaminated clothing. Consult a physician if irritation persists. Accidental injection of this product may cause local irritation. Consult a physician immediately. The Material Safety Data Sheet (MSDS) contains more detailed occupational safety information.

For customer service or to obtain a copy of the MSDS, call 1-800-211-3573. For technical assistance or to report suspected adverse reactions, call 1-800-219-9286.

PRECAUTIONS: As a class, cyclo-oxygenase inhibitory NSAIDs may be associated with gastrointestinal, renal, and hepatic toxicity. Sensitivity to drug-associated adverse events varies with the individual patient. Patients at greatest risk for adverse events are those that are dehydrated, on diuretic therapy, or those with existing renal, cardiovascular, and/or hepatic dysfunction. Concurrent administration of potentially nephrotoxic drugs should be carefully monitored. NSAIDs may inhibit the prostaglandins that maintain normal homeostatic function. Such anti-prostaglandin effects may result in clinically significant disease in patients with underlying or pre-existing disease that have not been previously diagnosed. Since many NSAIDs possess the potential to produce gastrointestinal ulceration, concominant use of RESFLOR GOLD® with other anti-inflammatory drugs, such as NSAIDs or corticosteroids, should be avoided or closely monitored.

Flunixin is a cyclo-oxygenase inhibitory NSAID, and as with others in this class, adverse effects may occur with its use. The most frequently reported adverse effects have been gastrointestinal signs. Events involving suspected renal, hematologic, neurologic, dermatologic, and hepatic effects have also been reported for other drugs in this class.

Not for use in animals intended for breeding purposes. The effects of florfenicol on bovine reproductive performance, pregnancy, and lactation have not been determined. Toxicity studies in dogs, rats, and mice have associated the use of florfenicol with testicular degeneration and atrophy. NSAIDs are known to have potential effects on both parturition and the estrous cycle. There may be a delay in the onset of estrus if flunixin is administered during the prostaglandin phase of the estrous cycle. The effects of flunixin on imminent parturition have not been evaluated in a controlled study. NSAIDs are known to have the potential to delay parturition through a tocolytic effect.

RESFLOR GOLD®, when administered as directed, may induce a transient reaction at the site of injection and underlying tissues that may result in trim loss of edible tissue at slaughter.

RESIDUE WARNINGS: Animals intended for human consumption must not be slaughtered within 38 days of treatment. This product is not approved for use in female dairy cattle 20 months of age or older, including dry dairy cows. Use in these cattle may cause drug residues in milk and/or in calves born to these cows. A withdrawal period has not been established in pre-ruminating calves. Do not use in calves to be processed for veal.

ADVERSE REACTIONS: Transient inappetence, diarrhea, decreased water consumption, and injection site swelling have been associated with the use of florfenicol in cattle. In addition, anaphylaxis and collapse have been reported post-approval with the use of another formulation of florfenicol in cattle.

In cattle, rare instances of anaphylactic-like reactions, some of which have been fatal, have been reported, primarily following intravenous use of flunixin meglumine.

CLINICAL PHARMACOLOGY:
The pharmacokinetics (PK) of florfenicol (Table 1) and flunixin (Table 2) after subcutaneous injection of RESFLOR GOLD® is described below:

Table 1. Mean (n=28) pharmacokinetic parameters for florfenicol in cattle after a single subcutaneous administration of RESFLOR GOLD (florfenicol dose of 40 mg/kg BW).

Mean Florfenicol PK parameters in Cattle						
PK Parameter	AUC_{0-t}[1] (ng*hr/mL)	AUC_{0-inf}[2] (ng*hr/mL)	C_{max}[3] (ng/mL)	T_{max}[4] (hr)	$T_{½}$[5] (hr)	MRT_{0-inf}[6] (hr)
Mean	242527	247577	11151	6.25	28.5	27.3
SD[7]	42741	41391	4194	3.87	9.91	11.6

Table 2. Mean (n=28) pharmacokinetic parameters for flunixin in cattle after a single subcutaneous administration of RESFLOR GOLD (flunixin dose of 2.2 mg/kg BW).

Mean Flunixin PK parameters in Cattle						
PK Parameter	AUC_{0-t}[1] (ng*hr/mL)	AUC_{0-inf}[2] (ng*hr/mL)	C_{max}[3] (ng/mL)	T_{max}[4] (hr)	$T_{½}$[5] (hr)	MRT_{0-inf}[6] (hr)
Mean	13370	14448**	1913	1.14	9.5**	11.4
SD[7]	4964	5116	791	0.97	3.27	4.41

1 AUC_{0-t} = Area under the plasma-concentration-time curve (AUC) from time zero to the last quantifiable concentrations
2 AUC_{0-inf} = AUC from time zero to infinity
3 C_{max} = Maximum plasma concentration
4 T_{max} = Time at which C_{max} was observed
5 $T_{½}$ = Terminal elimination half-life
6 MRT_{0-inf} = Mean residence time from time zero to infinity
7 SD = Standard deviation
** n=27

MICROBIOLOGY: Florfenicol is a synthetic, broad-spectrum antibiotic active against many Gram-negative and Gram-positive bacteria isolated from domestic animals. It acts by binding to the 50S ribosomal subunit and inhibiting bacterial protein synthesis. Florfenicol is generally considered a bacteriostatic drug, but exhibits bactericidal activity against certain bacterial species.
In vitro studies demonstrate that florfenicol is active against the BRD pathogens *M. haemolytica, P. multocida,* and *H. somni,* and *M. bovis* that florfenicol exhibits bactericidal activity against strains of *M. haemolytica* and *H. somni.*
The minimum inhibitory concentrations (MICs) of florfenicol were determined for non-mycoplasmal BRD isolates obtained from calves enrolled in BRD field studies in the U.S. in 2006 using methods recommended by the Clinical and Laboratory Standards Institute (M31-A2). MICs for *M. bovis* isolates were determined by an accepted method using Hayflick Broth with Alamar Blue (HBAN) medium under appropriate control. Isolates were obtained from pre-treatment nasal swabs from all calves enrolled at all four sites, post-treatment nasal swabs from treatment failures in the RESFLOR GOLD and saline control treatment groups at three sites, and lung tissue from one calf that died in the saline control treatment group. The results are shown in below Table 3.

Table 3. Florfenicol MIC values* of indicated pathogens isolated from cattle with naturally-ocurring BRD.

Indicated pathogens	Year of isolation	Number of isolates	MIC_{50}** (µg/mL)	MIC_{90}** (µg/mL)	MIC range (µg/mL)
Mannheimia haemolytica	2006	183	1.0	1.0	0.5 to 32
Pasteurella multocida	2006	139	0.5	0.5	≤ 0.125 to 16
Histophilus somni	2006	84	≤ 0.125	≤ 0.125	≤ 0.125 to 0.25
Mycoplasma bovis	2006	60	1.0	1.0	0.5 to 1.0

* The correlation between *in vitro* susceptibility data and clinical effectiveness is unknown.
** The lowest MIC to encompass 50% and 90% of the most susceptible isolates, respectively.

EFFECTIVENESS: In a multi-site field study, calves with naturally-occurring BRD were treated with RESFLOR GOLD®, Nuflor Gold® (NADA 141-265), or saline. A treatment success was defined as a calf with normal respiration to mild respiratory distress, normal attitude to mildly depressed, and a rectal temperature < 104.0 °F on Day 11.

The treatment success rate for BRD for the RESFLOR GOLD® treatment group (68.4%) was statistically significantly greater (p = 0.0255) compared to the saline control treatment group (42.9%). RESFLOR GOLD® was non-inferior to Nuflor Gold® for the treatment of BRD, with a one-sided 95% lower confidence bound for the difference between the two treatments equal to -13.2%.

In the same study, the change in rectal temperature from pre-treatment to six hours post-treatment was evaluated to determine the effectiveness of RESFLOR GOLD® for the control of BRD-associated pyrexia. The proportion of calves whose rectal temperatures decreased by ≥ 2.0 °F from pre-treatment to six hours post-treatment was statistically significantly greater (p = 0.0019) in the RESFLOR GOLD® treatment group compared to the saline control treatment group. The mean decrease in rectal temperature from pre-treatment to six hours post-treatment was statistically significantly greater in the RESFLOR GOLD® treatment group compared to the Nuflor Gold® and saline control treatment groups (p = 0.0031 and 0.0002, respectively).

The effectiveness of RESFLOR GOLD for the treatment of BRD associated with *Mycoplasma bovis* was demonstrated by examining the *M. bovis* data from cattle enrolled in the BRD treatment study described above. There were numerically more treatment successes (6 of 8 calves, 75%) than treatment failures (2 of 8 calves, 25%) in RESFLOR GOLD-treated calves that cultured positive for *M. bovis* pre-treatment.

ANIMAL SAFETY: A target animal safety study was conducted to evaluate the effects of RESFLOR GOLD® when administered to cattle subcutaneously at 1X, 3X, or 5X the labeled dose for three consecutive days (3X the labeled duration). Decreased feed and water consumption, and decreased body weights (secondary to decreased feed consumption) were observed in the 1X, 3X, and 5X groups. Injection site swellings were noted in the 1X, 3X, and 5X groups.

A separate injection site study was conducted in cattle. The study demonstrated that RESFLOR GOLD®, when administered according to the label directions, may induce a transient local reaction in the subcutaneous and underlying muscle tissue.

STORAGE INFORMATION: Do not store above 30°C (86°F). Use within 28 days of first use.

HOW SUPPLIED: RESFLOR GOLD® is available in 100, 250, and 500 mL sterile, multiple-dose, glass vials.

Made in Germany
Intervet Inc.
a subsidiary of Merck & Co.
Summit, NJ 07901

Rev. 7/12

122996 R3