

Calculating Drug Levels in feed. This should be, but isn't always, easy!

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A stumbling block in the effort to fill out the Veterinary Feed Directive (VFD) forms correctly is the space for listing the Drug level as Grams per Ton (g/T) of drug, especially for cattle, as there are so many feeding methods to accomplish the proper dosage. Those of us who have been treating animal diseases for many decades and generations, may have developed the habit of measuring Medicinal Feed Additive (MFA) drugs volumetrically. Regulations today call for an integrated, close relationship between the producer, veterinarian and the feed supplier. A great deal of information is required to have precise estimates of the modifiers of feed, and hence drug intake. This article will attempt to show examples of calculating Drug levels in different scenarios, for cattle.

The proper dosage should be paramount in our efforts to treat animals in our care. Under-dosing of drug could result in improper treatment, continued sickness and even death of the patient. Over-dosing of drugs is irresponsible and could lead to residue in the food we are producing. FDA Guidance for Industry #233 states that the VFD form will have a space for the Veterinarian to populate with the Drug level in the feed in "Grams per Ton".

The veterinarian has a very difficult time in filling out the Drug level portion of the VFD form, mostly because he/she is working with insufficient information from the producer and feed supplier. The VFD is much easier when the veterinarian is working in concert with the producer and feed supplier. In the process of establishing the Veterinary-Client-Patient-Relationship (VCPR), communication lacks as to the feeding method that will be used. It must be known whether the producer uses a Type B crumble or a Type A Medicated Feed Article into a Total Mixed Ration (TMR). The VFD form only calls for the estimated number of animals, but the veterinarian must also know the weight of the animals and the preferred feeding method. Is the drug included in a protein concentrate to be fed at a pound per head per day along with *ad libitum* access to a hay/silage mixture or is it in a TMR of which the moisture of the mix is unknown to the veterinarian? Now, more than ever before, the veterinarian, the producer and the feed supplier must communicate and work together. When all parties work in concert, the VFD is much easier and more likely correct. When the veterinarian is left to assume/guess the method of feeding, the Drug level is data left to interpretation and judgement as to correctness by an outside inspector. This is a major point to cause a veterinarian concern and give him/her cause to prefer alternative treatment methods where he/she knows exactly how treatment is going to be done.

The modifiers of intake are impossible to know without a great deal of prior information from all concerned. The producer, feed supplier and his nutritionist must help the veterinarian with all this information, or the intakes will be based solely on generalized assumptions. Modifiers of intake include moisture content, forage/grain quality, energy density, sex, stage of production, age, temperature, bunker/feeder space, genetics, number of feedings, access to water, feeder adjustment and activity, just to name a few. If these factors are known beforehand and are of sufficient magnitude, they must be included in the calculations going into g/T.

Examples with Cattle –

While there are examples in swine and chickens, this author is not aware of any drug label claims of VFD drugs where the dosage for cattle is indicated in Grams per Ton. The reason for this is drug sponsors did not conduct the claim proving trials in an *ad libitum* feeding manner, but conducted the experiments with known dosage of milligrams per head or milligrams per unit of body weight. Thus, the labels all list the required dosage and generally have tables of example g/T based on intakes or feeding methods. Common label dosage recommendations are 70 mg per head per day, 350 mg per head per day or 10 mg per pound of bodyweight per head per day, as examples. While the dosages may be somewhat common, the methods of feeding in cattle are considerably varied.

Using crumbles –

Irrespective of the feeding method or dosing rate, using a crumble requires the g/T on the VFD form to match the crumble potency.

A 2 gram per pound crumble will have a drug level on the VFD of 4,000 grams per ton ($2g \times 2,000 \text{ pounds} = 4,000 \text{ g/T}$)

A 10 gram per pound crumble will have a drug level on the VFD form of 20,000 grams per ton ($10g \times 2,000 \text{ pounds} = 20,000 \text{ g/T}$)

Example of feeding directions for a 500 pound calf needing 350 mg/head/day using a 10g crumble –

350 mg/head/day divided by 10,000 mg/lb crumble ($10g \times 1,000 \text{ mg/g} = 0.035 \text{ pounds of crumbles per head per day}$). Hopefully there are a large number of head in the pen so that a reasonable quantity can be weighed and fed to the pen. In this example the calf weight did not matter. Additionally, if a small number of cattle are in the pen, then a 2g crumble would make more practical sense. ($350\text{mg}/\text{head}/\text{day} \text{ divided by } 2,000\text{mg}/\text{lb} = 0.175\text{lb of 2g crumbles.}$)

Example of feeding directions for a 500 pound calf needing 10mg/pound of bodyweight per head per day using a 10 gram crumble.

$500 \times 10\text{mg}/\text{lb wt}/\text{day} = 5,000\text{mg}/\text{day} = 5\text{g}/\text{day} \text{ divided by } 10\text{g}/\text{lb crumble} = 0.5\text{lb of the 10g/lb crumble.}$

In both cases above the Grams per Ton on the VFD form would read 20,000g/T if a 10g /lb crumble was used in drug delivery, irrespective of the weight of the beast or the claim indicated. However, yes, the feeding directions would change.

Using a 0.5 lb per head per day protein concentrate –

When using a medicated concentrate or base mix to feed the cattle, the feeding rate of the concentrate and dosage are paramount. In this case of an intended feeding rate of a half-pound per head per day, the dosage must be supplied in that half-pound of basemix.

Example of a 500 lb calf requiring 350mg per head per day in a 0.5 lb protein mix –

A 0.5lb/day feeding rate = 4,000 feedings per ton times 350mgs/hd/day = $1,400,000\text{mgs}/\text{T} = 1,400\text{g/T}$
(Alternatively, $350\text{mg}/0.5\text{lb} = 700\text{mg}/\text{lb} \times 2000 = 1,400\text{g/T}$) in the protein mix.

The VFD in this case would read 1,400g/T in the Grams per Ton space and the feeding directions would read feed 0.5lb per head per day to achieve 350 mg/head/day dosage.

Example of a 500 lb calf requiring 10mg/lb wt/day in a 0.5 lb protein mix –

A 0.5lb feeding rate = 4,000 feedings per ton times 5,000mg/hd/day (500lb X 10mg/lb wt/day) = 20,000,000mg/T or 20,000g/T.

(Alternatively, 500lb times 10mg/lb wt/day = 5000mg/day divided by 0.5 lb =10,000mg/lb or 20,000g/T) of protein mix.

The VFD in this case would read 5,000g/T and the feeding directions would read feed 0.5lb per head per day to achieve 5,000mg/head /day or 5g/head/day.

Example of a 900 pound steer eating a 10 pound protein/grain mix per day. The remainder of the steer's diet is forage or silage. The indication calls for 10mg/lb wt/day.

2,000 divided by 10lb protein/grain mix = 200 feedings per ton times 9,000mg/hd/day (900lb X 10mg/lb wt./day) = 1,800,000 mg/T or 1,800g/T of protein/grain mix.

(Alternatively, 900lb times 10mg/lb wt/day = 9000mg; divided by 10 lb feed = 900mg per lb or 1,800g/T in the protein/grain mix.)

The VFD would read 1,800g/T of protein/grain mix to be fed at the rate of 10lb/hd to achieve 9,000mg/head/day.

In the example of a Total Mixed Ration (TMR), the weight of the beast and the intake come into the calculations.

How much do cattle eat daily? That depends. The rule of thumb is 2% of bodyweight of dry matter intake per day. Rule of thumb – a 400lb calf eats 8 pounds of dry matter; a 1200lb heifer eats 24 pounds of dry matter. The underlying trouble is cattle rarely eat according to the rule of thumb. It fits big cattle much better than younger, lighter cattle.

Modifiers of intake for **cows** often taken into account are the quality of forage and stage of production. References state that when forage quality is low (52% TDN or less) (TDN =Total Digestible Nutrients) and cows are not lactating, they will consume 1.8% and lactating cows about 2.0% of their weight on a dry matter basis. If the forage quality is average (TDN content between 52% and 59%), non-lactating cows will consume about 2.0% to 2.1% and lactating cows about 2.3% of their bodyweight daily on a dry matter basis. (Determining How Much Forage a Beef Cow Consumes Each Day, April, 2013, Dr. Rick Rasby, Univ. Nebraska Lincoln.) Just so that this isn't a source of more confusion, examples of low quality forage are corn stubble, wheat/oat straw or stalky, mature grass hay. Higher TDN forage is categorized as quality hay, alfalfa or ear chop.

Growing cattle are a different matter as age is confounded with weight. A 400lb calf on a grower ration will eat at 3% of bodyweight on a dry matter basis, while a 750lb steer will eat a grower/developer ration at 2.5% of bodyweight on a dry matter basis. Then too, a 1000lb critter on finishing diet takes in closer to 2% of bodyweight on a dry matter basis. See the chart below.

Table 1. Expected Feed Intake of Cattle in Feedlots.

<u>Weight of Cattle and type of ration fed.</u>	<u>Expected Dry Matter intake % of bodyweight</u>
400 pounds, Grower diet	3.0
550 pounds, Grower diet	2.8
700 pounds, Grower diet	2.6
850 pounds, Finisher ration	2.4
1,000 pounds, Finisher Ration	2.2
1,200 pounds, Finished for 120 days	2.0
1,200 pounds, Finished for 140 days	1.8
1,200 pounds, Finished for 160 days	1.6

Nutrition and Management, Alberta Feedlot Management Guide, 2nd edition, September, 2000, Dr. Barry Robinson and Dr. Erasmus Okine, Eds.

Cattle diets vary in the dry matter content depending upon the moisture level of the feedstuffs. Going to extremes, the dry matter of a diet based on wheat straw is dramatically different than that based on corn silage. Grains are rather typically 12% moisture or 88% dry matter. One would use the dry matter percentage to convert the intake of grain from dry matter basis to as fed basis. If the animal was predicted to eat 10 pounds of grain on a dry matter basis, it would be 11.36lb (10 / 0.88 = 11.36) on an as fed basis.

The Dry Matter/As Fed intake switch on the Global Vet Link (GVL) forms is not there for a source of confusion. It is intended to be an aid to those that are aware that cattle intake calculations start as dry matter intakes and then are converted to compensate for the moisture level of the diet. The uninitiated try to make this a bottleneck. The recipe is actually rather simple.

Another factor in this discussion is that the drug claims and dosages were all applied for and proven by the drug sponsors on an as fed basis.

Let's try an example –

A 400lb calf on a grower ration, that contains only a small amount of silage, is 85% dry matter. The claim indicates that the drug feeding rate should be 350mg/head/day.

A 400lb calf on a grower diet will eat about 3% of its bodyweight on a dry matter basis or 12lb/day. That converted to as fed is 14.12lb/day (12lb / 0.85DM = 14.12lb as fed.)

2,000lb divided by 14.12lb as fed = 141.6 feedings per ton of grower ration. 141.6 feedings X 350 mgs/hd/day = 49,560 mgs/T of grower ration or 49.5g/T. (If we did more rounding 2,000 /14 = 143 feedings times 350mg/hd/day = 50,050mgs/T. or 50g/T.

Or, alternatively, 350md/head/day / 14.12 lb feed = 24.8 mg/lb or 49.6 g/T as fed feed

The only way that a veterinarian could have any chance of calculating and properly filling the Drug Level space on a VFD would be with the aid of the producer, feed supplier and/or nutritionist, when the feeding method is a TMR. If a veterinarian is filling out a VFD form with insufficient knowledge of intake modifiers like Dry Matter of the diet, then assumptions will have to be made and should be listed on the VFD form *Special Instructions* section.

Another Dry Matter example-

A 1,000 pound steer is eating a TMR which is 30% moisture and needs to be treated at a therapeutic level of 10 mg/lb wt/day.

Using Table 1, we find that a steer eats approximately 2.2% of its bodyweight in dry matter a day. $1000\text{lb} \times .022 = 22\text{lb}$ of DM intake. That converts to 31.4lb on an as fed basis. (22lb DM intake divided by 70% dry matter = 31.4 lb on an as fed basis.) That 1,000lb steer needs 10,000mg/day of drug.

2,000lb divided by 31.4lb daily = 63.7 feedings times 10,000mg/day = 636,943mg/T., or 637g/T.

In this case the VFD would be populated with 637g/T. with feeding directions that the 1000lb steers were to be fed the TMR at 31.4lb to obtain 10 mg/lb wt/day. The 70% DM could be added for good measure.

Filling the space on VFD forms with the proper Grams per Ton is not an insurmountable task. Far from it. However, make no mistake, it becomes an easier task when information from all parties, the veterinarian, the producer and the feed supplier work together to improve the accuracy of the data and strengthen the VCPR.