

## How consistent is your ration?

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Formulation is generally at the forefront of our mind when it comes to ration quality. A high-quality ration undoubtedly begins with a solid formulation. However the formulation does not always equate to a high-quality ration, as it is only as valuable as ingredient loading, mixing, and feed delivery practices allow it to be. In other words, no matter how good of a formulation we begin with, it is only as valuable as we are effective at transforming it from what's on paper to what's delivered to the bunk. If those two are not the same, the outcome often leads to disappointment in the form of an increased incidence of bloat or acidosis, or performance that falls short of expectations. Both outcomes have economic consequences, and they rarely occur independently of one another. Just as we often blame the bull for open cows, we're generally quick to place the blame for nutritional issues or low performance on the formulation. Mixing efficacy, or lack-there-of, can have just as much of an impact on the outcome of the ration.

Ultimately, the main goal of mixing a ration is to blend ingredients in a way that delivers the same amount of ingredients – and thus nutrients – to every animal, through each bite, at every meal. Evaluating variation in nutrient or ingredient levels is one of the most cost-effective and reliable means of quantifying ration consistency. This practice most commonly utilizes a measurement of coefficient of variation (CV) both within and across batches to quantify consistency. In a nutshell, CV represents the standard deviation from the mean value, expressed as a percentage. A low CV represents low variation across samples, while a high CV represents high variation. As a general rule of thumb, a CV of less than 5 % should be the target when using macronutrients such as protein and fiber fractions, while a CV of less than 5 – 10 % should be the target for the concentration of a drug or micronutrient.

To use CV to evaluate ration consistency, collect 3 to 5 samples from the bunk, spaced evenly from the beginning through the end of distribution. These samples should be collected immediately following delivery, and collection should be replicated across 3 to 5 separate batches or feedings. If possible, have someone follow the mixer through feed-out. Avoid collecting samples after cattle have had a substantial period of time to eat. Once collected, samples should be submitted to a laboratory for analysis. Certain analytical laboratories, feed companies, and consulting groups offer ration consistency or mixing efficacy analysis as a service. If these services are unavailable, crude protein and one of the fiber fractions (neutral detergent fiber or acid detergent fiber) can serve as your “marker.” Another marker that is often used is an ionophore, such as Rumensin or Bovatec, or a micronutrient such as a specific trace mineral with a known target concentration in the final ration.

After receiving analysis results that contain the concentration of your marker(s), a number of online calculators and spreadsheets are available that can be used to determine CV of the mix. And as the saying goes, *if it ain't broke, don't fix it*. But if there is an issue with ration uniformity, assuming that you are using the right mixer for the job, the issue can almost always

be addressed by troubleshooting any combination of three factors: level of ingredient addition, order of ingredient addition, and mixing time(s).

A high CV within a batch (single feed delivery) is an indicator of an issue with mixing efficacy. The most common factor that drives this problem is the addition of ingredients to the mixer in a sequence that does not allow them to blend sufficiently. We often load ingredients in an order that is based on convenience rather than the kinetics of blending. If the goal is to create a uniform ration, ingredients should be added in the order and blended for the amount of time necessary to disperse them throughout the entire mixture, without causing them to re-segregate or “settle-out.” This is a fairly complex topic that is dependent upon a combination of many factors, and thus warrants its own discussion. But for now, consider the physical characteristics and inclusion-level of each ingredient, and how they may contribute to ease or difficulty of dispersion throughout the ration. And if necessary, work with your nutritionist or the manufacturer of your mixer to determine the necessary order of addition and mixing times.

A high CV across batches (multiple feed deliveries) is an indicator of inconsistencies in ingredient inclusion, mixing order, or mixing duration each time the ration is mixed. The first of these is often caused by an issue with accuracy and/or precision. Think of accuracy as your ability to hit a target at the exact location that you’re trying to hit, and precision as your ability to do it over and over again. If a high CV across batches is the issue, first ensure that your scales are measuring accurately and consistently. If they are, then ensure that the correct amount of each ingredient is being added each time, and that the formulation does not call for an amount that is more precise than you can effectively measure and add to the mixer. Rations should be formulated only to that degree of precision. Otherwise, you’re essentially trying to hit a target that you can’t see. You may hit it every once in a while, but the majority of the time you won’t. To address the latter, ensure that the ration is mixed in the same order, and that mixing duration is consistent across batches. As simple as it may seem, small inconsistencies in any of these can have a substantial effect on uniformity. And keep in mind, a high within-batch CV can lead to a high across-batch CV. So before troubleshooting high across-batch CVs, make sure that within-batch variation is not the major underlying issue.

At the end of the day, mixing ingredients to provide cattle with a consistent and uniform ration is a combination of art and science. These are just the initial steps that can be taken to quantify ration uniformity and troubleshoot issues with inconsistency. And when in doubt, your nutritionist or Extension personnel are great resources for tips on ensuring that you are consistently delivering the desired ration to the bunk.