Is my "Guaranteed Analysis" Really Guaranteed?

Horse feeds are milled from agricultural products. Agricultural products are, by nature, quite variable in nutrient content. The nutrient content in an ingredient can vary significantly from lot to lot. How then is it possible to guarantee the nutrient content of a brand and type of feed, given that it is produced in lots and although those lots may contain the same ingredients, the nutrient content in those ingredients fluctuates? Some feed companies are diligent and do test incoming raw ingredients. Some rely on outside testing. Some do no testing at all.

During the calendar year 2023, 15 various feed samples were provided for analysis to compare their actual nutrient concentrations to those listed on the Guaranteed Analysis (GA). Feed samples from several major manufacturers were tested, as well as one local mill sample. Samples were sent to Equi-Analytical as blinded samples, identified with a sample ID number only. Data was tabulated against each individual Guaranteed Analysis from the manufacturer's package, except for Digestible Energy (DE). DE is not generally published on the GA, and those values are estimates from individual manufacturers.

Twelve analytes were evaluated:

- Digestible Energy (DE)
- Crude Protein (CP)
- Ethanol Soluble Carbohydrates (ESC)
- Starch
- Calcium (Ca)
- Phosphorous (P)
- Magnesium (Mg)
- Potassium (K)
- Sodium (Na)
- Zinc (Zn
- Copper (Cu)
- Manganese (Mn)

LIMITATIONS:

It is important to note that these samples are grab samples, one sample from one lot, and only provide information for a moment in time. They may or may not be indicative of the overall conformance of the product to its GA.

"As Fed" results from Equi-Analytical were recorded. Percent error was calculated as follows:

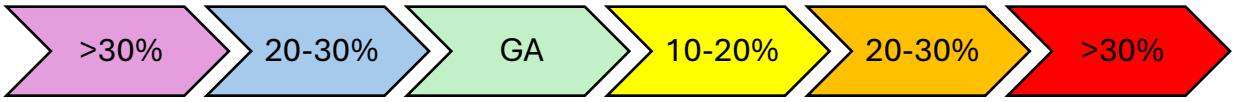
$$\% \text{ Error} = \frac{\text{Absolute value of (Laboratory result – GA concentration) x 100}}{\text{Laboratory result}}$$

DATA

Feed tags generally list nutrient concentrations as "Maximum" or "Minimum", so the data was categorized by whether it conformed to the GA and how accurately. "Conforms to GA" means that the concentration of the nutrient is above the minimum or below the maximum value stated.

Six levels of conformance were created:

- **A.** Conforms to GA (min or max) but with >30% error (purple)
- **B.** Conforms to GA (min or max) with >20% and <30% error (lt. blue)
- **C.** Conforms to GA with <20% error **OR** does not Conform to GA but is <10% error (green)
- **D.** Does not conform to GA, >10% and <20% error (yellow)
- **E.** Does not conform to GA, 20% to <30% error (orange)
- **F.** Does not conform to GA, >30% error (red)



CONFORMS to GA NON-CONFORMING

Category C would be the optimum category for each nutrient, and as noted, many analytes do fall within those parameters. All samples had at least two analytes fall outside this category. The worst-performing samples had (1) eight of twelve nutrients and (2) four of five nutrients fall outside of this range. All the samples had at least one parameter that did not conform to the GA.

Table 1 provides the number of samples which fell into each category:

TABLE 1

	A	B	C	D	E	F
DE			8		4	2
Protein	2		13			
ESC	2		5	3	4	
Starch	2	2	6	3	1	
Calcium			14			1
Phosphorous		2	11	1		1
Magnesium			9	1		1
Potassium		1	9			1
Sodium			9			2
Zinc	3	3	7	1		1
Copper	2	2	8		1	2
Manganese	1		9			1

Table 2 is a breakdown of percent error by sample, including the color code for the percent error. (White blocks indicate that the GA did not list that nutrient, and it was not included in the data analysis)

TABLE 2

	23001	23002	23003	23004	23005	23006	23008	23009	23010	23011	23012	23013	23014	23015	23016
DE (Mcal/kg)	35.74	26.92	30.77	26.92	2.33	20.88	3.23	5.77	10.34	12.50	3.85	10.71	2.56	26.28	------
Crude Protein (%)	32.43	9.38	14.29	21.38	9.94	4.76	3.78	5.41	6.04	4.17	6.87	12.50	1.32	6.06	54.84
ESC	4.26	28.95	24.24	8.20	14.29	16.67	22.33	13.04	14.89	25.00	34.62	1.35	5.80	31.15	------
Starch	25.00	14.29	36.36	13.39	7.14	26.76	19.64	16.67	8.73	26.19	42.86	9.94	27.45	22.95	------
Calcium	4.35	7.28	9.09	9.52	1.96	13.53	4.46	5.00	5.11	4.26	21.88	6.25	4.17	15.79	62.96
Phosphorous	18.18	15.38	12.28	9.09	1.52	20.00	6.83	32.29	15.49	0.00	29.82	23.08	11.11	0.00	14.29
Magnesium	11.76	2.44	3.23	11.11	------	------	4.76	------	0.00	33.33	13.16	0.00	15.38	2.94	------
Potassium	37.93	14.53	23.08	0.90	------	------	5.06	------	19.35	13.33	25.00	28.57	23.08	0.81	------
Sodium	21.21	19.05	0.00	1.35	------	------	31.03	------	3.23	17.19	205.56	16.67	2.99	114.29	------
Zinc	1117.39	28.57	6.84	35.48	25.44	22.22	13.92	4.11	17.01	31.03	24.91	27.54	0.67	1.10	77.50
Copper	2757.14	6.06	35.14	13.79	30.38	1.23	1.32	25.00	28.57	15.49	23.61	21.05	6.38	13.92	79.34
Manganese	739.29	15.66	13.04	43.45	23.30	------	10.78	------	7.51	7.26	26.42	16.08	17.45	------	------

Table 3 provides the average percent error, maximum % error, and minimum % error for each of the analytes of interest. If a GA did not provide information on a specific nutrient, that data was not included.

TABLE 3

Parameter		No samples reported	Avg. % Error	Max % Error	Min % Error
DE (Mcal/kg)		14	15.6	35.7	2.3
Crude Protein (%)		15	12.9	54.8	1.3
ESC		14	17.5	34.6	1.4
Starch		14	21.2	42.9	7.1
Calcium		15	11.7	63.0	2.0
Phosphorous		15	14.0	23.1	0.0
Magnesium		11	8.9	33.3	0.0
Potassium		11	17.4	37.9	0.9
Sodium		11	39.3	205.6	0.0
Zinc*		14	22.6	77.5	0.7
Copper*		14	21.5	79.3	1.2
Manganese*		10	18.1	43.5	7.3

* In sample 23001, the percent error for Zinc, Copper and Manganese were 600%. These values were omitted from the average to prevent seriously skewing the data. It is noteworthy, however, that these analytes were far below the minimum that the feed tag guaranteed.

How Much Difference

Horses don't eat percents, nor do they eat parts per million (ppm). Horses eat Kilograms, grams, pounds and ounces. So, it's not just a matter of the percent error. The error has to be applied to the amount of feed provided to the horse to determine the real difference in feeding rate of any nutrient.

The samples taken varied in feed type. Categories of feed included performance feeds, ration balancers, complete senior feeds and senior feeds that were not intended to be fed as forage replacement. Each type of feed is formulated to be fed at a specific feed rate, and those feeding directions are found on the feed tag. Fed at the specified minimum rate, the feed is purported to deliver enough vitamins and minerals to meet the horse's daily requirements. Given the assumption that we have a 1000-pound horse, we calculated the amount fed per day of each feed if provided at the minimum feed rate instructions on the tag.

Feeding rate (FR) (lb/day) x 454 g/lb = grams fed per day

Table 4 assesses the difference between the amount of nutrient fed based on the GA and the reported sample concentration. Differences were calculated as follows (Percent is expressed as a decimal (72% = 0.72)):

For values reported in percent:

(Lab result % x FR) – (GA% x FR) = difference in grams

For values reported in ppm:

$$\frac{\text{(Lab result ppm x FR) – (GA ppm x FR)}}{\text{1000 mg/g}} = \text{difference in mg}$$

Positive values mean that the amount of nutrient fed is higher than the GA reports, and negative values mean that the amount of nutrient fed is lower.

The units for these differences follow:

- KCal for DE
- Grams for Protein, ESC, Starch, Ca, P, Mg, K and Na
- Milligrams for Zn, Cu and Mn.

TABLE 4

	23001	23002	23003	23004	23005	23006	23008	23009	23010	23011	23012	23013	23014	23015	23016
Parameter															
DE (Kcal)	400	-2289	-2180	-2671	-189	-1539	45	-405	-600	180	-318	-818	-36	-2618	
Crude Protein (g)	27	41	55	108	44	19	5	22	18	-5	-29	55	2	34	463
ESC (g)	1	60	44	16	19	-27	10	25	14	11	-57	-3	2	-65	
Starch (g)	-1	16	-87	48	27	-104	5	-55	22	5	-114	44	-6	-95	
Calcium (g)	0	10	3	-3	1	5	1	4	5	1	7	1	-3	10	46
Phosphorous (g)	1	3	2	2	0	4	0	8	2	0	5	3	-1	0	16
Magnesium (g)	0	0	0	-2	11		0		0	-3	2	0	-1	0	
Potassium (g)	-1	5	8	0	31		0		5	1	13	10	1	0	
Sodium (g)	-1	-3	0	0	10		1		0	0	-12	3	0	-11	
Zinc (mg)	-231	283	-22	384	158	218	-50	16	82	203	232	155	-2	10	1501
Copper (mg)	-87	-11	-35	25	65	3	2	-22	52	25	54	44	-5	-37	523
Manganese (mg)	-186	71	41	232	112		13		26	20	251	63	42		

What does this mean?

Agricultural products vary greatly in nutrient content, and even if a company does a great job with quality control on incoming ingredients it is impossible to completely guarantee the nutrient content in a feed product. The only way to guarantee the nutrient profile in a feed product would be to institute a robust finished product quality control program. Even then, the variations due to the heterogenous nature of the mixing process makes complete uniformity impossible.

As a horse owner, that means that knowing exactly how many grams or milligrams of any nutrient you are feeding your horse is impossible. Stop trying to micro-manage your horse's diet! Between variations in hay (even if you test it) and the fact that GAs are less than perfect, the idea of setting up a diet where the horse gets exactly all the percents and exactly all the ratios is unreasonable. Instead, perhaps consider creating a diet that, on paper, exceeds the minimum requirements but doesn't provide nutrients in extreme excess. Contact a trained nutrition advisor or PhD Nutritionist for help making sure you have the best diet for your individual horse!