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May 4, 2005

To: DPAG
From: Dr. Meyer
Re: Clarification of items from Monday's meeting May 1, 2005 and question from May 4 am draft.

1. There are insufficient data for us to adequately determine an emissions factor. For some of the categories of compounds there are NO data available that are useful for emissions determinations.

2. One of the key items we have observed through the various presentations is that when multiple days of samples are taken the same compounds do not appear at all samplings and when they do appear their concentrations are markedly different. This was consistent across all scientists. The message here is that real world activities have different compounds and concentrations at different times and days. The data clearly identify that there is no defensible reason to select data from various research projects and combine them together. Furthermore, when measureable values were detected there were sizeable variations.

3. Comparison of emissions from beef slurry studies to open-lot, freestall facilities has no basis. Many of the studies do not adequately define their "manure" to understand the feedstuff for the slurry systems to be able to determine if the results of the slurry can be interpreted. It is common in the literature for scientists to report manure was used when only feces were used.

4. Feces from US feedlots will contain relatively high concentrations of starch. The primary substrate for the VFA (volatile fatty acid) emissions in many of these studies is starch. It is therefore essential that if someone is going to extrapolate beyond the means of beef slurry data (i.e. erroneously apply it to dairy manure) then one would at a minimum need to adjust for starch excretion. It is certainly reasonable to adjust beef slurry studies from US systems downward to 1/8 or ¼ if used for dairy based on starch excretion values. Archibeque et al., 2005 reported that feeding high moisture corn instead of dry rolled corn reduced starch excretion from 448 to 292 g/hd/d. Feeding of dry rolled corn is a common practice in feedlots. Miller and Varel have determined that malodorous VFA production is related to starch fermentation rather than protein or other carbohydrate fermentation. The following table summarizes information published in the Journal of Dairy Science related to starch digestibility from different studies conducted at U.C. Davis. In all of these studies, animals were fed more starch (13 to 15% of diet dry matter) than is typically fed to lactating animals in commercial dairies in California (near 10%). Many diets fed to lactating cows in California contain numerous by-product feeds. All of the papers included in this analysis reported diets that were manipulated to make higher than average starch concentration for experimental purposes. Actual field digestibility values are expected to be higher when fed at lower starch concentrations. Additionally, feeding of dry rolled or dry cracked corn to lactating cows in California is uncommon in 2005.

J. Dairy Science Avila, DePeters, Perez-Monti, Taylor, Zinn 2000

	Control	Tallow	Blend	Yellow grease	Treatment average
dry matter intake kg/hd/d	23.9	24.9	25.0	25.0	
starch Intake kg/hd/d	3.3	3.2	3.1	3.0	
starch intake as % dry matter	13.8	12.9	12.4	12.0	
digestibility	94.6	97.0	95.0	96.7	96.2
excretion g/hd/d	178.2	96.0	155.0	99.0	116.7

J. Dairy Science Joy, DePeters, Fadel, Zinn 1997

	DR corn	39 sf	31 sf		
dry matter intake kg/hd/d	20.1	20.1	21.0		
starch Intake kg/hd/d	2.9	2.9	3.2		
starch intake as % dry matter	14.4	14.6	15.2		
digestibility	78.0	85.1	94.4		89.8
excretion g/hd/d	638.3	435.7	179.2		307.4

note: dry rolled corn is not fed much in California to lactating cows.

J. Dairy Science Espindola, DePeters, Fadel, Zinn Perez-Monti 1997

	Dry rolled wheat	Steam rolled wheat	Steam Rolled Wheat		
dry matter intake kg/hd/d	24.5	23.6	23.4		
starch Intake kg/hd/d	3.7	3.5	3.5		
starch intake as % dry matter	15.1	14.8	15.0		
digestibility	99.3	99.3	99.3		
excretion g/hd/d	25.9	24.5	24.5		25.0

If we assume starch is fed at 10% of diet dry matter and dry matter intake ranges from 20 to 35 kg/hd/d (the latter would be much higher producing cows than reported in these papers) intakes would be 2 to 3.5 kg of starch (Dr. Peter Robinson, UC Davis Dairy Nutrition Specialist). Using a digestibility range of 98% one would estimate 40 to 70 g/hd/day excretion of starch (average 55 g/hd/d). The ratio of feedlot manure starch per head per day to dairy manure starch is 448/55 8:1 to 292/55 4:1 when using the Archibeque data as a reference.

Avila, C.D., E.J. DePeters, H. Perez-Monti, S.J. Taylor, and R.A. Zinn. 2000. Influences of saturation ratio of supplemental dietary fat on digestion and milk yield in dairy cows. J. Dairy Sci. 83: 1505-1519.

Espindola, M.S., E.J. DePeters, J.G. Fadel, R.A. Zinn, and H. Perez-Monti. 1997. Effects on nutrient digestion of wheat processing and method of tallow addition to the diets of lactating dairy cows. J. Dairy Sci. 80: 1160-1171.

Joy, M.T., E.J. DePeters, J.G. Fadel, and R.A. Zinn. 1997. Effects of corn processing on the site and extent of digestion in lactating cows. 1997. J.Dairy Sci. 80: 2087-2097.

5. Hobbs et al., 2004 made four assumptions in their work: 1) emissions from manure from grazing and housed livestock are the same as those determined from a stored

manure surface; 2) aging waste has a similar reduction in emission rates of NMVOCs to that for ammonia; 3) emissions of ammonia, NMVOCs and odours from manure are a result of decay processes of organic matter; 4) stored solid manure has similar ammonia and NMVOC emissions to those of liquid manure (2-8% dry matter). For the first assumption to be true grazing and housed animals would need to consume the same diet. Nutrient amounts consumed on a daily basis effect manure composition and subsequent decompositon and decompositon intermediary metabolites. N excretion from cattle can vary by 15 to 20% based on diet. This potentially will alter N emissions in the manure system and is not necessarily linked to NMVOC emissions. Evidence is not presented to support assumptions 1, 2, and 4. In fact, the manuscript specifically says on page 1418 column 2 "We did not find a significant correlation between NMVOC and ammonia emissions for dairy cattle slurry, as the former were too low." NOTE: IF IN FACT THE NMVOC EMISSIONS ARE FROM ENTERIC OR FEED SOURCES one does not anticipate that there would be a high correlation between NMVOC and NH_3. The emissions of NH_3 in a short term study is predominatly assumed to be from hydrolysis of urea (a urine compound) with only very small amounts coming from feces. Over time, breakdown of organic N can yield NH_3. There may be some isolated cases where emissions within a facility or location are correlated. However, NH_3 emission from manure is highly diet dependent.

The study reports that 1 m^3 of manure was collected and stored in 200 l containers for duplicate analysis. Yet, throughout the remainder of the manuscript it is not clear what was done with the duplicate measurements. The authors imply the slurry was stirred (P1416 Column 1). It is not clear how full the containers were or how they were enclosed. Headspace gas was sampled. It is not clear where these samples were obtained.

6. Use of data from McGinn should not occur. These are feedlot data. They do not apply to dairies based on the discussion in item 4. In addition to the concern of starch excretion differences there are typically differences in animal stocking densities. Further, the McGinn study had considerable rainfall.

7. The Idaho data have been used and the research has not been provided for committee members to understand the context of the data.

8. How are the 18 and 25% values derived for VFA emissions from McGinn and Ngwabie?

9. The study by Rabaud et al., 2003 was done to identify and quantify VOC emitted from a commercial dairy. Reported in the study were minimum and maximum air concentrations. There were a total of 48 samples. The manuscript does not contain the minimum detection concentration. It also does not define a mean or the variation associated with multiple samples. If one wanted to establish a relationship between VFA and amines one would need to do it on a per sample basis and NOT by taking either the sum of the minimum or the sum of the maximum values and establishing a relationship. Either 4 or 5 samples had detectable values for VFA. There were 4 with Acetic acid and 1 with Valeric acid. It is impossible to determine if the Valeric also had Acetic Acid. NOT A SINGLE COMPOUND USED IN THE VFA:AMINE CALCULATION WAS DETECTED IN 50% OF THE SAMPLES. Interestingly enough, compounds detected in only one sample were identified as maximum with no minimum value. THERE IS INSUFFICIENT INFORMATION PRESENTED TO DO ANY KIND OF VFA:AMINE RELATIONSHIP CORRELATION. Any such calculation is not defensible.

10. Where did an amine to ammonia ratio come from for the calculation to estimate amines from Ngwabie's paper.

11. There was a brief discussion regarding the use of ionophores in lactating cattle diets. A manuscript was emailed out to the group before the May 1 meeting. This manuscript contained information in many other manuscripts. There is no change in total volatilve fatty acid formation within the rumen although the proportion of propionate is increased slightly and acetate is decreased slightly. Less methane is formed in the rumen as a result of less free hydrogen. Slightly less feed is needed to obtain the same amount of milk solids production thereby actually reducing manure solids excretion and methane emissions from the animal. Some amount of the ionophore does pass through the animal. At this time there are not studies regarding the effect of the ionophore on manure decomposition. There have been anecdotal comments from individuals regarding methane production in systems. Initially after the ionophore in introduced into the animals methane yields are reduced. After a short time, the yields return to their normal function. It is believed that 3 holding times are sufficient for the microbes to return to their normal activity.