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## Introduction

Determination of fetal hepatic mineral content is used diagnostically to evaluate potential role of nutritional status in fetal disease processes. Most laboratories express hepatic mineral content on a wet weight basis; however, hepatic dry matter increases with fetal and postnatal age. The objective of this study was to develop a predictive model to estimate fetal liver dry matter (DM) content for use in determining dry weight mineral content for interpretation.

## Methods and Materials

Paired maternal and fetal liver samples (n=191) were collected at an abattoir as part of a study to evaluate hepatic mineral interrelationships. Breed, sex and measured crown-rump (C-R) length were recorded at time of collection. Fetal age was predicted from measured C-R length using published models for bovine fetal growth. Liver DM was determined in a convection oven in duplicate. Regression and ANOVA models were used to evaluate relationships between fetal variables and liver DM ratio. Fetal age and hepatic DM relationships were compared to other similar abattoir (n=106) and submitted diagnostic laboratory (n=105) samples.

## Results and Discussion

Mean (range) fetal age and hepatic DM ratio in collected samples were 6.4 (3.8-9.4) months and .221 (.177-.284), respectively. Similar ranges in hepatic DM and fetal age were seen in all studies, though mean values were different across abattoir studies (Table 1). Maternal hepatic DM content was greater than fetal values within and across abattoir studies. This observation suggests fetal and maternal interpretation of hepatic mineral concentrations should be on a dry weight basis.

**Table 1.** Comparisons between maternal and fetal hepatic dry matter content across two abattoir studies.

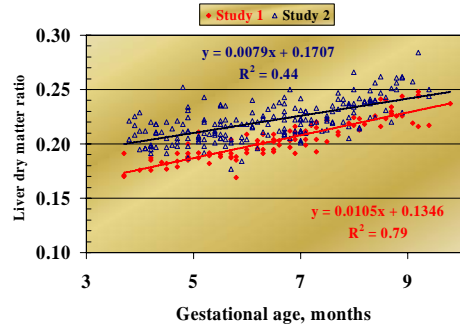
	N	Mean	Range	S.D.
<b>Maternal Liver Dry Matter Ratio</b>				
Study 1	105	0.326 <sup>a</sup>	0.28 - 0.40	0.019
Study 2	181	0.312 <sup>b</sup>	0.24 - 0.41	0.024
<b>Fetal Liver Dry Matter Ratio</b>				
Study 1	106	0.205 <sup>c</sup>	0.17 - 0.25	0.018
Study 2	191	0.221 <sup>d</sup>	0.18 - 0.28	0.018
<b>Gestational Age, months</b>				
Study 1	101	6.6	3.7 - 9.8	1.6
Study 2	192	6.4	3.8 - 9.4	1.5

abcdP<0.0001

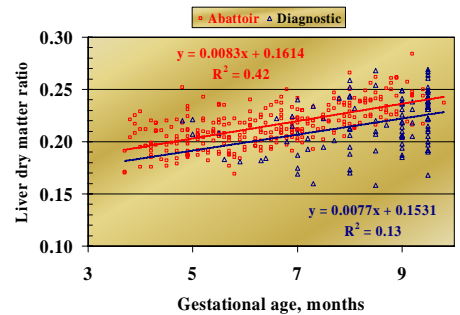
Fetal age was associated with hepatic DM ratio ( $r^2=.44$ ,  $P<.0001$ ), though not as strongly as observed in a previous abattoir study (Figure 1). Change in hepatic DM ratio by fetal age (.0079 DM ratio/month,  $P<.0001$ ) was not different ( $P>.3$ ) from similar regression coefficients in other abattoir (slope=.0105,  $P<.0001$ ) and diagnostic laboratory (slope=.0077,  $P<.0001$ ) datasets, though intercepts were different (.17, .13, .15, respectively,  $P=.006$ ). However, there was a study by source (dam or fetus) interaction ( $P<.0001$ ) effect on hepatic DM ratio.

Relationship fetal age and hepatic DM content between combined abattoir data and diagnostic laboratory samples were compared (Figure 2). Diagnostic samples had much greater variation and lower association between fetal age and hepatic DM content. This lesser association may be due to improper sample handling adversely affecting DM content (i.e., desiccation or freezing). Use of altered DM content values to convert wet weight mineral concentrations to a dry weight basis will adversely alter the calculated value and its interpretation.

**Figure 1.** Regression of bovine fetal hepatic dry matter ratio on gestational age for two independent sets of samples collected from different abattoirs.



**Figure 2.** Comparison of regression models of bovine fetal hepatic dry matter ratio and gestational age for combined abattoir and diagnostic samples.



Using combined abattoir data (n=288), hepatic DM ratio was regressed onto fetal age (months) or C-R length (inches or cm). Final prediction models (95% confidence intervals [CI]) for fetal hepatic DM ratio are shown in Table 2.

**Table 2.** Linear regression models to estimate bovine fetal hepatic dry matter ratio from fetal age or crown-rump (C-R) length.

Independent Variable	Slope		Intercept		Overall Model	
	Mean	95% CI	Mean	95% CI	R <sup>2</sup>	P
Age (mo)	.0076	.0065 - .0086	0.17	.164 - .176	.42	<.0001
Crown-Rump Length						
Inches	.0013	.0011 - .0015	0.19	.183 - .191	.43	<.0001
Centimeter	.0005	.0004 - .0006	0.19	.183 - .191	.43	<.0001

## Conclusions

These prediction models can be used to estimate fetal hepatic DM when insufficient sample is available for DM determination or if improper sample handling occurred, thus altering DM ratio. Diagnostic interpretation of fetal hepatic mineral concentrations on a dry weight basis eliminates confounding effect of changing DM content. Fetal hepatic dry weight mineral concentration criteria need to be characterized.

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