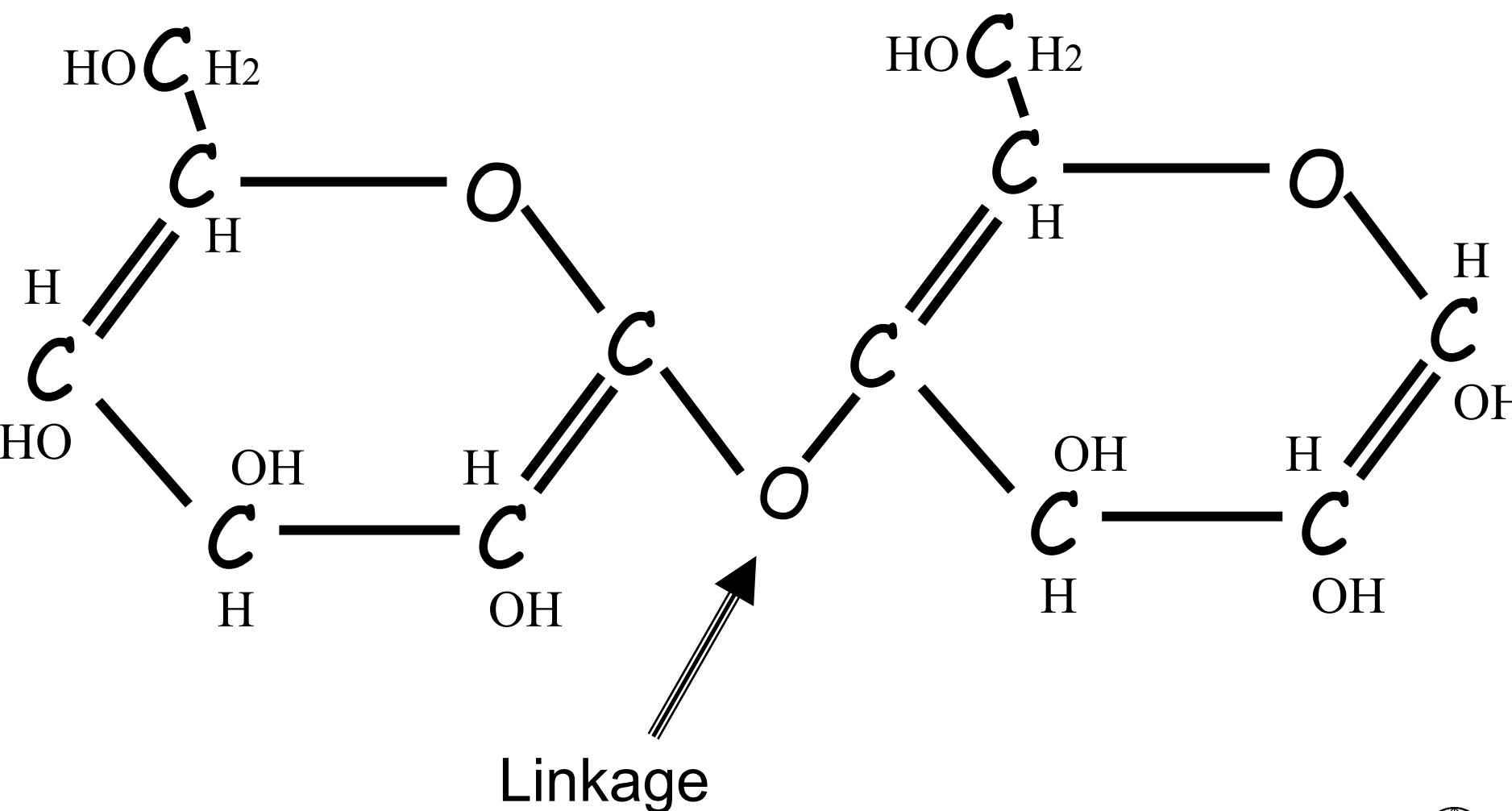


Sugar?

Monosaccharides link to form complex CH₂O



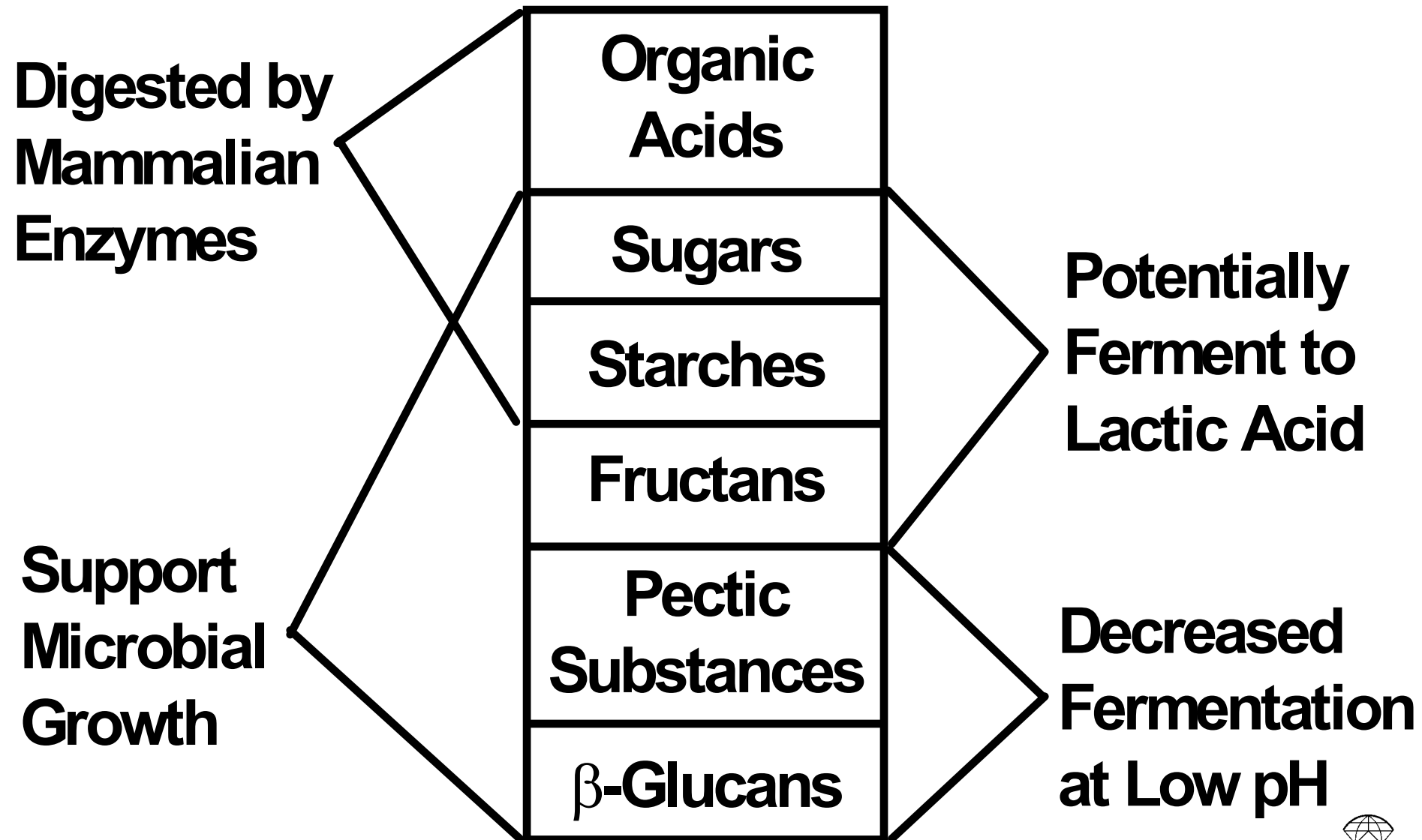
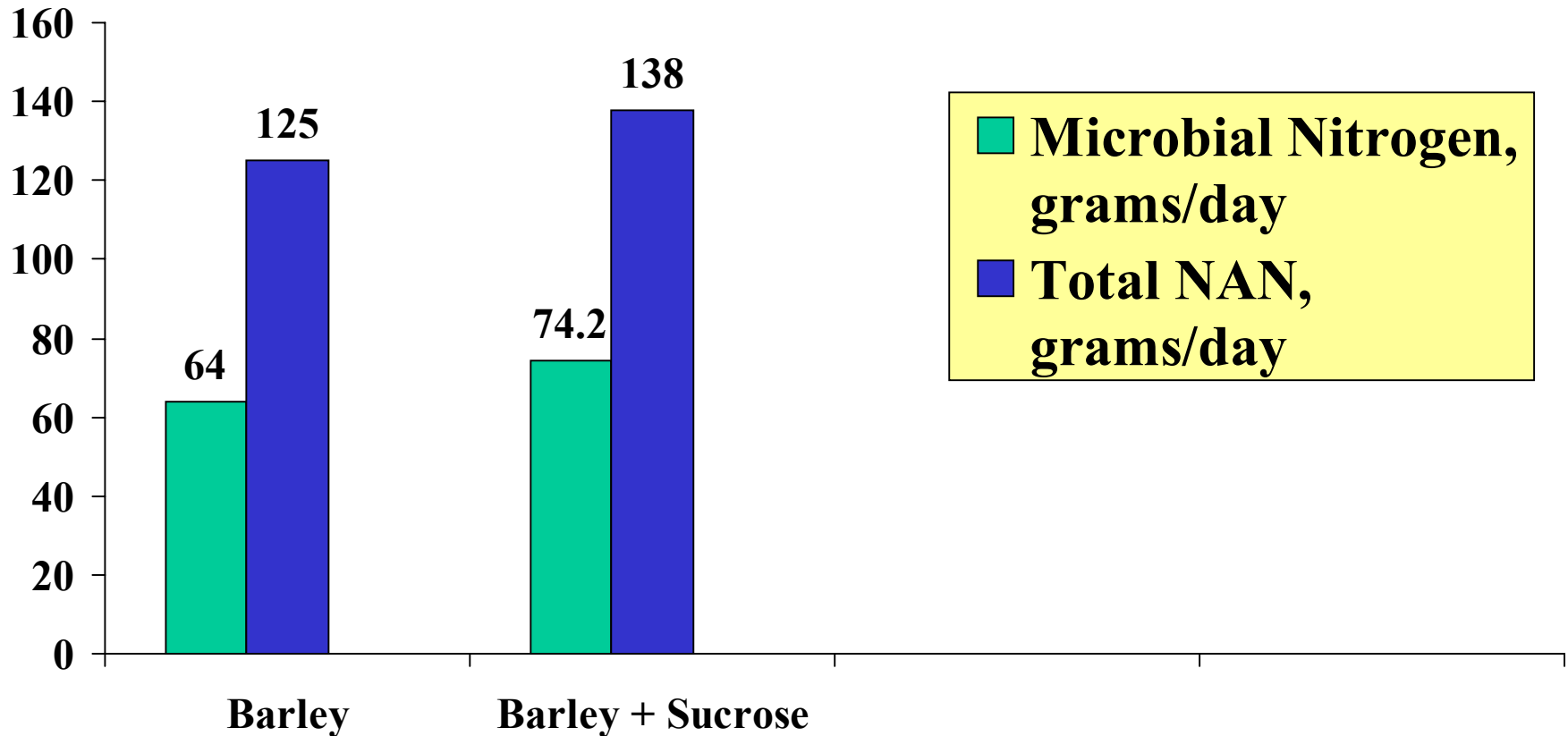


Table 1. Composition and Digestion of Carbohydrate Fractions in CNCPS

Composition	Rumen Digestion (%/h)	CNCPS Fraction
Sugars	200-350	A
Fermentation and Organic Acids	1-2	A
Starch	10-40	B ₁
Soluble Available Fiber	40-60	B ₁
Pectins		
B Glucans		
Insoluble Available Fiber	2-10	B ₂
Cellulose		
Hemicellulose		
Unavailable Fiber	0	C
Lignin		
Fiber associated with lignin		

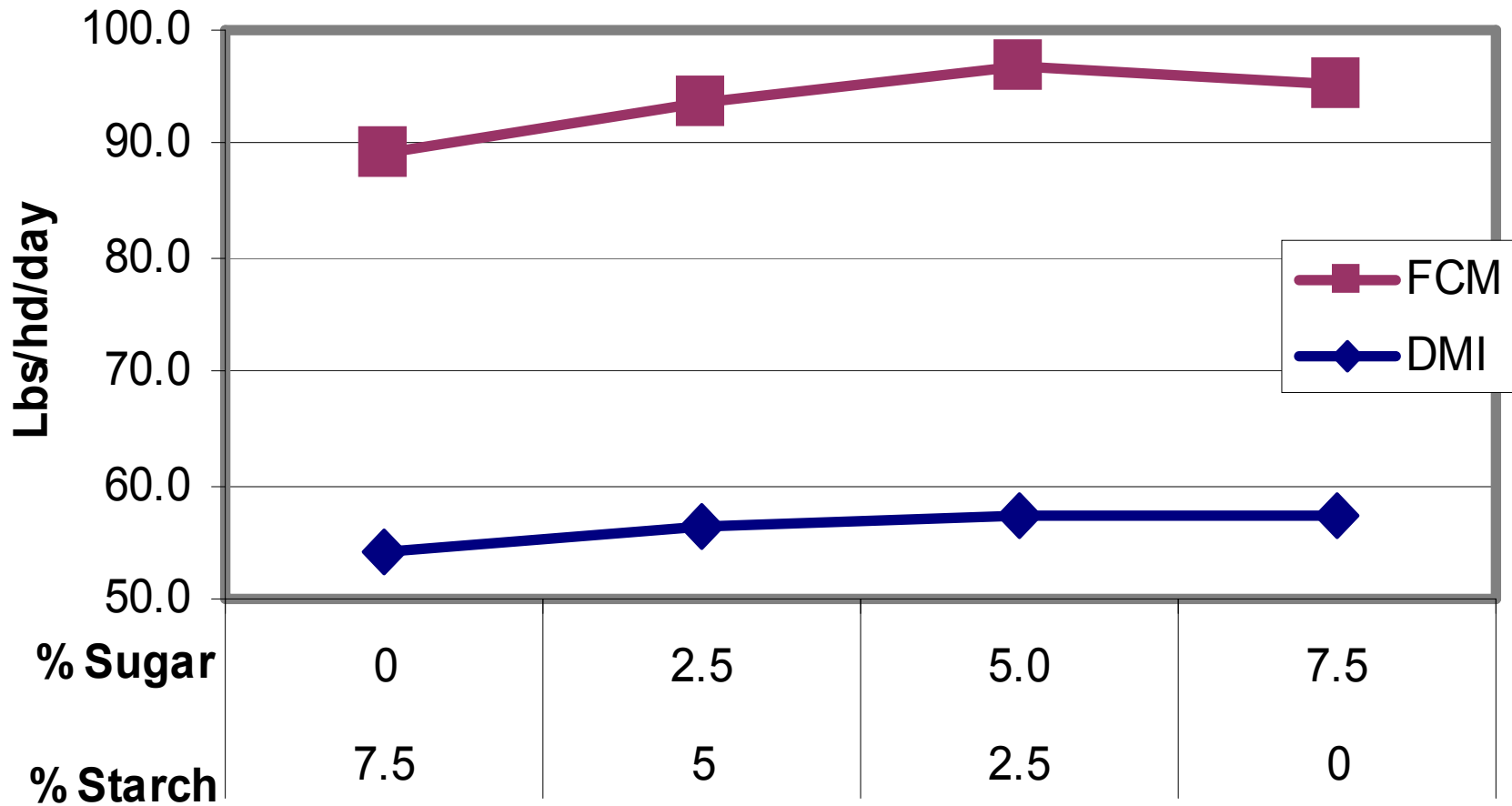
Impact of Sugar on Microbial Protein Production in Dairy Heifers fed a TMR



•Treatment effects are significant. Microbial protein was increased 14.5% and NAN was increased 10.2%

•Source: Piwonka and Firkins. 1993. OSU Research

% Sugar X Intake and Fat Corrected Milk



**Effect of replacing supplemental starch with sucrose
on lactation performance by dairy cows**
(Broderick et al., 2000)

	% sucrose	0	2.5	5.0	7.5
<u>Item</u>	% starch	<u>7.5</u>	<u>5.0</u>	<u>2.5</u>	<u>0</u>
DMI, lb/d		53.9	56.3	57.2	57.2
Milk, lb/d		85.6	88.9	88.0	86.7
FCM, lb/d		89.1	92.8	96.6	95.0
Fat, %		3.81	3.82	4.07	4.16
lb/d		3.23	3.37	3.63	3.56
Protein, %		3.24	3.22	3.27	3.30
lb/d		2.73	2.82	2.84	2.82



JDSA 2001 Abst - 815 Effects of replacing dietary high moisture corn with dried molasses on production of dairy cows.

Broderick* and W. J. Smith, *U.S. Dairy Forage Research Center, Madison, WI.*

HMSC %	29	25	21	17
<u>Molasses %</u>	<u>0</u>	<u>4</u>	<u>8</u>	<u>12</u>
DMI - Lb/day	55.3	56.9	57.8	57.3
Ib/day/FCM	91.3	92.6	95.7	87.1
Fat %	4.07	4.26	4.11	4.06
Fat - Lb/day	3.40	3.51	3.59	3.24
Protein %	3.12	3.09	3.11	3.04
Protein - Ib/day	2.62	2.51	2.71	2.40
SNF - Ib/day	7.45	7.28	7.70	7.01



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SNF - Ib/day	7.45	7.28	7.70	7.01
% Sugar - TMR	2.6	4.2	5.6	7.2

Making Nutritional Sense of Nonstructural Carbohydrates

Mary Beth Hall - University of Florida -

"inclusion of molasses (0, 4 or 8% of DM) in lactating cow rations varied in having positive or negative effects on milk yield, milk components, and DM intake."



Making Nutritional Sense of Nonstructural Carbohydrates

Mary Beth Hall - University of Florida -

" If they are added to the point that they depress pH, sugars can depress fiber digestion in the rumen, however, it appears that they may also be capable of enhancing it".



Sugar content

Florida - 2000

Ingredient	Alfalfa Hay	Alfalfa Silg.	Corn Grain	Corn Silg.
% Sugar	5.8 – 12.1	1.1 – 7.7	0 – 5.2	0.3 – 4.6

U. W. Va - 1997

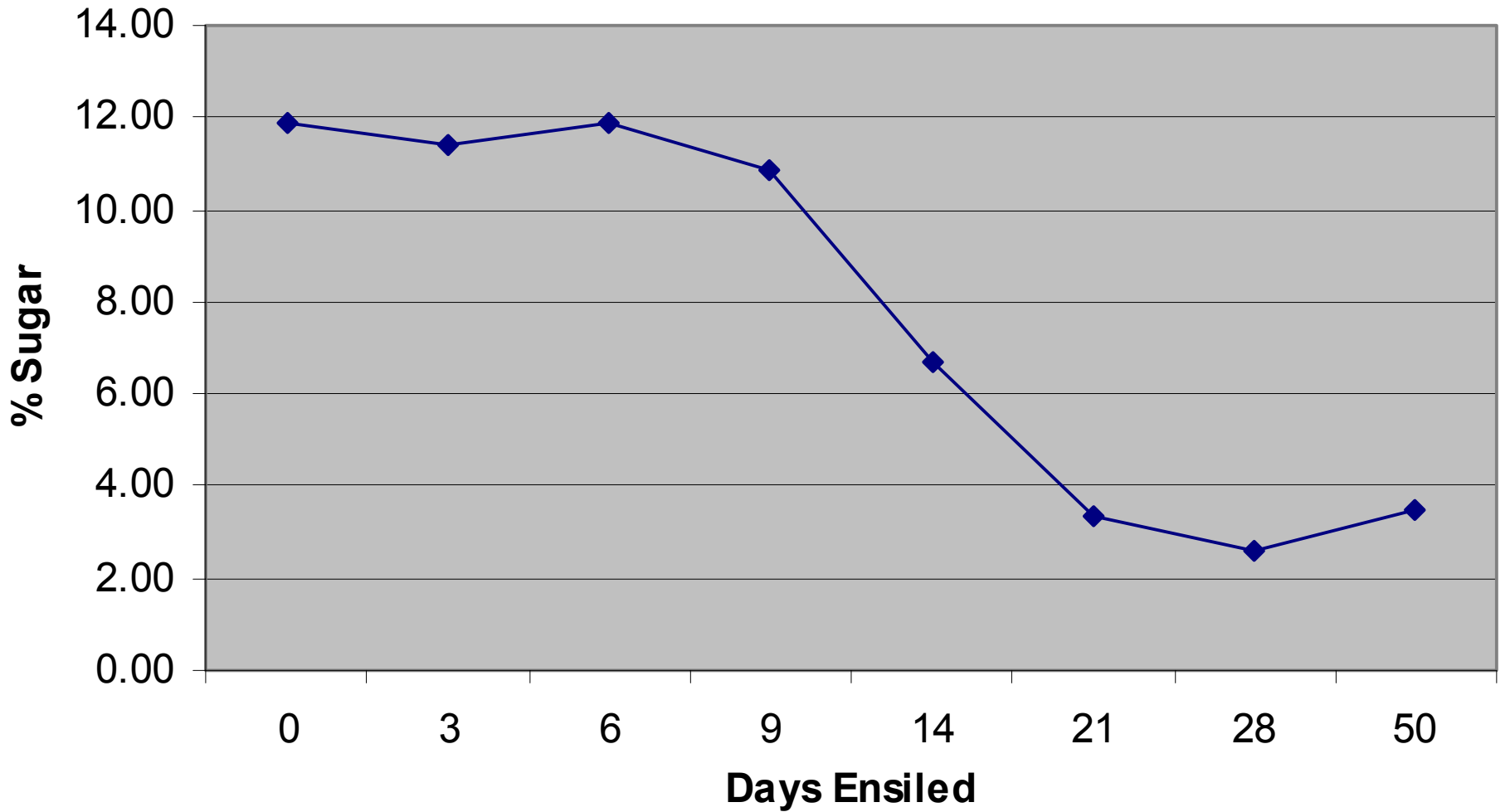
Freshcut Alfalfa	Alfalfa Silage	Alfalfa Hay	Grass Hay	Fresh cut Corn Plant	Corn	HM Ear Corn	Corn Silage
10.7	3.3 – 6.6	5.0 – 5.7	6.1 – 11.7	15.0	1.1	0.8 – 1.6	1.4 – 3.7



<u>Lab</u>	<u>Description</u>	<u>DM</u>	<u>Sugar %</u>
Cvly	Corn Silage	28.3	0.90
Cvly	Corn Silage	28.3	0.90
Cvly	Corn Silage	30.7	0.90
Cvly	Corn Silage	26.7	1.10
Cvly	Corn Silage	28.7	1.30
Cvly	Corn Silage	25.5	1.40
Cvly	Corn Silage	32.6	1.50
RFPL	Corn Silage	30.4	1.6
RFPL	Corn Silage	32.3	1.7
RFPL	Corn Silage	28	2
RFPL	Corn Silage	41.3	2
RFPL	Corn Silage	39	3.2
RFPL	Corn Silage	38.1	3.2



Corn Silage Sugar Content



<u>Lab</u>	<u>Description</u>	<u>DM</u>	<u>Sugar %</u>
Cvly	Haylage	27.3	0.70
Cvly	Haylage	23	1.10
Cvly	Haylage	31.4	1.40
Cvly	Haylage	30.4	1.40
Cvly	Haylage	36.9	1.60
Cvly	Haylage	35.3	1.80
Cvly	Haylage	30.5	1.90
Cvly	Haylage	31.1	2.10
Cvly	Haylage	40.7	2.20
Cvly	Haylage	18.7	2.30
RFPL	Haylage	43.7	2.6
Cvly	Haylage	35.3	2.80
RFPL	Haylage	46.5	3.8
Cvly	Haylage	28.9	3.90
RFPL	Haylage	42.8	5.1
Cvly	Haylage	59.8	5.80
Cvly	Haylage	51.6	6.20

<u>Lab</u>	<u>Description</u>	<u>DM</u>	<u>Sugar %</u>
Cvily	TMR ?	36.3	1.10
Cvily	TMR ?	37.3	1.30
Cvily	TMR	45.2	1.60
Cvily	TMR ?	41.6	2.30
RFPL	TMR	44	2.40
RFPL	TMR	51.2	2.50
RFPL	TMR	56.1	2.50
RFPL	TMR	55.3	2.50
RFPL	TMR	42.6	2.90
RFPL	TMR	57	3.90
Cvily	TMR ?	40.7	4.10
Cvily	TMR ?	42.7	5.10
Cvily	TMR	45.3	5.20
Cvily	TMR	41.4	5.60
Cvily	TMR	48.9	6.00
Cvily	TMR ?	37.7	6.00
Cvily	TMR	50.3	8.40

From Miner Institute Monthly report – Oct '00

“There have been questions on whether we should put sugar in the ration and if so how much? There seems to be high ammonia concentrations in the forage, what should we do about it? What about the starch level in the ration and what should we do about low fiber digestibility?

My answer to these questions is to first to analyze the forages for pH, ammonia, sugar, starch, fermentation acids and fiber digestibility. With this information, it is then possible to make some decisions about ration formulation. We need to formulate the total lactating ration to have 4 to 6% of the DM to be sugar. The base ration this year will probably be about 1 to 2% DM as sugar. You can meet the sugar by using sources such as beet or citrus pulp (citrus is higher), molasses, sugar, and whey. “



Sugar Sources

<u>Ingredient</u>	<u>% Sugar</u>
Molasses	43
Liquid Supplements	~30
Bakery/Cookie Waste	5.5 – 16.6%
Chocolate BP	29.6 – 34.1
Citrus Pulp	29.9 -
Beet Pulp	0.6 – 2
Condensed Whey	16.5



Indicators to Add Sugar

- Rumen soluble protein is high
- Ensilages are poorly preserved
 - High VFA / Extremely low or high dry matter
- Hay is poor quality
- Intake is low
- Ration sugar content is below 4%

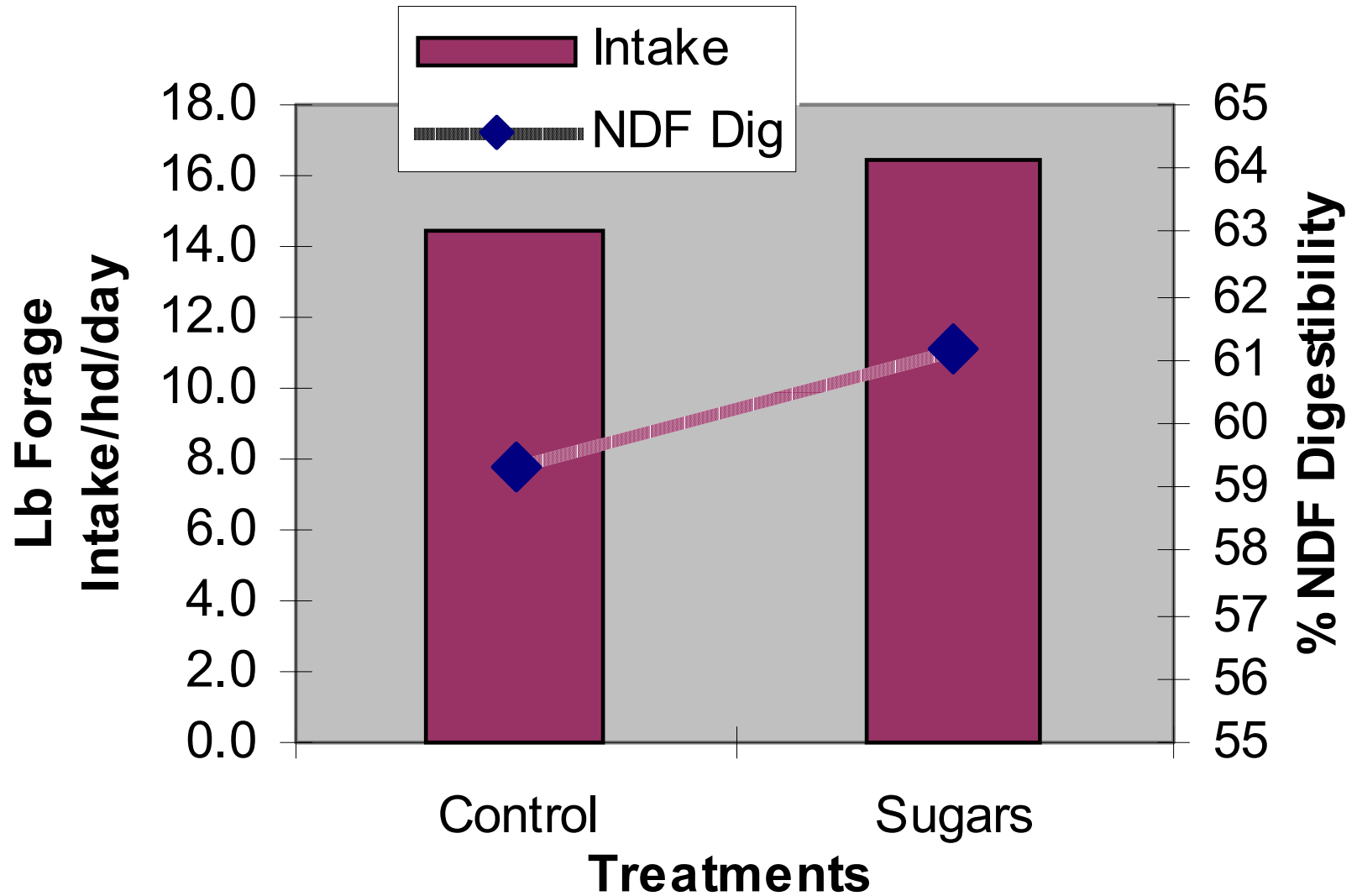


Molasses/Liquid Supplements

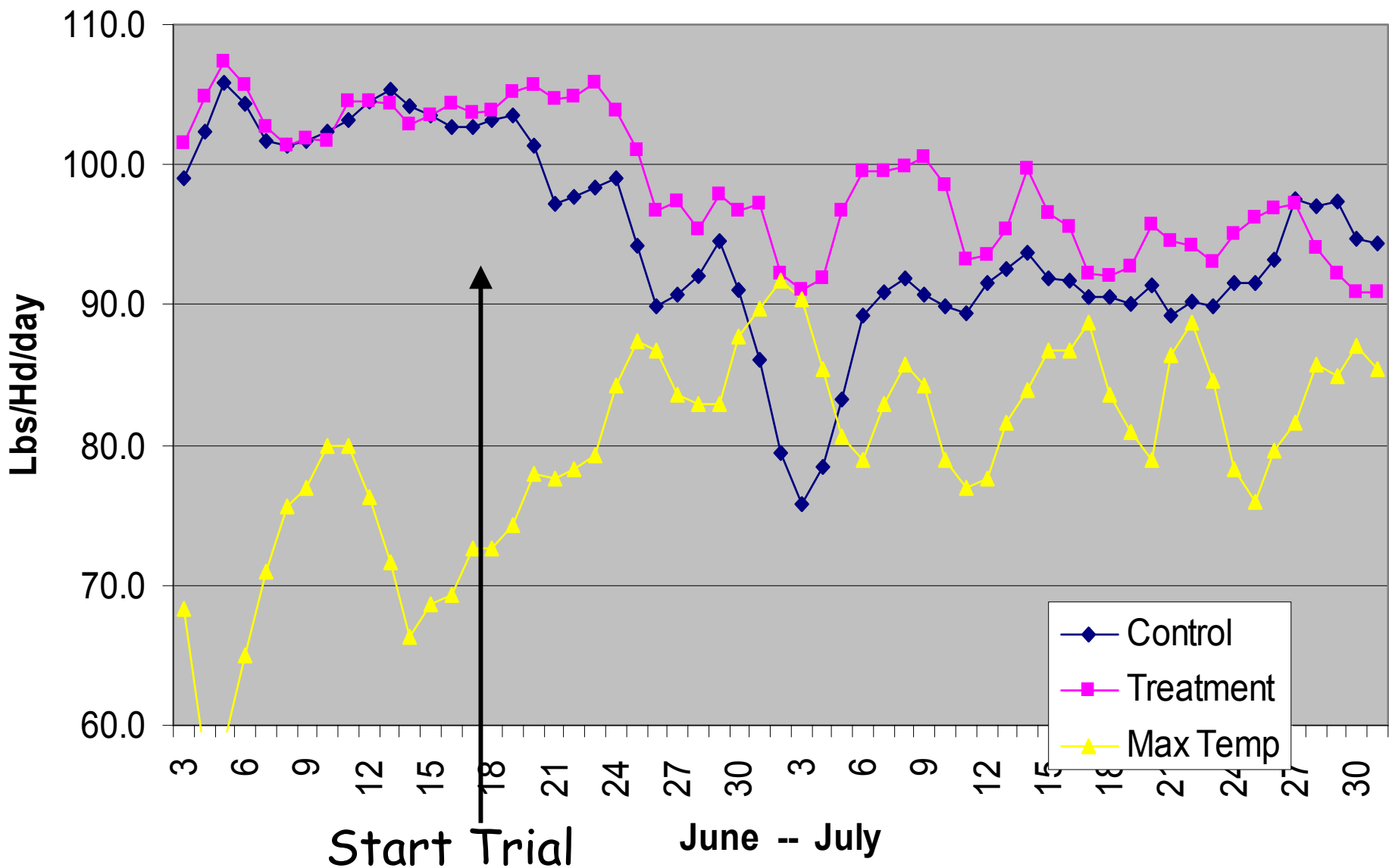
- Liquids do more than supply sugar
 - Carry other nutrients
 - Palatability
 - Dust Control
 - Mix Integrity



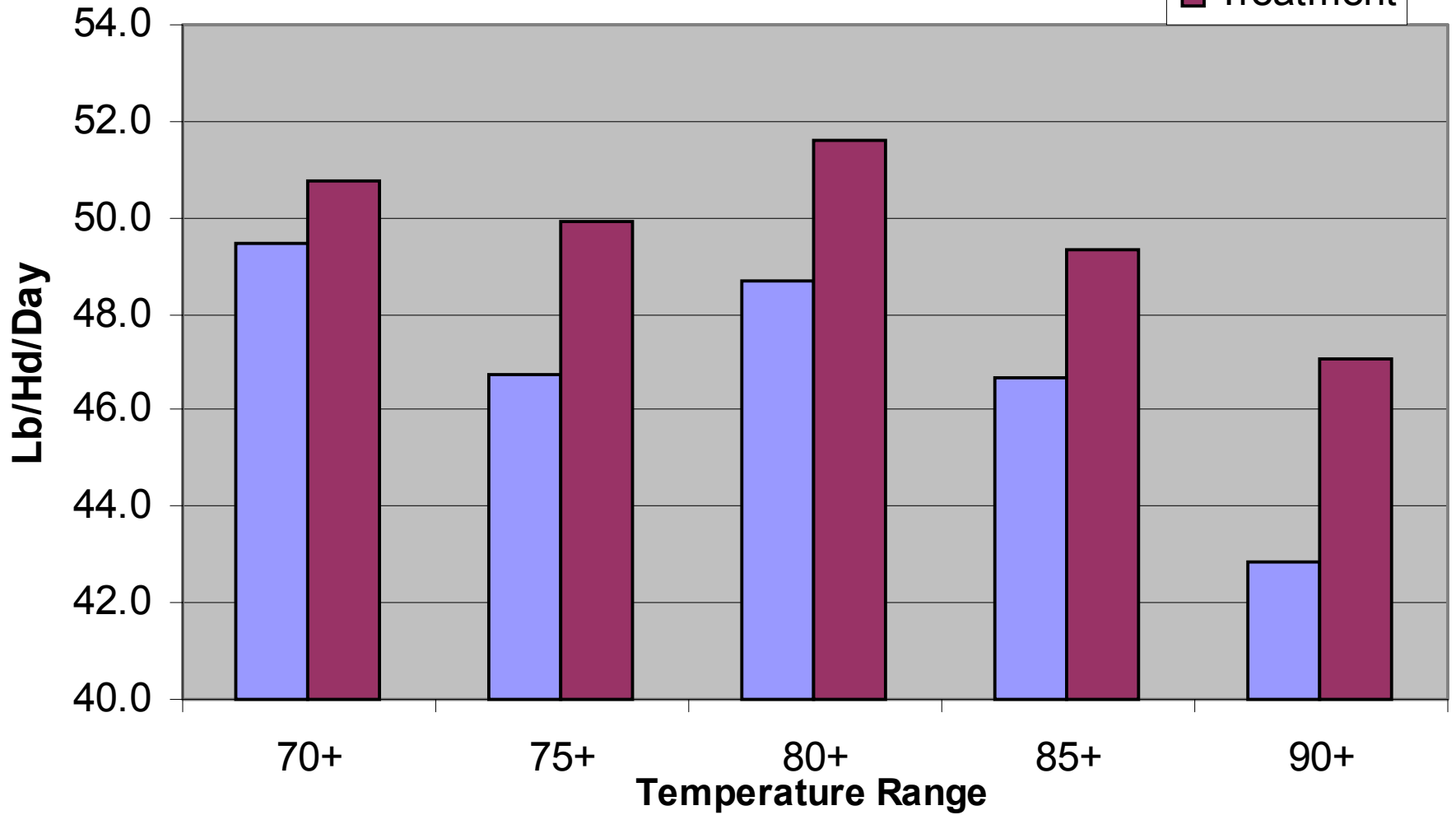
Effect of Sugar on Forage Value



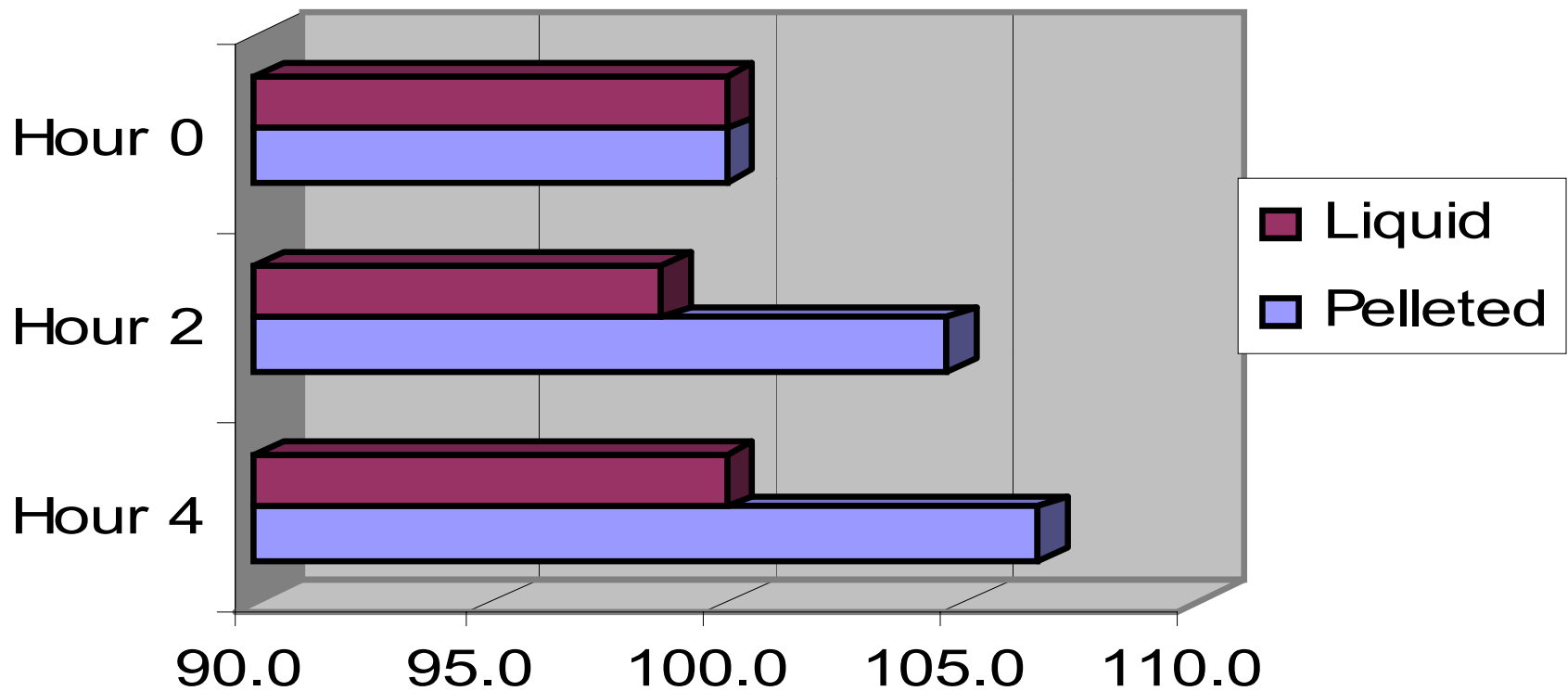
As Fed Feed Intake - Rolling 3 day averages



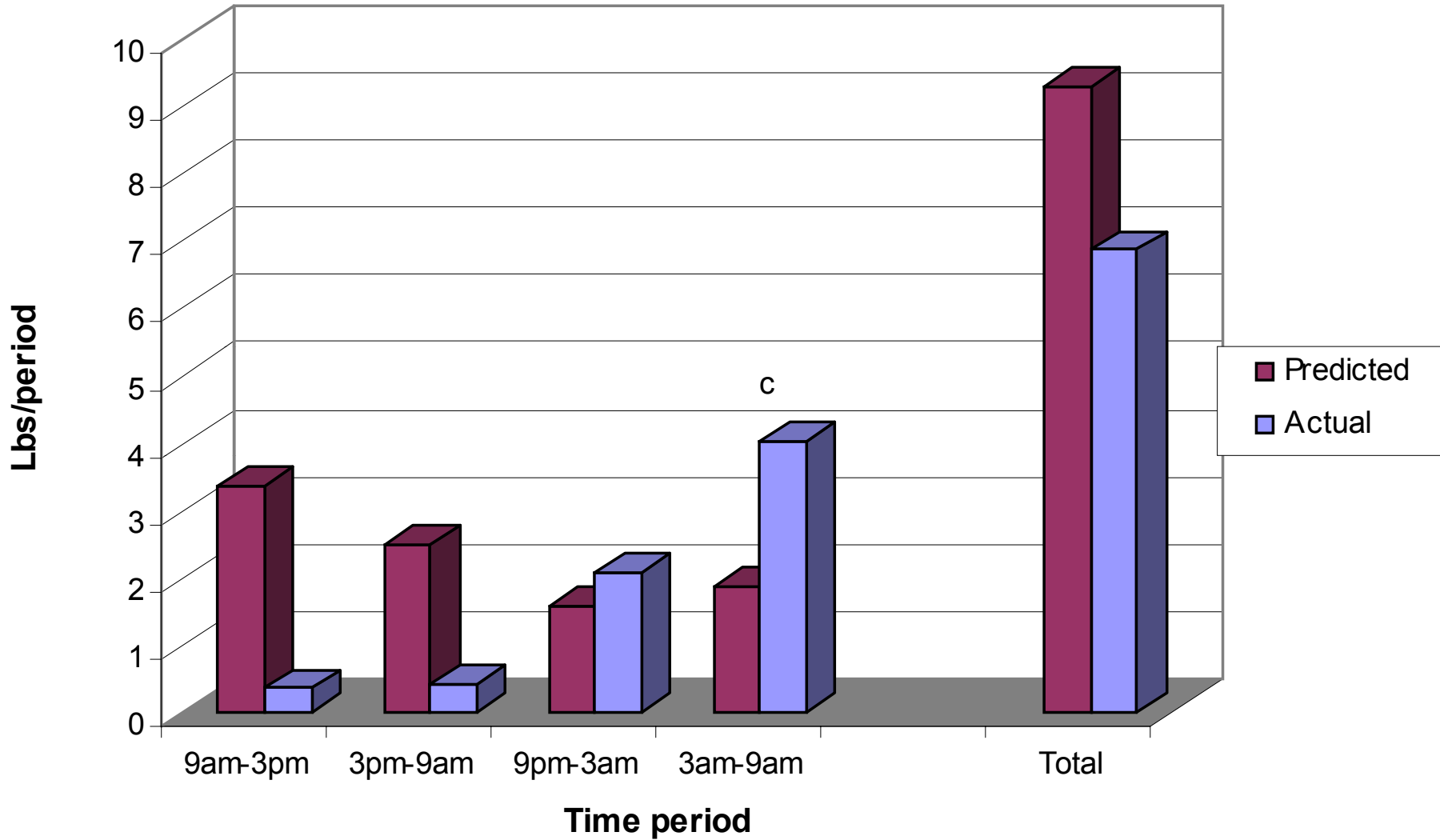
DMI x Temperature Range



% of Initial Concentration at Time after Feeding Composite of 3 Days Samples



Actual vs Predicted Long Fiber Intake



% Feed Retained on top shaker box before and after feeding

<u>Dairy</u>	<u>No Liquid</u>		<u>Liquid</u>	
	<u>TMR</u>	<u>Refusals</u>	<u>TMR</u>	<u>Refusals</u>
A	9.6	26.7	15.8	8.5
B	3.1	16.7	7.8	8.1
C	16.5	53.5	34.7	27.2
D	33.5	52.8	26.7	21.8
E	25.0	55.0	33.0	25.0
Average	17.5	40.9	23.6	18.1



Sugar

- Is a source of energy
- Is more rapidly fermented in the rumen than any other compound
- Like any other nutrient, can be used correctly or incorrectly
- Can be provided in an product that delivers other benefits

