AMMONIATED FEEDS

Ammoniated Industrial By-products in Dairy Heifer Rations

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Previous investigations have established that ammoniated industrial by-products are economical sources of nitrogen for beef cattle and sheep, but work on this nitrogen source is lacking in the dairy field. This experiment was established as preliminary to more investigation of the nutrition of dairy cattle. The supplementation of an ammoniated industrial by-product, hemicellulose extract (wood sugar derivative), at the 10% level in a grain ration for growing Holstein heifers was comparable in body weight gains and digestibility coefficients for crude protein (N × 6.25) to a similar grain ration supplemented with soybean oil meal. Ammoniated cane molasses at levels of 50% of the grain ration was not toxic when fed to a yearling dairy heifer. Many industrial plants in the United States have by-products that have been dumped into streams as wastes, causing pollution. If these by-products, upon ammoniation, can be used as economical nitrogen and energy extenders for ruminants, industrial plants and feeders of cattle, as well as consumers, may all benefit.

Sources of nonprotein nitrogen, such as urea (*1, 2, 4, 11–14, 17–19*), ammonium bicarbonate (*5*), and ammoniated beet pulp (*9*), can be utilized for growth and production by the ruminant.

Available industrial by-products containing readily fermentable carbohydrates have been ammoniated to increase their nitrogen content, thereby becoming a possible source of nitrogen for the ruminant. One of these by-products, hemicellulose extract (Masonite Corp., Laurel, Miss.), a pine wood sugar derivative, reacts with ammonia, increasing its nitrogen content to give a protein equivalent (N × 6.25) of 28.6%. The hemicellulose extract contains approximately 45% moisture, 5% ash, and 50% sugars (mono- and polysaccharides), with negligible fiber content. It has a gross energy content of 2638 cal. per gram as determined by bomb calorimeter.

Information concerning the value of ammoniated hemicellulose extract as a feed for the growing dairy heifer is lacking, although there have been investigations with related animals and similar products. It has been demonstrated (*7*) that dairy calves can use ammoniated cane molasses (13.8 to 19.4% protein equivalent) as a partial substitute for crude protein in their rations. The product gave good growth in older calves (12 to 16 weeks of age) when used at a 10% level of their rations. When 50% of the linseed meal was replaced with ammoniated cane molasses in a ration for beef cattle (*3*), better growth was obtained than with linseed meal as the sole protein supplement. Tillman and Kidwell (*16*) found no significant differences in gain when ammoniated condensed distiller's molasses solubles, condensed residue from yeast fermentation, replaced 25 and 50% of the molasses in a normal ration for growing beef cattle.

The study presented in this report was designed to determine whether ammoniated hemicellulose extract would have any nutrient value for growing dairy heifers when replacing the soybean oil meal in a grain ration fed at a generally used level.

Experimental Procedure

A 90-day feeding trial was conducted using eight nonpregnant Holstein heifers approximately 12 months old. After a preliminary feeding period of 15 days, body weights were recorded for 3 successive days and the heifers were divided into two similar groups of four each on the basis of body weights. Three-day body weights were then recorded each 30 days and the feeding was adjusted according to Morrison's (*10*) estimated requirements for growing dairy cattle for each successive 30-day feeding period.

Each heifer received 5 pounds of the grain mixture daily during the trial and sufficient timothy, clover, hay, and corn silage to meet requirements (*10*) for growth. The ammoniated by-product

Table I. Rations Used in Evaluating Ammoniated Hemicellulose Extract

Ingredients	Hemicellulose Extract Grain Ration, Lb.	Control Grain Ration, Lb.
Am. hemicellulose extract	10.0	. . .
Soybean oil meal	. . .	4.1
Peanut skins	12.5	20.0
Oats	20.0	20.0
Wheat bran	10.0	10.0
Hominy feed	45.0	43.4
Salt	1.0	1.0
Dicalcium phosphate	1.5	1.5
	100.0	100.0

of the hemicellulose extract ration replaced all of the soybean oil meal and 75 pounds of the peanut skins of the control grain ration as presented in Table I. The chemical composition of the concentrates, hay, and silage used is presented in Table II. Approximately 20% of the nitrogen required per heifer per day was supplied by the ammoniated product. The ammoniated hemicellulose extract, being a sirupy, even-textured molasseslike material of low viscosity, is easily mixed at the 10% level of the grain mixture. This rate is the generally used maximum level of molasses products in commercial rations for dairy cattle.

A grain mixture (1 to 1 corn and oats with 1% salt and 1% dicalcium phosphate) supplemented with ammoniated blackstrap (cane) molasses was fed ad libitum to another Holstein heifer in order to note if refusals, general ill effects, or digestive disturbances would occur because of the ammonia added or the higher levels of molasses fed in excess of the 10% level. The heifer was started on a grain ration containing 20% of the ammoniated blackstrap. This level was increased each 15 days by 10% until the ration contained 60% of this product—(i.e., 15 days each at 20, 30, 40, 50, and 60% levels); refusal occurred only on the 60% concentration. The ammoniated blackstrap molasses product had the following approximate chemical analysis: protein equivalent 18.6%, moisture 23%, ash 10%, reducing sugars 55%, and negligible fiber.

Condition of hair coats, general health and appearance, and condition of feces were observed and recorded throughout the trial on all heifers. Digestibility studies were conducted employing the chromium oxide method (*6*). These data are presented in Table IV. The data on actual body weights and gains were analyzed statistically by the analyses of variance and covariance (*15*).

Results and Discussions

The data presented in Table III compare the feed consumption and feed efficiency of the ammoniated hemicellulose extract grain ration with that of the control grain ration. The control grain ration required slightly less feed per pound of gain than did the extract ration, but the difference was not statistically significant. Low-protein mixed hay and corn silage were fed in approximately equal amounts to each group in order to meet their requirements (*10*) for growth. These roughages did not alter the difference in feed consumption or feed efficiency of the complete ration.

Analysis of variance of body weight gains and actual body weights as presented in Table IV did not reveal any significant difference between groups. The mean weight of the group receiving the hemicellulose extract ration was slightly less than that of the control group at the start of the experiment. This difference is evident throughout the 90-day feeding period. Because of this slight variation, analysis of covariance was used to eliminate the effect of differences in beginning weights, the results being compared with those obtained by analysis of variance. The adjusted mean gain for the group fed hemicellulose extraction was 123.7 pounds compared to 128.8 pounds for the control group. Statistical analysis did not indicate any significant differences between the two groups in rates of gain.

The digestibility coefficients of the total protein in the complete ration are presented in Table V. These data show some variability between individuals, but statistical analysis indicates no difference between the two groups. The lack of differences between groups demonstrates that the heifers fed the ammoniated hemicellulose extract ration were able to use the nitrogen supplied by the by-product as well as the control ration containing soybean oil meal.

The heifer receiving the ammoniated blackstrap molasses in excess of the 10% level continued to consume all her daily allotment of feed until fed at the 60% level. Ill effects and digestive disturbances were negative at this level and the heifer's general health and appearance were normal. When the level was lowered to 50%, the heifer immediately consumed all of the feed given her (average daily consumption of grain was 15.6 pounds per day for 90 days).

Table II. Composition of Grain Rations, Hay, Silage (% Basis) Used in Evaluation of Ammoniated Hemicellulose Extract in Rations of Growing Heifers

Ingredients	*Am. Hemicellulose Grain Ration*	*Control Grain Ration*	*Mixed Hay*	*Corn Silage*
Dry matter	90.89	90.17	93.00	24.70
Ash	5.02	4.44	4.66	6.98
Protein (N × 6.25)	14.00	14.00	9.20	2.98
Ether extract	7.22	9.74	2.56	3.05
Crude fiber	7.90	7.84	25.51	29.21
N-free extract	55.46	51.55	54.87	53.96

Table III. Feed Consumption and Feed Efficiency of Heifers Fed Ammoniated Hemicellulose Extract and Control Ration Containing Soybean Oil Meal

	Daily Grain Consumption per Heifer, Pounds		*Grain per Pound Gain, Pounds*	
Ingredients	*Hemicellulose extract ration*	*Control ration*	*Hemicellulose extract ration*	*Control ration*
Am. hemicellulose extract	0.50	...	0.36	...
Soybean oil meal	...	0.205	...	0.14
Peanut skins	0.625	1.00	0.45	0.70
Oats	1.00	1.00	0.72	0.70
Wheat bran	0.50	0.50	0.36	0.35
Hominy feed	2.25	2.17	1.62	1.53
Salt	0.05	0.05	0.036	0.036
Dicalcium phosphate	0.075	0.075	0.054	0.053
Total grain	5.00	5.00	3.60	3.51

Table IV. Body Weights and Body Weight Gains of Heifers Fed Ammoniated Hemicellulose Extract and Control Ration

		Body Weight, Pounds				*Gain, Pounds*	
Heifer No.	*Ration*	*Starting*	*30 days*	*60 days*	*90 days*	*Total*	*Av. daily*
992	Hemicellulose extract	665	715	770	798	133	1.48
993	Hemicellulose extract	662	752	772	822	160	1.78
996	Hemicellulose extract	729	760	759	822	93	1.03
997	Hemicellulose extract	788	828	861	901	113	1.26
Group av.		711.0	763.5	790.5	835.8	124.8	1.39
994	Control	700	745	813	838	138	1.53
995	Control	802	852	894	929	127	1.41
998	Control	816	852	887	911	95	1.06
999	Control	562	617	661	713	151	1.68
Group av.		720.0	766.5	813.8	847.8	127.8	1.42

Table V. Digestibility Coefficients (%) on Crude Protein of Complete Ration

(Grain concentrate, silage, and hay)

Heifer No.	Hemicellulose Extract Ration Crude Protein	Heifer	Control Ration Crude Protein
992	67.8	994	54.3
993	67.1	995	67.0
996	60.2	998	72.5
997	53.3	999	55.9
Av. per group	62.1		62.4

Hay and silage were kept at a minimum in order that the heifer would receive most of the protein equivalent content from the grain. The total protein digestibility coefficient for the total ration as determined at 50% ammoniated material in the ration fed to this animal was 60.6%, which compares favorably with the other animals on trial (Table III).

Ammonia nitrogen may be absorbed and excreted in the urine; however, other experimentation (*8*), using the same by-product with Holstein lactating cows, has shown no increase in ammonia nitrogen (Van Slyke–Cullen aeration method) or total protein in the urine when compared to the control ration not containing the ammoniated by-product (hemicellulose extract, 30.0 mg., and control, 28.0 mg. of ammonia per liter of urine, respectively).

Feed refusals, digestive disturbances, fecal abnormalities, and general ill effects were negligible on both rations during the 90-day feeding trial. Hair coats and general appearances of the heifers fed the hemicellulose extract compared favorably to the heifers receiving the control ration.

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Schradan Metabolism Related to Tissue Enzyme System

SCHRADAN

Metabolism of Octamethylpyrophosphoramide by Insects

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SCHRADAN IS OF CONSIDERABLE INTEREST as one of the first organic systemic insecticides. Besides being systemic, it has two other important properties. First, it is selective, killing only sap-sucking insects, most of which belong to the order Hemiptera. This was first observed in the field (*25, 26*) and has been confirmed by more direct methods (Table I). Secondly, it appears to kill by inhibiting the cholinesterase of insect nerves, judging by the symptoms shown by poisoned insects and by the observation of Duspiva (7) that poisoned aphids had their cholinesterase strongly inhibited; yet it is in vitro a very weak anticholinesterase, against erythrocyte cholinesterase (*10*), serum cholinesterase (*30*), and bee brain cholinesterase (*27*). Presumably, a conversion occurs in the plant or the insect (or both) from a weak to a strong anticholinesterase.

Following their observation that mammals are susceptible to schradan poisoning, Dubois *et al.* (*5*) showed that mammalian liver slices could accomplish such a conversion. Cheng (*3*) showed that this mamalian conversion occurred only in the liver, by demonstrating that schradan is nontoxic to the hepatectomized rat. Conversion can also be produced by plants to a small extent (*12*), by "animals, bacteria and insects" (*31*), and chemically by oxidation with permanganate (*2*) and by chlorination (*30*). Biological oxidation probably follows the