The feeding of mustard oil meal in the concentrate mixture to dairy calves
by Wei-yip Huang

A THESIS Submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of Master of Science in Dairy Production
Montana State University

Abstract:
Two feeding trials were conducted with 36 purebred Holstein and Jersey calves 3 to l6 months of age® The calves were divided into four groups taking into consideration breed, age, and body weight to make the groups as uniform as possible® One group was fed mustard oil meal in the concentrate mix, and the other, used as a check group, was fed soybean oil meal in the concentrate mix* The summary of the results is shown in Table VIII Calves 3 to 6 months of age fed mustard oil meal in the concentrate ration gained 1.347 pounds per calf daily. Calves of the same age group fed soybean oil meal in the concentrate ration gained 1.458 pounds per calf daily. The diffe ence was 0.111 pounds of daily gain in favor of the calves fed soybean oil meal.

Calves 6 months of age and over fed mustard oil meal in the concentrate ration gained 1.176 pounds per calf daily. Calves in the same age group fed soybean oil meal in the concentrate ration gained 1.132 pounds per calf daily. The difference was O.044 pounds daily gain per calf in favor of those fed mustard oil meal®.

The average daily gain per Calf for all calves fed mustard oil meal in the concentrate ration was 1.262 pounds. The average daily gain per calf for all calves fed soybean oil meal in the concentrate ration was 1.295 pounds® This was 0.033 pounds in favor of the calves fed soybean oil meal in the concentrate ration®

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INTRODUCTION

A large amount (20) of wild mustard seed is produced in Montana annually as a by-product in the cereal grains. When the oil is removed from the mustard seed it leaves a highly nutritious material, known as mustard oil meal, which may be used as a feed for farm animals. This meal has possibilities as a substitute for other oil meals in the ration. Mustard oil meal has been used as an ingredient in commercial feeds by many feed manufacturers who found it a low cost protein (31). The reports from farmers indicate that they are not in agreement on whether or not there are any detrimental effects on farm animals from feeding commercial feed mix containing mustard oil meal.

Wild yellow mustard seed is seldom used for oil production because its oil content is relatively low (31). Brown mustard, oriental mustard, wild rabbit ear mustard and fan weed seed are used to make vegetable oil. These seeds contain a high percentage of oil varying from 32 to 38 percent with the average oil content of about 35 percent (31). Most of the mustard oil meal now being fed to livestock is manufactured from these varieties.

Mustard seed obtained as a by-product from screenings of cereal grains has limited demand. Some growers that produce mustard seed without a contract have reported (22, 26) that they were unable to sell their crops. Therefore if its feeding value is proved, surplus mustard seed should make an economical concentrate for the livestock industry of the state. Proven feeding value may stimulate mustard seed production in Montana.

It was with this objective that the feeding trials made by the Montana Agricultural Experiment Station reported in this thesis were conducted.

REVIEW OF LITERATURE

Tretsven and Nelson (29) conducted two feeding trials with wild yellow mustard seed as part of the concentrate ration of milking cows. They compared it with soybean oil meal and found it slightly superior as a feed for milking cows. The flavor of the milk and the quality of the butter produced by the cows fed ground wild yellow mustard seed was equal to that produced by cows fed soybean oil meal.

The Montana Veterinary Research Laboratory (30) conducted some experiments on feeding sheep with wild mustard seed pellets made from mustard seed obtained from wheat Screenings. They fed 2.2 pounds of very finely ground mustard seed pellets per 100 pounds of body weight. The ground mustard seed product was suspended in water and immediately given as a drench produced no ill e fects on three lambs. However, the same material ground and soaked in water and held at room temperature for 24 hours killed two lambs to which it was fed. The continued feeding of this same material without the preliminary treatment in water proved entirely harmless to lambs. Swingle (27) failed to isolate toxic material from mustard or mustard oil meal, and he suggested that it might be possible that mustard contains glucosides which hydrolyzed under the action of the enzyme, myrosin, and water to yield respective mustard oils, which may be toxic.

Ackles (7) in his best known growth studies, found the growth rate for 26 Ayrshire heifers from birth to 3, 6, and 12 months of age to be 1.12, 1.21, and 1.08 pounds per day respectively. McCandlish (19) reported corresponding figures for heifers of the four dairy breeds of

1.07, 1.37, and 1.17. Ragsdale (25) gave the standard of growth for dairy cattle which is widely used by research workers.

Wadaran, Kennedy, Bechdel, and Anderson (32) studied the chemical composition of a large number of samples of bovine blood. They reported that the plasma inorganic calcium and phosphorus content ranged from 7.7 to 13.2 and from 3.38 to 7.54 mg. per 100 ml. of blood plasma respectively. These findings agree with other investigators (3, 21, 24).

The importance of Vitamin A in dairy cattle nutrition was first reported by Jones, Eckles and Palmer (10). Hart and Gilbert (9) found that the Vitamin A deficiency developed in cattle under range conditions during long seasons of dry feeding. Moore (16) studied plasma carotene of heifers and found that before turning them to pasture, the plasma carotene content for all breeds ranged from 140 to 550 ug. per 100 ml. of blood plasma. Moore (17) also fed Vitamin A supplement to the calves which maintained the plasma carotene level at 20 ug. per 100 ml. of blood plasma. They did not show symptoms of nyctalopia. Terri, Kennedy and Morrow (28) studied the composition of calf blood and carotene content for calves under 6 months of age and obtained results ranging from 21 to 144 ug. per 100 ml. of blood plasma. Keyes and associates (12) who studied the growth of calves recommended a more liberal supply of Vitamin A and D. They recommend 30 ug. of carotene or equivalent per pound of live weight per day.

EXPERIMENTAL PROCEDURE

EXPERIMENTAL PLAN

Two feeding trials were conducted on feeding wild mustard oil meal to dairy calves at the Montana Agricultural Experiment Station. The first feeding trial was carried on from December, 1947, to May, 1948, and the second trial from November, 1948, to April, 1949. The length of each trial was 170 days.

Thirty-six healthy and vigorous purebred calves, 19 Holsteins and 17 Jerseys, from three to sixteen months of age were selected from the college dairy herd and used in these trials. Breed, age, and body weight were taken into consideration to make the groups and lots as uniform as possible. The calves in each feeding trial were divided into two different age groups. Each group was again divided into uniform lots, one lot was fed the wild mustard oil meal in the concentrate mix and the other lot fed soy bean oil meal was used as a control.

FEEDING AND MANAGEMENT.

The calves in each group were fed the concentrate ration given in Tables I, II, VI, and VII. The rations used in the feeding trials were mixed thoroughly at the beginning of each experimental period so as to keep the feed supply uniform for each trial. Samples from each ration were taken and analyzed by the Chemistry Research Department of the Montana Agricultural Experiment Station. The analysis are shown in Table III. Individual samples of both mustard oil meal and soybean oil meal used in the rations were also analyzed and chemical compositions are shown in Table III. The calves were fed 3 pounds of grain and

TABLE I

Concentrate Rations Fed to the Calves 3 to 6 Months of Age

	Lot I	Lot II
	Percent	Percent
Wheat Bran	25	25
Rolled Oats	30	30
Ground Barley	15	15
Butter Milk, Dried	20	20
Bone Meal	1	1
Iodized Salt	1	1
Mustard Oil Meal	8	
Soybean Oil Meal	—	8
Total	100	100
Protein	19.7	25.3

TABLE II

Concentrate Rations Fed to the Calves 6 Months of Age and Above

	Lot III	Lot IV
	Percent	Percent
Wheat Bran	20	20
Rolled Oats	20	20
Ground Barley	30	30
Molasses Beet Pulp	18	18
Bone Meal	1	1
Iodized Salt	1	1
Mustard Oil Meal	10	
Soybean Oil Meal	—	10
Total	100	100
Protein	17.6	15.3

TABLE III

Chemical Composition of Rations, Mustard Oil Meal and Soybean Oil Meal Used in Feeding Trials

		Protein %	Moisture %	Ether Extract %	Crude Fiber %	N. F. E. %	Ash %	Inorganic Calcium %	Inorganic Phosphorus %
Group I	Mustard Oil Meal, Lot I	19.7	6.0	5.1	6.4	55.6	7.2		
	Soybean Oil Meal, Lot II	25.3	6.0	4.8	5.7	51.3	6.9		
Group II	Mustard Oil Meal, Lot III	17.6	6.4	2.6	10.4	57.1	5.9		
	Soybean Oil Meal, Lot IV	15.3	5.6	3.5	9.5	59.4	5.8		
Group III	Mustard Oil Meal, Lot V	16.6	5.9	3.5	7.0	58.5	8.5	1.00	0.79
	Soybean Oil Meal, Lot VI	16.6	5.9	3.5	7.6	58.5	7.9	0.90	0.74
Group IV	Mustard Oil Meal, Lot VII	15.5	5.6	3.5	11.2	57.9	6.3	0.75	0.47
	Soybean Oil Meal, Lot VIII	15.4	5.6	3.5	11.6	54.4	6.3	0.72	0.45
Mustard Oil Meal		41.5	4.2	6.4	7.3	34.4	6.2	0.96	0.45
Soybean Oil Meal		46.4	5.2	4.9	7.6	29.4	6.5	0.67	

TABLE IV

Summary of Lots Showing Daily Gain, Grain and Hay Consumed and Feed Required to Produce 100 Pounds Live Weight

	Group I			Group II			Summary of Lots			Group III			Group IV			Summary of Lots		
	Lot I	Lot II	Diff.	Lot III	Lot IV	Diff.	I & III	II & IV	Diff.	Lot V	Lot VI	Diff.	Lot VII	Lot VIII	Diff.	V & VII	VI & VIII	Diff.
No. of calves in each group	3	3	3	3	3		6	6		3	3		3	3		6	6	
Length of the feeding trials, days	170	170	170	170	170					170	170		170	170				
Ave. daily gain per calf, pounds	1.408	1.635	0.227	1.129	1.148	0.019	1.269	1.391	.122	1.286	1.280	0.006	1.222	1.117	0.105	1.254	1.199	0.055
Ave. daily grain consumption, pounds	2.966	2.919	.047	3.053	3.053		3.000	2.986	.014	2.276	2.319	.043	2.693	2.825	.132	2.484	2.572	0.088
Ave. grain consumed to produce 100 pounds weight, lbs.	210.7	178.5	32.2	270.4	253.0	82.6	481.1	431.5	49.6	176.9	180.3	3.4	232.3	252.7	20.4	409.2	433.0	23.8
Ave. daily hay consumption, pounds	8.884	8.827	.057	13.969	14.507	.538	11.426	11.668	.242	9.464	9.144	.320	13.470	13.756	.286	11.467	11.450	.017
Hay consumed to produce 100 lbs. weight	631.0	539.8	91.2	1237.7	1202.3	35.4	1868.7	1742.1	126.6	735.8	713.9	21.9	1095.0	1228.1	133.1	1830.8	1942.0	111.2

TABLE V

		Average Milligrams of Inorganic Calcium and Phosphorus				Micrograms of Carotene and Vitamin A			
		Group I		Group II		Group III		Group IV	
		Fed Mustard Oil Meal	Fed Soybean Oil Meal	Fed Mustard Oil Meal	Fed Soybean Oil Meal	Fed Mustard Oil Meal	Fed Soybean Oil Meal	Fed Mustard Oil Meal	Fed Soybean Oil Meal
		Lot I	Lot II	Lot III	Lot IV	Lot V	Lot VI	Lot VII	Lot VIII
Plasma Inorganic Calcium mg./100 ml.	Initial	10.0	10.0	12.7	13.0	10.1	9.8	10.3	10.2
	Final	9.0	9.3	9.7	9.0	10.0	9.5	9.3	9.3
Plasma Inorganic Phosphorus mg./100 ml.	Initial	5.4	5.8	4.5	4.8	7.0	6.4	6.3	6.3
	Final	7.7	7.7	5.6	6.2	5.3	5.7	4.9	4.6
Carotene	Initial					56	76	256	200
ug./100 ml.	Final					310	363	413	440
Vitamin A	Initial					23	22	27	25
ug./100 ml.	Final					20	21	23	22