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VARIOUS OILS AND FATS AS SUBSTITUTES FOR BUTTERFAT IN THE RATION OF YOUNG CALVES¹

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The literature dealing with the value of various fats and oils in nutrition is very extensive, yet but few studies have been reported comparing their feeding value with butterfat for young calves. This fact is rather unusual considering the obvious practical value of such information in relation to economical calf raising and especially to profitable veal production.

The studies reported have largely been confined to a comparatively few oils and fats and results have generally been unfavorable. Lindsey (7) using calves several months old reported generally favorable results from feeding "oleo" at the rate of one ounce per quart of skim milk and mixed thoroughly. He states, "Scarcely any of the calves were able to take more than this amount per quart without disturbing their digestion." Other products used were corn oil and cottonseed oil, but these could be fed only at the rate of one-half ounce per quart of skim milk "without producing bad effects." A calf fed a combination of corn oil and cottonseed oil seemed to thrive at first but later its condition became less favorable and when slaughtered the carcass "contained very little fat." Hendricks (5), also reported less growth in calves fed cottonseed oil and skim milk than in those fed whole milk or skim milk and cod liver oil. Leach and Golding (6) using calves 15 to 22 days old fed pilchard oil homogenized into skim milk. Severe scouring developed but increases in weight continued during the first week, then their condition became unsatisfactory and in no case did a calf live more than three weeks. Rats on a similar diet grew satisfactorily and produced litters of living young. Schmalfuss and co-workers (11) found emulsified coconut oil to be equal to cod liver oil for feeding to calves. Similarly, Fingerling (3) found that emulsified peanut oil was a satisfactory supplement to skim milk for calves provided it was not added in too great amounts.

In 1939 we (4) reported, very briefly, our results obtained from feeding calves butter oil, lard, corn oil, cottonseed oil and soybean oil, respectively, homogenized into skim milk. The results as measured in terms of rate of gain in weight, physical appearance and general well-being of calves indicated clearly the superior nutritive value of butterfat over all the other fats and oils tested. The calves fed lard made nearly as rapid gains in weight

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RESULTS

No real difficulty was encountered in getting calves to drink the desired amounts of the various prepared skim milk, oil or fat products. However,

TABLE 1

Average weight at 30-day intervals and nutrient per day and per 100 pounds live weight of calves fed various oils and fats

Age	Weight	Nutrients per day		T.D.N. per* 100 lbs. weight	Weight	Nutrients per day		T.D.N. per* 100 lbs. weight
		Protein	T.D.N.			Protein	T.D.N.	
days	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Whole Milk Group (2 calves)					Butter Oil Group (2 calves)			
30	100	.35	1.73	1.96	108	.35	1.70	1.72
60	140	.38	1.89	1.58	141	.45	2.19	1.75
90	186	.45	2.37	1.45	176	.67	3.23	2.03
120	231	.59	3.14	1.50	225	.74	3.58	1.79
	Average	.....	.....	1.62	.....	.....	.....	1.82
Low Fat Group (5 calves)					Lard Group (6 calves)			
30	101	.31	1.16	1.18	104	.30	1.45	1.54
60	123	.48	1.53	1.37	135	.49	2.36	1.98
90	155	.73	2.60	1.87	163	.57	2.79	1.87
120	176	.88	3.07	1.85	209	.73	3.55	1.91
	Average	.....	.....	1.57	.....	.....	.....	1.83
Tallow Group (4 calves)					Coconut Oil Group (4 calves)			
30	89	.27	1.33	1.64	86	.24	1.19	1.55
60	119	.41	2.02	1.94	112	.30	1.46	1.47
90	165	.71	3.45	2.43	141	.48	2.32	1.84
120	.....	.....	.....	.....	176	.65	3.14	1.99
	Average	.....	.....	2.00	.....	.....	.....	1.71
Peanut Oil Group (3 calves)					Corn Oil Group (6 calves)			
30	84	.29	1.43	1.83	79	.29	1.42	1.82
60	112	.40	1.94	1.98	92	.32	1.48	1.74
90	.....	.....	.....	.....	109	.38	1.72	1.72
120	.....	.....	.....	.....	123	.38	1.79	1.54
	Average	.....	.....	1.90	.....	.....	.....	1.71
Cottonseed Oil Group (2 calves)					Soybean Oil Group (5 calves)			
30	85	.29	1.42	1.73	87	.25	1.12	1.32
60	104	.31	1.30	1.38	102	.30	1.29	1.37
90	119	.36	1.51	1.36	109	.36	1.52	1.45
120	127	.49	2.31	1.88	132	.39	1.62	1.35
	Average	.....	.....	1.59	.....	.....	.....	1.37

* Based on average weight during period.

it was necessary in some cases, due to poor physical condition of the calf, to either reduce the amount of the product fed, to change temporarily to whole milk, or to reduce the fat content of the milk fed (see table 2). This occurred almost wholly with calves fed either corn oil, cottonseed oil or soybean oil. The necessity of limiting the food intake in these groups made equivalent reductions necessary in other groups in order to keep them on approximately the same nutrient intake basis. The average nutrient intake of the various groups at different ages and weights is indicated in table 1. Table 2 indicates the kind of fat or oil fed and the fat content of milk fed to each calf along with facts relating to its physical condition. It also shows the age and weight of the animal at start and end of experimental period, together with average daily gain in weight of each group. Figure 2 indicates the growth of the calves in each group.

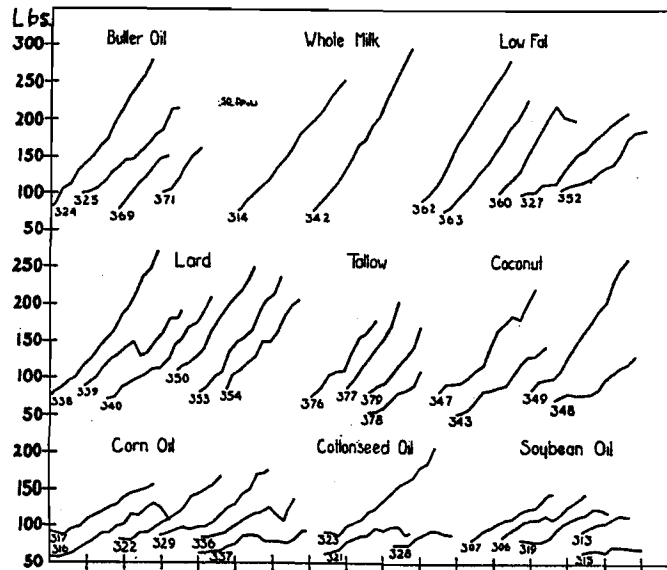


FIG. 2. Growth curves of calves fed various fats and oils.

It will be observed from table 2, that the calves fed fats of animal origin, butterfat, tallow and lard, made significantly greater average daily gains in weight than those receiving the vegetable oils, but especially soybean oil, cottonseed oil and corn oil. Another significant difference noted between the groups was the greater amount of fat present in the carcasses of milk-fat fed calves. Even lard- and tallow-fat fed calves that had made good gains in weight and were in healthy, thrifty condition when slaughtered were inferior in this respect. This fact may be of special significance in relation to the quality of veal produced.

No apparent differences were observed between calves fed whole milk and those receiving the butter oil homogenized in skim milk. Both groups were

TABLE 2

Number, breed and sex of calves fed different fats and oils; their age and weight at beginning and end of experimental period and physical condition while on experiment; also, fat content of milk fed

Number, breed & sex of calf			Age—days		Weight—lbs.		Physical condition of calf, fat content of milk fed, etc.
			Start	End	Start	End	
Whole Milk Group							
314	Gr. H.	M	7	147	77	253	3.5 per cent fat. Condition excellent.
342	" "	F	7	149	75	301	" " " " " "
Average daily gain in weight, 1.43 pounds							
Butter Oil Group							
324	Gr. H.	M	10	141	84	284	3.5 per cent fat. Condition excellent.
325	" Ayr.	"	8	137	98	209	" " " " " "
369	" H.	"	9	65	80	150	" " " " " "
371	" "	"	9	60	100	160	" " " " " "
Average daily gain in weight, 1.22 pounds							
Low Fat Group							
327	Gr. H.	M	9	154	100	211	Indigestion at start, otherwise thrifty and healthy.
352	" "	"	11	126	106	185	Severe indigestion part of time; condition fair.
360	" "	"	22	128	100	214	Fed up to 18 pounds skim milk daily; condition excellent.
362	" "	F	22	140	92	280	Fed up to 18 pounds skim milk daily; condition excellent.
363	Jer.	M	20	135	76	227	Fed up to 18 pounds skim milk daily; condition excellent.
Average daily gain in weight, 1.07 pounds							
Lard Group							
338	Gr. H.	M	6	150	75	270	3.5 per cent fat. Condition good.
339	" "	"	6	148	89	205	3.5 per cent fat-lard milk to 82 days of age. Scoured, weak. Whole milk to 106 days of age. Scouring ceased. 3.5 per cent lard-milk to end. Condition fair to good.
340	Guern.	M	7	151	71	212	3.5 per cent lard milk. Scoured occasionally. Condition good.
350	Gr. H.	F	15	119	110	250	3.5 per cent lard milk. Scoured occasionally. Condition good.
353	" "	M	12	122	82	238	3.5 per cent lard milk. Scoured occasionally. Condition good.
354	" "	F	17	119	85	207	3.5 per cent lard milk. Scoured occasionally. Condition good.
Average daily gain in weight, 1.17 pounds							
Tallow Group							
376	Gr. H.	F	15	105	75	182	3.5 per cent tallow milk fed up to 18 lbs. daily. Some scouring but condition fair to good.
377	" "	M	8	81	88	206	3.5 per cent tallow milk fed up to 18 lbs. daily. Some scouring but condition fair to good.

TABLE 2—(Continued)

Number, breed & sex of calf	Age—days		Weight—lbs.		Physical condition of calf, fat content of milk fed, etc.
	Start	End	Start	End	
Corn Oil Group (Continued)					
329 Guern. M	9	154	87	176	3.5 per cent oil throughout but limited to not over 10 pounds milk daily. Severe dermatitis and slow gain in weight. Appeared emaciated and unthrifty.
336 Guern. M	21	150	86	137	3.5 per cent oil milk fed. Slight indigestion. Very slow or no gain in weight. Thin and rough appearance.
337 Guern. M	11	155	64	95	3.5 per cent oil-milk fed but limited to not over 7 lbs. daily. Scoured. Some dermatitis. Little or no gain in weight. Weak and emaciated. Died.
385 Albino F	13	33	56	40	3.5 per cent oil-milk fed. Severe scouring. Died. Hock joints swollen. Severe gastritis and enteritis.
392 Jer. M	10	61	59	75	3.5 per cent oil-milk fed. Slight indigestion. Was quite active and playful. Good appetite but thin. Hair rough. Became weak and unable to stand. When changed to whole milk at 61 days made rapid recovery.
Average daily gain in weight, .40 pounds					
Cottonseed Oil Group					
321 Gr. H. F	12	126	65	92	3.5 per cent oil to age 29 days. Unthrifty and slight indigestion, weak. Whole milk to 41 days, 2 per cent oil milk to 103 days of age, 3.5 per cent oil to 124 days, then whole milk again. Thin, emaciated appearance, rough, weak, died. Little or no internal fat. No evident changes in liver and kidneys.
323 Gr. H. M	10	151	93	209	3.5 per cent oil to age 27 days. Whole milk to 39 days, 2 per cent oil to 100 days, then 3.5 per cent oil milk. This was a very rugged calf at start. Little or no scouring, considerable loss of hair. Ate considerable alfalfa hay. Gained slowly but steadily. Appearance fair.
328 Gr. H. F	10	85	77	90	3.5 per cent oil milk throughout. No indigestion. General decline set in at about 8 weeks of age. Died. Several hemorrhagic areas in abomasum. Decided absence of depot fat.
389 Gr. H. M	6	45	85	77	3.5 per cent oil milk throughout. Weakened, declined, died. Emaciated appearance.
Average daily gain in weight, .31 pounds					
Soybean Oil Group					
305 Gr. H. M	7	39	90	87	3.5 per cent oil milk. Severe indigestion. Died.

The condition of the calves in the groups fed coconut oil and peanut oil respectively were on the whole inferior to calves fed lard or tallow but were definitely superior to the animals fed either corn oil, cottonseed oil or soybean oil. In the latter three groups, the calves almost invariably appeared thin and emaciated with rough unkempt hair. Some of them also showed a characteristic loss of hair or dermatitis, the areas about the face, ears and neck being first affected. Subsequent losses occurred on the lateral and medial areas of the cannons of the rear legs. A brown, oily-like crust covered the denuded areas. The time of the appearance of the condition, its extent and duration varied widely in different individuals. The fact that some animals in these groups were not affected, that it appeared in a few individuals in other groups and also that it sometimes occurs in calves on normal rations makes it difficult to suggest a probable cause.

Indigestion or scours appeared among the calves in all groups but those fed corn oil, soybean oil and cottonseed oil were the most seriously affected. Some calves in these groups died from this disorder at an early age (data not included) and others probably would have done so if the ration had not been changed as indicated in table 2. Others in these three groups, although not affected by scours, gained very slowly in weight for a time although they appeared rather haggard and dull, as though starving. This was followed by gradual weakening and some loss in weight, often terminating in death if whole milk was not substituted in time. Several calves (319 and 392) that were in a very weakened condition and unable to stand made remarkable recoveries after such a change in diet was made.

DISCUSSION

The study indicates that under the conditions of the trials, butterfat was superior to all other fats and oils tested as a food for young dairy calves. It appears that tallow and lard may also be used quite satisfactorily for this purpose under the plan of feeding followed. The reason for the superiority of milk fat over other fats and oils tested and for the reasonably good results obtained with the lard and tallow is not indicated by the data. It is true that the calves in these groups were fed on a slightly higher plane than those in some of the other groups but this alone is hardly sufficient to account for the marked differences observed in the rate of gain in weight and physical condition of the calf. No doubt the more frequent and perhaps more severe cases of scours among calves in the corn oil, cottonseed oil and soybean oil groups affected the results but this was probably not the most important factor involved, for death or slow gain in weight also occurred in calves in these groups in which indigestion was absent. It may be pointed out as a matter of general observation in regard to these three groups that the older the calf and the more vigorous it was when placed on experiment the better the results obtained. The latter is probably the chief reason for the fairly satisfactory growth of calf No. 323 on cottonseed oil.

A question may be raised as to whether or not each of the various oils actually were digested and absorbed into the body. Unfortunately, no digestion trials were conducted. However, the relatively high fat volume of the blood plasma of the animals fed the less satisfactory oils as compared to that of those fed milk fat suggests that these oils probably were absorbed. Too much emphasis should not be given to this fact, however, because of the very limited amount of data on hand. What happened to these oils if they actually were absorbed is not known. Were they altered and later excreted through the skin, causing the dermatitis-like condition previously described, or were they excreted back into the intestine? Only further investigations can answer these questions. Post mortem examinations indicated that they were not stored as depot fat in the body to any great extent.

No attempt will be made at this time to explain the differences noted in the nutritive value of the fats and oils tested. It may be pointed out, however, that the work of Burr and Burr (2) and the more recent studies of Hart and co-workers (9, 10) suggests that the nature and kind of fatty acid combinations present may be extremely important. Also, it is possible that some of the oils fed lacked in certain essential factors or that they contained substances toxic to the young calf. We are now investigating these and other phases of this problem.

SUMMARY

Feeding tests were conducted to compare the feeding value of the following fats and oils for calves: butterfat, lard, tallow, coconut oil, peanut oil, corn oil, cottonseed oil and soybean oil. The effect of a very fat-poor diet on calves was also determined. Each oil or fat was added to skim milk, homogenized to form a product containing 3.5 per cent fat and fed along with a low fat content concentrate mixture, cod liver oil and some alfalfa hay. One control group was fed normal whole milk not homogenized. Test periods ranged from a few days to about six months.

In average daily gain in weight as well as in general well-being, the calves fed butterfat excelled those in all other groups. Following closely were those receiving lard and tallow. Corn oil, cottonseed oil and soybean oil were the least satisfactory. The average daily gains of calves in the latter three groups were .40 pound, .31 pound and .32 pound, respectively. They appeared unthrifty, listless and emaciated. Some calves in these groups died and others were saved only by changing to whole milk.

Post mortem examinations showed considerably more fat deposited in calves fed butterfat than in those that had been fed other oils and fats.

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