Vitamins, Antibiotics, Hormones and Enzymes

C. R. ADAMS, *D. V.M.*
Roche Chemical Division
Hoffmann La Roche
Nutley, New Jersey

It is generally accepted that vitamins A and E are essential nutrients for all species of animals. However, differences of opinion do exist as to the conditions under which supplemental vitamins A and E are required and at what levels they should be fed.

Over the past ten years considerable research has been reported on vitamin A supplementation of rations for beef cattle. Most of these publications have shown improvement in rate of gain and feed conversion. With breeding animals, improved conception rates and better bull fertility have also been observed with vitamin A supplementation.

Several of the conditions that have been reported to influence the intake, absorption and utilization of vitamin A as well as carotene are listed in Table 1.

TABLE 1

1.	Environmental and physiological stress increase the vitamin A requirements and accelerate depletion of body stores.
2.	Cattle cannot utilize carotene as efficiently as vitamin A, especially when liver vitamin A reserves are low.
3.	High nitrates in forage or water apparently interfere with the utilization of carotene.
4.	High nitrates in feed or water are also associated with depleting body stores of vitamin A.
5.	The actual vitamin A status of cattle is usually unknown.
6.	With the increased feeding of high concentrate rations, carotene intake may be inadequate. The carotene content of the feedlot ration is seldom known. More rapid gains with higher concentrate feeding increases vitamin A requirements.
7.	Vitamin A deficient cattle are usually more susceptible to infectious diseases and parasitism.
8.	Vitamin A deficient bulls usually show decreased sexual activity.
9.	Vitamin A deficient bulls show a decrease in number and motility of sperm with an increase in abnormal forms.
10.	Vitamin A deficiency in the cow can result in poor conception, abortion, birth of dead, weak or blind calves and often in an increased occurrence of retained placenta.
11.	Calves from cows not receiving adequate vitamin A are more susceptible to respiratory and intestinal diseases.

Brood cows, bulls and replacement stock raised under range or

pasture conditions, more often than realized, do not receive enough or make inefficient use of the carotene in forage.

Supplementation of rations for fattening beef cattle with vitamin A has been well established and is a routine widespread practice in the beef industry today. Cattle entering the feedlot will usually receive either an injection of vitamin A (dosage generally 500,000 i.u.) or a high level in the feed for two or three weeks during the "conditioning" period. Levels of vitamin A regularly fed during the fattening period range from 20,000 to 50,000 i.u. per head daily.

However, the method of providing adequate vitamin A to cattle on range, particularly during the winter or dry seasons, presents a different problem than feedlot cattle.

Under the usual conditions existing in range country, the vitamin A-activity (in the form of carotene) available to the animal is often not adequate for optimum breeding performance, normal growth or maximum disease resistance. Most frequently, animals with low stores of vitamin A, or those marginally deficient, do not show any outward symptoms of a deficiency. Pregnant cows often do not have adequate body stores of vitamin A to either carry them through an entire gestation period or drop a healthy, vigorous calf. The vitamin A requirements of brood cows is greatest during the last two or three months of the gestation period and the requirement for vitamin A at this time is usually three to five times greater than needed for maintenance; yet it is during this critical period of gestation that vitamin A body stores may be dangerously low or entirely depleted (Table 2).

TABLE 2

Influence of Vitamin A Injection on Brood Cow Productivity

Group	Cows	Treatment	Calf Crop			
			1961		1962	
No.	No.		No.	%	No.	%
1	91	none	37	40.7	69	75.8
2	92	2 million i.u., intramuscular injection 9/61 & 3/62	43	46.7	81	88.0

From German and Adams, 1963

Although the vitamin A requirements for beef and dairy cattle published by the National Research Council, 1970, are excellent guides, they are considered minimum figures not allowing any overages that may be required during periods of environmental or physiological stress.

Early research reported that white muscle disease in lambs and calves could be induced by adding unsaturated fat to the ration or occurred as spontaneous outbreaks in the field. Such cases were usually corrected by treatment with vitamin E. In other occurrences, particularly as experienced in the Northwest, the best response to

nutritional muscular dystrophy is obtained with selenium treatment. It would appear that nutritional muscular dystrophy can be caused by either a deficiency of selenium, vitamin E or both.

There is a growing feeling that marginal deficiencies of vitamin E, which seldom manifest themselves in easily detectable symptoms, are more common among domestic animals than previously believed.

Reporting on experiments with fattening beef cattle, Iowa State University, 1964 (9), observed growth responses with vitamin E or selenium supplementation to a "no-hay" ration, in studies conducted over a period of two years. In the experiments during the third year, no responses were evident with added selenium and only a slight benefit noted from vitamin E supplementation. These investigators attributed the lack of response to selenium and poor response to vitamin E as being due to higher levels of selenium and vitamin E occurring in the rations used the third year (Table 3).

TABLE 3

Vitamin E and Selenium for Fattening Beef Cattle

	Control		Vitamin E		Control		Selenium	
	A.D.G.	F.E.	A.D.G.	F.E.	A.D.G.	F.E.	A.D.G.	F.E.
1962	2.79	761	2.95	739	2.71	858	3.08	785
1963	2.59	961	2.65	936	2.66	917	2.79	882
1964	2.68	862	2.75	849	2.64	945	2.60	974

Iowa State University Cattle Feeders Day, 1964

Beeson, et al. 1962 (2), reported growth responses to supplemental vitamin E in fattening beef cattle receiving a corn and cob meal, soybean meal ration.

A subsequent experiment reported by the Purdue workers, 1964 (11), showed only a slight, non-significant growth response to supplemental vitamin E for fattening cattle on a "no-hay" ground ear corn, soybean meal ration. More recently, 1971 (12), the Purdue researchers reported growth improvement with a vitamin E injection of 125 i.u. in fattening cattle receiving roasted corn, supplement and hay. However, cattle receiving raw corn in place of roasted corn showed no response to the vitamin E injections (Table 4).

TABLE 4

Vitamin E and Selenium Injections for Finishing Heifers

	(127 Day Results)	
	Raw Corn	Roasted Corn
	av. daily gain	av. daily gain
Control	2.44	2.36
Vitamin E Injection (125 i.u.)	2.38	2.68
Selenium Injection (12.5 mg)	2.17	2.43
Vitamin E & Selenium Injections	2.34	2.60

Purdue Feeders Day Report, 1971

Dyer, 1966 (6), has published the results of vitamin E studies with both wintering and fattening cattle. Wintering calves made a twenty (20) percent greater rate of gain and the fattening cattle an eight (8) percent greater rate of gain with vitamin E supplementation.

Chapman, et al. 1964 (3), have observed growth responses to vitamin E supplementation with beef cattle on full feed as well as with limited fed cattle on pasture. Additional research reported by Chapman, 1968 (4), has shown growth increases in fattening cattle receiving either 20 or 50 i.u. supplemental vitamin E per head daily.

Another publication on vitamin E-beef cattle research by Beardsley, 1968 (1), showed growth increases in cattle on pasture with vitamin E supplementation. These studies showed about a ten (10) percent improvement in growth rate when vitamin E was administered by injection.

Unfortunately, there are no officially recognized published requirements of vitamin E for cattle, but we have prepared a set of recommendations or suggested levels of supplemental vitamin E for cattle. These recommendations are based both on research and practical field experience and should serve as a reasonable guide for the addition of vitamin E to rations for cattle (Table 5).

TABLE 5

Suggested Feeding Levels of Vitamin E for Cattle

	I.U./Ton Complete Feed	I.U. Per Head Daily
Weanling Calves	10,000	25
Growing-Fattening	7,000	50
Breeding-Lactating	10,000	50-100

Antibiotics are administered to cattle for purposes of preventing or treating disease and to improve growth and feed efficiency. The level and length of time antibiotics are fed in the ration is varied to obtain either improvement in performance or disease control.

In Tables 6 and 7 some of the more commonly used feed additives for cattle are listed.

Feeding "low" levels of antibiotics to fattening cattle, usually 50 to 75 milligrams daily, as a means of improving weight gains, feed conversion and reducing liver abscesses, is a fairly common practice today. Higher levels of antibiotics, often 350 to 500 milligrams per head daily, are added to the feed of cattle entering the feedlot. This practice has been shown to reduce the incidence of shipping fever, as well as other diseases, and also to improve the performance of these stressed cattle. More recently, the addition of antibiotic-sulfonamide combination to feed for newly arrived feedlot cattle has also proved effective in controlling disease and improving performance during the first few weeks after entering the feedlot.

The addition of diethylstilbestrol (DES) to feed for fattening cattle was established as an economic "necessity" seventeen years ago.

TABLE 6

Commonly Used Feed Additives for Cattle

Drug	Purpose	Required Withdrawal Time
ANTIBIOTICS		
Chlortetracycline 70 mg/hd/day	Growth & disease control	
100 - 350 mg/hd/day	Disease prevention	None
> 350 mg/hd/day	Disease treatment and prevention	48 hours
Bacitracin - Zinc and MD	Growth	None
Erythromycin	Growth	None
Neomycin	Disease treatment and prevention	None
Neo-oxytetracycline	Disease treatment and prevention	None
Penicillin	Disease prevention	None
Oxytetracycline	Growth - Disease prevention and treatment	None
HORMONES		
Diethylstilbestrol	Growth	7 days
Melengestrol Acetate	Growth - estrus inhibition	48 hours
Medroxyprogesterone	Estrus control - synchronization	None
DES plus Bacitracin MD and Zn	Growth	7 days
DES plus OTC	Growth	7 days
DES plus CTC	Growth	7 days
Chlormadinone Acetate	Estrus control	28 days

TABLE 7

Commonly Used Feed Additives for Cattle

Drug	Purpose	Required Withdrawal Time
Thibendazole	Intestinal parasites	*3 days*
Phenothiazine	Internal parasites - horn and face flies	*None*
Ammonium Chloride	Prevention urinary calculi	*None*
Ethylenediamine Dihydriodide	Prevention of foot rot	None
Trimethylalkyl Ammonium Stearate	Growth	None
Iodinated Casein	Improve milk production and growth	None
Poloxalene	Prevention of bloat	None
Propylene Glycol	Prevention of ketosis	None
Ronnel	Control grubs	21 - 60 days

Today, it is estimated that about 85% of the 26 million head of cattle on feed receive DES in their feed or by implantation.

In feed, DES is added to provide 10 or 20 milligrams per head daily and implantation is usually at levels of 24 to 36 milligrams per head once or twice depending on the length of the fattening period.

Research reported recently from Iowa State University, Table 8, indicated that the "trans" form of DES is more effective in improving weight gain and feed efficiency than the "cis" form. In the usual chemical synthesis of DES both trans and cis forms are produced. These results, as those reported recently by Purdue University, Table 9, show

TABLE 8

Response of Fattening Cattle to
Two Forms of Diethylstibestrol

	Control	DES-Trans 20 mg	DES-CIS 20 mg
Av. daily gain	2.36	2.92	2.76
% Improvement	-	17	24
Feed/100 lbs. gain	725	675	637
% Improvement	-	6	12
Feed Cost/lb. gain*	21. ¢	18.5 ¢	19.6 ¢

*Feed Cost include cost of DES
(Proc. Iowa St. Univ. Cattle Day, 1971.)

TABLE 9

Effect of Different Hormones
of Performance of Fattening Beef Heifers

	Control	DES Trans, 10 mg	DES DIS, 10 mg	MGA 0.35 mg	RAL 36 mg implt.
Av. daily gain	2.09	2.35	2.12	2.20	2.31
% Improvement	-	13	1.5	5	10
Feed/100 lbs. gain	737	668	716	751	676
Feed Cost/lb. gain*	14.0	12.8	13.6	14.4	12.9

*Feed cost do not include cost of hormone.
(Proc. Purdue Univ. Cattle Day, 1971.)

an advantage for the use of the trans form of DES.

Although the management practices of a cattleman usually indicate the method of administering DES, personal preference and relative costs are also determining factors.

It has been reported that in a number of feedlots, DES is administered both in the feed and by implantation. This may be considered an economically beneficial practice by some, but the results of a study shown in Table 10 suggest that the combination treatment may not offer an advantage over a single treatment program.

A recently introduced growth stimulant, resorcylic acid lactone (RAL), administered by means of implantation, has been reported to produce growth and feed efficiency improvements equivalent to those obtained with DES (Table 9).

At this time, one cannot help but get the impression that enzyme supplementation of rations for ruminants is almost "ancient history," however there are still cattlemen that undoubtedly feel enzymes are of value.

TABLE 10

Performance of Fattening Steer
Receiving DES in Feed
by Implant and Combination Treatment

	Control	DES Oral, 10 mg	Implant, 36 mg	DES, Oral and Implant
Av. daily gain, Kg	1.32	1.38	1.45	1.36
Feed/Kg gain	6.66	6.42	6.58	6.30

Furr, et al., Proc. West. Sect. Amer. Soc. Animal Science, 1968.)

It is difficult to review research publications issued within the past several years and find any reporting on enzymes for cattle.

Consider the ruminant, its large fermentation tank, the rumen, may contain as many as 50 billion bacteria per milliliter of rumen fluid, all secreting enzymes which break down the nutrients ingested which are mostly carbohydrate and protein in nature. No wonder the experiments conducted on enzyme supplements for cattle several years ago were quite variable.

Most research over the past 15 years on enzymes for cattle has dealt with amylases (acting on carbohydrate), proteases (acting on proteins), celluases (acting on cellulose) and lipases (acting on fats). A summary of several years of enzyme research conducted at Washington State University is shown in Table 11.

TABLE 11

Summary of Results from 13 Feeding
Trials with Enzymes for Fattening Cattle

	Av. daily gain, lbs.		Av. pounds of Feed per amount of gain	
No. Animals	Control	Enzyme	Control	Enzyme
346	2.97	3.15	7.63	7.41
% Improvement	-	6	-	3

(Dyer, Proc. Wash. St. Univ. Nut. Conf., 1963.)

In conclusion, gentlemen, remember the recommendations you make to your clients regarding the proper use of drugs and nutrients in their feeding program can result only in a safer, happier and more prosperous future for us all.

References

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