# Economics and Animal Welfare Considerations of Early Castration and Utilization of Ralgro® Implants

**John M. Bonner,** *Ph.D.*
**Michael F. Cain,** *Ph.D.*
*Veterinary Products Division*
*Internal Minerals & Chemical Corporation*
*P.O. Box 207*
*Terre Haute, IN 47807*



## Introduction

Increasing calf weaning weight is the goal of every cow-calf producer because of its direct relationship to herd profitability. Currently, many production technologies and management strategies exist that can be used to increase weaning weights. One of the best and most economical methods is implanting suckling calves with RALGRO.

RALGRO is the brand name for a growth promoting implant made and marketed by the Veterinary Products Division of International Minerals & Chemical Corporation (IMC). RALGRO implants fit easily into cow-calf management practices and are a safe, reliable and effective product for increasing lean weight gains and improving feed efficiency in cattle from birth to slaughter. These important economic responses have been documented by many controlled research trials. Also, vital safety data for both the live animal and the resulting carcass has been generated to ensure the well-being of implanted animals and to guarantee that carcasses from implanted animals are safe for human consumption.

In spite of this, implanting growth promotants has been a somewhat controversial practice among animal welfarists and consumer activist groups since Diethylstilbestrol (DES) was banned from use in 1979. Another management strategy that has been controversial is the timing of castration and its subsequent effect on animal health and weaning weight. Therefore, the purpose of this paper is to (1) review important safety and technical information pertaining to RALGRO implants, (2) review the reasons for the adoption of castration, its effect on weaning weight and the advantages and disadvantages of utilizing castration as a management tool, (3) discuss the efficacy of RALGRO implants, and (4) discuss the importance of using RALGRO and early castration as part of a total cow-calf management system.

## RALGRO Safety and Technical Information

The active ingredient in RALGRO implants is zeranol. Zeranol is a crystalline chemical compound belonging to a class of natural products called the resorcylic acid lactones. It is made by a multi-step fermentation process from zearalenone, a natural metabolite of the mold *Gibberella zeae*. *Gibberella zeae* is a naturally occurring mold which was originally isolated from maize grains in the United States.

In 1969, after extensive review of the efficacy and safety data of zeranol, the U.S. Food and Drug Administration cleared RALGRO as a new product for subcutaneous implantation in cattle and sheep. This agency classified zeranol as a non-steroidal (non-hormonal) anabolic agent, in other words, a compound that promotes true growth which is defined as an increase in the mass of muscle tissue.

In order to establish the safety of RALGRO, its active ingredient, zeranol, has undergone a battery of toxicity tests in several animal species. The results of these studies have enabled IMC to obtain clearances in over 40 nations for the sale of RALGRO to livestock producers. The acute toxicity of a compound is generally stated as the Lethal-Dose 50 ($LD_{50}$). This number is expressed in milligrams (mg) of compound per kilogram (kg) of body weight. The $LD_{50}$ values of zeranol given orally to mice and rats are greater than 40,000 mg/kg. In contrast, the $LD_{50}$ of aspirin is 1,750 mg/kg. This indicates that zeranol has an extremely low order of acute toxicity for these two species of animals. Likewise, data on the long-term toxicity of zeranol for rats, dogs and monkeys have shown that dosages (mg/kg) required to give toxic effects were very large compared to the amounts absobed daily (mg/kg) by a 200 kg steer after implantation with 36 mg of zeranol. In the 10-year monkey and seven-year dog tests, interim sacrifices have been made and no signs of pathology have been found which were drug-related other than those in the dog which were attributable to excessive stimulation of the endocrine system.

Additionally, tissue residue test was conducted by IMC and the WARF Institute, Madison, Wisconsin, using tritiated zeranol (radiometric assay based on the hyrdogen isotope, tritium). This procedure has a sensitivity of 0.1 parts per billion. In this test, muscle tissue from implanted cattle slaughtered 10, 30 and 50 days following implantation contained no detectable residues. These toxicity and tissue residue data conclusively show that zeranol is a safe product for use in beef production.

Other important considerations in the overall welfare of livestock are the environmental influences that affect

homeostasis during the production cycle. Limited studies on important economical stresses such as heat (Brown, 1978 and Becker *et al.*, 1983), nutritional deprivation (unpublished data - Argentina sheep trial), and transportation stress (Brown, 1978 and Patterson, 1982) indicate that RALGRO may assist in maintaining more optimal hormonal and enzymatic levels, as well as certain blood parameters that increase the animal's ability to minimize metabolic compensation to stress. Therefore, not only is zeranol non-toxic to the animal but may in fact be beneficial in reducing production related stress.

RALGRO is used in the form of small pellets each of which contains 12 mg of zeranol. The correct dose for beef cattle is three pellets or 36 mg. The pellets are made by mixing then putting this mixture through a pelletizing machine. The finished pellets are packaged in plastic cartridges containing 24 doses and can easily be implanted with a single injection using the RALOGUN® pellet injector.

As illustrated in Figures 1 and 2, RALGRO is implanted properly when the RALOGUN needle penetrates the skin just over the ring of cartilage at the base of the ear. It is then inserted subcutaneously towards the head into the "pocket" of loose skin in an area that is below the major blood vessels which supply the ear. In this area, the skin can easily be picked up with your fingers making implanting with RALGRO no more stressful than a simple vaccination. Also, utilization of this site facilitates proper absorption of RALGRO and has virtually eliminated implant technique errors and ear trauma; thus, problems due to ear infection are minimal. Consequently, implanting with RALGRO is entirely safe and humane.

FIGURE 1

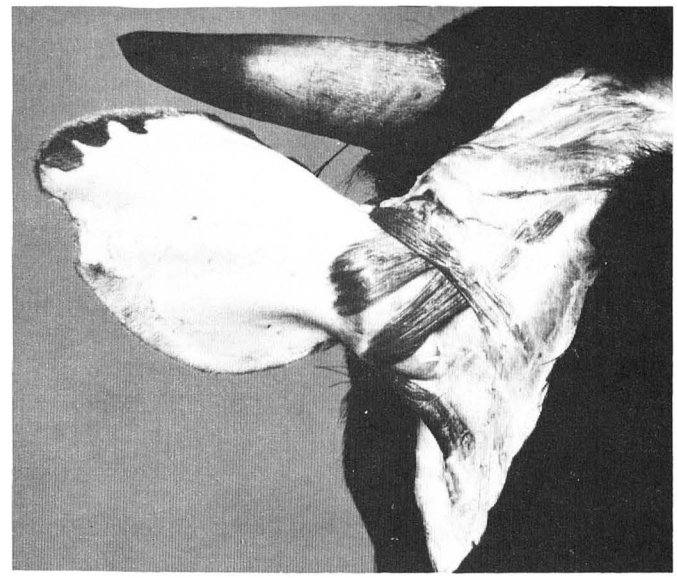
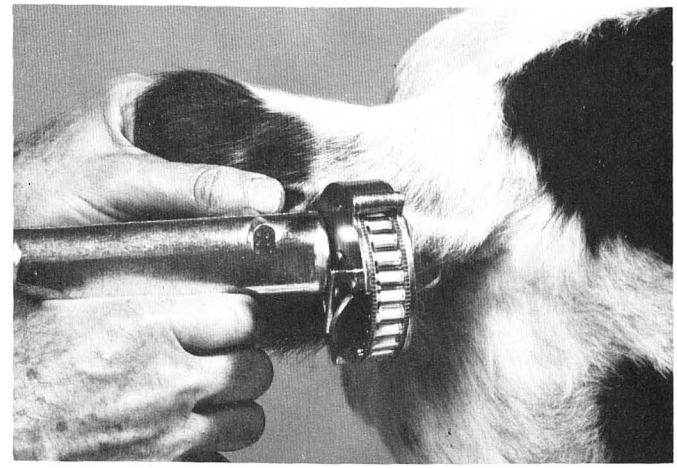


FIGURE 2



### Adoption, Effects and Utilization of Castration

It is generally well-accepted that bull calves wean at heavier weights than comparable male calves castrated in the first few months after birth. This is supported by the early work of Marlowe and Gaines (1958). Using performance testing records of 2,007 creep-fed and 4,166 non-creep-fed calves, they reported that bull calves gained 5% faster than steer calves when weaning weights were adjusted to a 210-day weaning age. Because of this difference in preweaning weight gain, cow-calf producers commonly ask the question 'should they castrate early (1-2 months of age) or leave the calves intact to take advantage of the heavier weaning weight'. When answering this question, it is important to consider the reasons why castration was adopted and the effects that would occur at weaning if castration were done at that time.

Castrated males are easier to manage than bull calves and castration effectively eliminates indiscriminate mating within the breeding herd. Castration reduces sexual drive and aggressiveness which helps prevent riding, fighting and an adverse social structure that often causes poor performing individual animals. As a general rule, feeder and stocker steers have more outlets than bulls and generally bring higher prices. In addition, castration alters the secondary sex characteristics of an animal (Preston and Willis, 1974) and also alters the maturation process. Therefore, the body form and composition are modified (Robertson and Laing, 1965; Harte, 1971). The later developing parts, for example the loin, mature earlier by castration and the balance between fore- and hind-quarters is changed. Additionally, fat distribution in the body is changed and fat deposition, particularly intramuscular fat, is increased. Generally, steer carcasses grade higher than bull carcasses. Also, under current USDA grading standards and consumer preferences, there would be few occasions where bull (bullock) beef would move competitively in channels with steer beef. Consequently, castration has become a recommended management practice for cow-calf producers.

With this in mind, the question of early versus late castration still remains. Most veterinarians, animal scientists and producers indicate that calves should be

castrated before they are three months of age. While it is true that bull calves gain faster than steers, it is also true that the stress, trauma and risk of castration increases with age. Castration at weaning usually causes a serious setback in weight gains for a two to three week period. Another important consideration of late castration is animal welfare. Promoters of animal welfare have cited late castration as cruel and inhumane if performed without anesthesia. Conversely, castration at birth or early in life produces little shrink or stress.

Two recent trials at Iowa State University (Strohbehn *et al.*, 1981 and Strohbehn, 1981) indicate the stress and effects on weight gain due to late castration. In trial 1, 424 crossbred calves representing three successive calf crops (1978 through 1980) were utilized to study the effect of calf management on growth rate to a specified sale date. Within each year, calves were born between March 10 and May 10 (60-day calving seasons). Calves were born and managed at the same location each year and averaged 523.4, 515.3 and 575.1 pounds at the December 13th sale date for the three years 1978, 1979 and 1980, respectively. Data presented in Table 1 show the castration and weaning time interaction effect on 84-day weight gain from September to the December 13th sales date. It is clearly evident that there is a direct relationship between castration time and pre-sale 84-day weight gain. Calves castrated 70, 41 and 28 days before sale date gained 158.4, 154.8 and 147.8 pounds, respectively, as compared to 166.8 for the bull calves. When a comparison is made within calves weaned on sale date and between those castrated 28 days before sale date and those intact on sale date, a difference of 19.0 pounds (166.8 - 147.8) is apparent in the intact males. Therefore, even after a 28-day recovery period, this group still has not overcome the stress and shrink associated with late castration.

TABLE 1. Castration Time and Weaning Time Interaction Effect on 84-day Weight Gain from September to the mid-December Sale Date.

| | | Castration Time | |
|---|---|---|---|
| **Weaning** | | **28 Days** | **1 Day** |
| **Time** | | **Before Weaning** | **After Weaning** |
| Nov. 1 | — 42 days before sale date | 158.4 | 154.8 |
| Dec. 13 | — On sale date | 147.8 | 166.8* |

* Calves in this group have not been castrated by sale date.

In trial 2, the same calves were used to study the effect of calf management on feedlot growth. Data presented in Table 2 show the effect of castration time on 90-day feedlot gains. Again, the stress associated with late castration is evident. The intact calves had the highest 84-day preweaning gain in trial 1. However, when these calves were castrated upon arrival at the feedlot, they gained significantly less (180.2 pounds) over the following 90-day period than calves castrated 70, 41, or 28 days prior to sale day (196.6, 201.8 and 192.5 pounds, respectivley). Therefore, discounts for bull calves or calves that have not healed from late castration appear to be justified. The vaccination times referred to in the footnotes of Table 2 had no effect on the November 1 weaned cattle. However, the data indicate that the stress of late castration can be offset somewhat by vaccinating 28 days before sale date regardless of whether or not cattle are castrated at that time.

TABLE 2. Effect of Castration Time on 90-Day Feedlot Gains in Calves Weaned 42-Days Before or on Sale Date.

| | | Castration Time | |
|---|---|---|---|
| **Weaning** | | **28 Days** | **1 Day** |
| **Time** | | **Before Weaning** | **After Weaning** |
| Nov. 1 | — 42 days before[1,2], sale date | 196.6 | 201.8 |
| Dec. 13 | — On sale date[1,3] | 192.5 | 180.2 |

[1] Calves were vaccinated for IBR, PI3, Pasteurella, BVD. Haemophilus Somnus, Blackleg, Black Disease, ME and Overeating Toxiods.
[2] Averages of two vaccination times; Oct. 4 or Nov. 2.
[3] Averages of two vaccination times; Nov. 15 or Dec. 14

From these data, it appears that producers have three management options to follow: first, they can castrate early and lose the extra gains that can be achieved from intact males; second, they can wean and sell intact males and risk sizeable discounts at the marketplace; or lastly, they can castrate late and hold these calves for a two month recuperation period. This later option reduces market flexibility and success is dependent upon many factors such as the price and availability of feed, labor and facilities. One alternative that effectively eliminates the disadvantages of these three management programs is early castration and implanting with RALGRO.

## Efficacy of RALGRO

The efficacy of RALGRO implants in suckling calves has been demonstrated in numerous research and demonstration trials conducted by private corporations, university personnel, beef consultants and producers. These test have been employed with numerous cattle types under varying production environments, nutritional regimes and management systems. This assures the producer a predictable economic response with return on investment normally running between $10 to $20 per $1.00 invested. In addition, basic research (Sharp and Dyer, 1970) has shown that RALGRO increases protein retention without increasing fat deposition. This is accomplished as RALGRO stimulates the pituitary gland to increase the secretion of the animal's own natural growth hormone (Borger *et al.*, 1971; Wiggins *et al.*, 1976, and Olsen *et al.*, 1977).

Calf implantation with RALGRO can occur the day of birth. The response that is achieved depends on many environmental, health, nutritional and management factors.

Although some producers have obtained responses to one RALGRO implant in excess of 35 pounds, the typical suckling calf response is 25 pounds. An additional 20 extra pounds can be expected with a second implant. It is not unusual for good cattle that are healthy and adequately managed to gain an extra 45 to 50 pounds from birth to weaning with two RALGRO implants. Results such as these are shown in Table 3.

TABLE 3. One Versus Two Implants During the Suckling Period[1].

| | No. of Calves | Gain, lb. birth to 7/26 | Gain, lb. 7/26 to 10/21 | Gain, lb. birth to 10/21 | RALGRO Advantage, lb. |
|---|---|---|---|---|---|
| Control | 21 | 251.2 | 131.6 | 328.8 | |
| One RALGRO Implant (birth) | 18 | 263.3 | 147.4 | 410.7 | +27.9 |
| One RALGRO Implant (4 months) | 20 | 245.6 | 165.6 | 411.2 | +28.4 |
| Two RALGRO Implants (birth and 4 months) | 18 | 265.2 | 163.7 | 428.9 | +46.1 |

[1] Steer Calves

While this Kansas trial is supported by a considerable amount of work in many other states, the efficacy and reliability of RALGRO is probably best illustrated by the results of Tennessee on-farm demonstrations. Tables 4 and 5 show the results of these demonstrations conducted by the Tennessee Extension Service in the years 1976 through 1980. This work effectively verifies a consistent response of 20 to 30 pounds when suckling calves are implanted with RALGRO. In addition, 1979 and 1980 Tennessee reimplant studies (Table 6) once again indicate the cumulative effects

TABLE 4. Tennessee Suckling Calf Implant Demonstrations.

| | 1976 & 1977* | | 1978** | |
|---|---|---|---|---|
| | Control | RALGRO | Control | RALGRO |
| Number of Calves | 358 | 742 | 151 | 134 |
| Total Gain, lb. | 161 | 186 | 209 | 240 |
| RALGRO Advantage, lb. | | +25 | | +31 |

* 68 Demonstrations; 53 Counties
** 5 Demonstrations; 5 Counties

TABLE 5. Tennessee Suckling Calf Implant Demonstrations.

| | 1979* | | 1980** | |
|---|---|---|---|---|
| | Control | RALGRO | Control | RALGRO |
| Number of Calves | 219 | 405 | 50 | 136 |
| Total Gain, lb. | 124 | 146 | 150 | 173 |
| RALGRO Advantage, lb. | | +22 | | +23 |

* 18 Demonstrations; 10 Counties
** 5 Demonstrations; 3 Counties

TABLE 6. Tennessee Suckling Calf Reimplant Demonstrations*

| | 1978 — 1979 | |
|---|---|---|
| | Control | RALGRO |
| Number of Calves | 80 | 97 |
| Total Gain, lb. | 340 | 345 |
| RALGRO Advantage, lb. | | +41 |

* 5 Demonstrations; 4 Counties

of reimplanting with an average two year response of 41 pounds. These data clearly show that RALGRO is a high pay-off investment and provides that extra competitive edge in total cattle management programs.

## RALGRO and Early Castration

To answer the question, does the gain response from RALGRO offset the gains lost by early castration, one need only to look at the data. It was mentioned earlier that on the average bulls gain five (5) percent faster than steers. Also, the data presented indicate that implanted steer calves will gain seven to ten percent faster than unimplanted steer calves. Consequently, it would appear that implanting more than compensates for the gains lost by early castration. However, a true comparison is best obtained by testing bulls and implanted steers side-by-side under similar environmental, management and nutritional regimes.

Ralston (1978) compared implanted steer calves with bull calves over a three year period (1973 through 1975). Although data presented in Table 7 indicate a large difference in favor of the bull calves for the year 1974, years 1973 and 1975 indicate that bull calves and steer calves implanted once with RALGRO will weigh approximately the same at weaning. Also, it is important to point out that the steer calves have more market flexibility and value than do the bull calves. Additionally, the bull calves will have to be castrated either before or after shipment to be backgrounded or finished which will subject them to much more stress and shrink.

Vatthauer *et al.*, (1980) conducted a similar study over a

TABLE 7. Implanted Steers Versus Intact Males.

| | Years | | |
|---|---|---|---|
| | 1973 | 1974 | 1975 |
| RALGRO and Castrated — AB[a] | (14)[b] | (21) | (21) |
| Birth Weight, lb. | 77 | 73 | 79 |
| Weaning Weight, lb. | 507 | 483 | 505 |
| RALGRO and Castrated — 90 Days | (13) | | |
| Birth Weight, lb. | 79 | — | — |
| Weaning Weight, lb. | 507 | — | — |
| Intact Males | (12) | (21) | (21) |
| Birth Weight, lb. | 82 | 79 | 79 |
| Weaning Weight, lb. | 507 | 512 | 509 |

[a] AB — at birth
[b] ( ) = number per treatment

three year period (1977 through 1979) to compare (1) weaning weights of early (1 to 2 months) castrated, implanted steer calves and nonimplanted bull calves and (2) one month postweaning gains of these two groups after the bull calves had been castrated at weaning. The data presented in Table 8 again show little difference between weaning weights of bull calves versus steer calves implanted once with RALGRO. However, when weights were again taken one month post-castration of the bull calves, there was a three year average difference of over 14 pounds in favor of the implanted steers.

TABLE 8. Effects of Early Castration and Implanting Suckling Bull Calves.

| | Control Bulls | | | Implanted Steers | | |
|---|---|---|---|---|---|---|
| | **1977** | **1978** | **1979** | **1977** | **1978** | **1979** |
| No. | 21 | 24 | 24 | 22 | 25 | 25 |
| Weights (lbs.) | | | | | | |
| Initial | 231.0 | 246.0 | 233.0 | 249.4 | 240.8 | 237.0 |
| Weaned | 431.6 | 469.8 | 518.6 | 441.3 | 467.0 | 526.9 |
| Gain | 200.6 | 223.8 | 285.6 | 191.9 | 226.2 | 289.9 |
| Ave. Gain | | 236.7 | | | 236.0 | |
| Difference | +8.7 | | | | +2.4 | +4.3 |
| Ave. Difference | | 0.7 | | | | |
| Final[a] | 487.3 | 504.8 | 560.6 | 519.2 | 521.1 | 570.1 |
| Gain | 55.7 | 35.1 | 42.0 | 77.9 | 54.1 | 43.2 |
| Ave. Gain | | 44.3 | | | 58.4 | |
| Difference | | | | +22.2 | +19.0 | +1.2 |
| Ave. Difference | | | | | +14.1 | |
| Total Gain | 256.3 | 258.8 | 327.6 | 269.8 | 280.3 | 333.1 |
| Ave | | 280.9 | | | 294.4 | |
| Difference | | | | +13.5 | +21.5 | +5.5 |
| Ave. Difference | | | | | +13.5 | |

[a]One month post-castration of the bull calves.

Another trial was conducted in Kansas (1979) to compare the weaning weights of bull calves, nonimplanted steer calves and steer calves that had been implanted with RALGRO twice (28 and 128 days of age). Data presented in Table 9 show a sizeable advantage of 36 and 47 pounds for the implanted steers over the bull and nonimplanted steer calves, respectively.

A Florida study was designed to determine the effect of castrating and implanting on Holstein calves up to six months of age. Data presented in Table 10 indicate a 34 and 11 pound advantage for implanted steers over nonimplanted steers and bulls, respectively.

Data collected in a two year Iowa study suggest that castration at birth does not have a negative impact on growth rate during the nursing period. In fact, when one incorporates growth rate up to 6 weeks following weaning, birth castrated males come out in a very favorable position. This would suggest that birth castration with a normal response to growth stimulant implants would be superior in growth rate to males castrated at weaning and then implanted.

The data presented within this text strongly favor castrating early (birth to 2 months of age) and implanting twice with RALGRO to maximize herd weaning weights. This becomes even more apparent in the following hypothetical example:

| | | |
|---|---|---|
| Weaning Weights: | | |
| bull calves | 480 | |
| nonimplanted steer calves | 456 lb. (5% less than bulls) | |
| twice implanted steer calves | 496 lb. (40 lb. response to 2 implants) | |
| Cost and Returns: | | |
| implants and labor | $ 4.00 | |
| value bull calves | $63.00/hundred weight ($2.00/hundred weight discount) | |
| value steer calves | $65.00/hundred weight | |
| Value: | | |
| bull calves | 480 × .63 = | 302.40 |
| nonimplanted steer calves | 456 × .65 = | 296.40 |
| twice implanted steer calves | 496 × .65 − 4.00 = | 318.40 |
| RALGRO Advantage: | | |
| over bull calves | $16.00/head | |
| over nonimplanted calves | $22.00/head | |

TABLE 9. Implanted Steers Versus Intact Males.

| | Intact | Steers[1] | |
|---|---|---|---|
| | **Males** | **Control** | **RALGRO** |
| Number of Calves | 13 | 12 | 13 |
| Weaning wt., lb. | 441 | 430 | 477 |
| RALGRO Advantage | | | |
| Over Intact | | | +36 |
| Over Control | | | +47 |

[1]RALGRO steers implanted at 28 and 128 days.

TABLE 10. Effects of RALGRO Implants on Growth of Holstein Calves From Birth To Six Months of Age.

| **Group 1** | **Group 2** | **Group 3** |
|---|---|---|
| —castrated at 4 weeks of age —not implanted | —castrated 4 weeks of age —implanted at birth and 90d (180 days) | —remained as bulls —not implanted |

| | **G 1** | **G 2** | **G 3** |
|---|---|---|---|
| Castrated | Yes | Yes | No |
| RALGRO Implant | No | Yes | No |
| Number of Head | 97 | 90 | 48 |
| Ave. Initial Weight, lb. | 86 | 86 | 86 |
| Ave. 90-day Weight, lb. | 215 | 226 | 220 |
| Ave. 90-day Gain, lb. | 129 | 140 | 134 |
| Ave. 180-day Weight, lb. | 462 | 497 | 486 |
| Ave. 180-day Gain, lb. | 376 | 410 | 399 |
| Advantage due to RALGRO Implants | | | |
| Vs. nonimplanted steers | | +34 lb. per head | |
| Vs. intact bulls | | +11 lb. per head | |

a, b, c Values with uncommon superscripts within an age group are significantly different ($P < 0.05$).

It is evident that RALGRO and early castration offer cow-calf producers the ideal management system for maximizing preweaning gains, market flexibility and value and for causing the least amount of stress and trauma to the animal.

#### References


1. Brown, G.R. 1978. Implant may cut heat stress. Beef, October, 1978. 2. Brown, G.R. 1978. RALGRO for shipping stress. Unpublished data. 3. Brown, R.G. Toxicology and tissue residues of zeranol. International Minerals and Chemical Corporation, Terre Haute, IN. 4. Becker, B.A., S. Doelger, F.D. El-Nouty, D. Satterlee and H.O. Johnson. 1982. Effects of RALGRO on physiological responses of beef cattle to short term heat stress. J. Dairy Sci. In Press. 5. Borger, M.L., L.L. Wilson, J.D. Sink, J.H. Ziegler and S.L. Davis. 1973. Zeranol and dietary protein level effects on live performance, carcass merit, certain endocrine factors and blood metabolite levels of steers. J. Anim Sci. 36:706. 6. DISMEDIC S.A.C.I.F.I. 1976. What we know about RALGRO in Argentina. Buenos Aires, Argentina. 7. Donovan, G.A., R.K. Braun, R.C. Little, S. Suissa. 1983. Weight changes of male dairy calves following zeranol implants. J. Dairy Sci. 66:840. 8. Harte, F.J. 1975. The advantages of producing bulls for beef. Farm and Food Research. 2:4. 9. Marlow, T.J. and J.A. Gaines. 1958. The influence of age, sex and season of birth of calf and age of dam on preweaning growth rate and type score of beef calves. J. Anim. Sci. 17:706. 10. Olsen, R.F., P.J. Wangsness, R.J. Martin and J.H. Gahagan. 1977. Effects of zeranol on blood metabolites and hormones in wether lambs. J. Anim. Sci. 45:1392. 11. Patterson, J. 1982 Unpublished data. University of Missouri. 12. Preson, R.L. and Willis. 1974. Intensive Beef Production. 2nd edition. 13. Ralston, A.T. 1978. Effect of zearalanol on weaning weight of male calves. J. Anim. Sci. 47:1203. 14. Robertson, I.S. and A. Laing. 1965. A comparison of entire, partially and fully castrated beef cattle housed in stalls and yards. Anim. Prod. 7:279. 15. Strohbehn, D.R., R.L. Willham and G. Rouse. 1981. Effect of calf management on growth rate of crossbred calves up to sale time as feeder calves. A.S. Leaflet R329. Iowa State University, Ames IA. 16. Strohbehn, D.R. 1981. Effect of management on growth and efficiency of crossbred calves as feeder calves after sale time. A.S. Leaflet R330. Iowa State University, Ames, IA. 17. Strohbehn, D.R. 1983. Progress Report. Unpublished Data, Iowa State University, Ames, IA. 18. Vatthauer, R., D. Peschel and W. Paulson. 1980. Early castration and implanting of suckling calves; three year summary. Lancaster Cow-Calf Day Proceedings. University of Wisconsin, Madison, WI. 19. Wassink, C.J. Depletion of tritiated RALGRO in steer tissue by radioactive tracer analysis. International Minerals & Chemical Corporation, Terre Haute, IN. 20. Wiggins, J.P., L.L. Wilson, H. Rothenbacker and S.L. Davis. 1976. Effects of diethylstilbestrol, zeranol and sex on live, blood metabolite, carcass and endocrine characteristics of lambs. J. Anim. Sci. 43:518.


# Abstracts

## Relationship of the dosage form of a corticosteroid to its therapeutic efficacy


*Gordon L. Coppoc, DVM, PhD*


*JAVMA, Vol 185, No. 10, November 15, 1984*


Corticosteroids come in a variety of parent compounds, derivatives, and vehicles. The specific spectrum of pharmacologic effects produced, as well as the rapidity of onset and duration of action, depends on the derivative (e.g., ester) and dose form, as well as on the steroid base. Adverse side effects of corticosteroids, such as iatrogenic Cushing's disease, increased susceptibility to infectious disease, slowed wound healing, loss of muscle mass, and suppression of the pituitary-adrenal axis are not rare occurrences in animals.

The wide range of biological actions, the wide and overlapping range of dosages required to produce various therapeutic and toxic effects, the subtlety of many of the effects, and the variation in time of onset all contribute to the problems observed. Other contributing factors are variation in sensitivities of animals of the same species and between species.

The specific spectrum of pharmacologic effects produced depends on which of the many steroid bases is used. Corticosteroids have classically been divided into mineralocorticoids and glucocorticoids. Although this concept has been extremely useful, the division is not absolute, even for corticosteroids regarded as having only 1 activity. Dexamethasone and triamcinolone are commonly regarded as having no mineralocorticoid activity, but Slone et al have shown that 20-mg doses IM of either of these drugs can lower serum potassium and increase serum sodium in bilaterally adrenalectomized horses. These steroids will also reverse hypoadrenal crisis at these rather high doses.

## Factors influencing the occurrence of drug residues in animal tissues after the use of antimicrobial agents in animal feeds


*Richard F. Bevill, DVM, PhD*


*JAVMA, Vol 185, No. 10, November 15, 1984*


A variety of antimicrobial substances have been approved by the Food and Drug Administration (FDA) for use in animal feeds. Seventeen drugs are approved for use in swine, cattle, or poultry feeds to increase rate of gain, improve feed efficiency, or as prevention or treatment of specific diseases of bacterial origin. An additional 36 substances have been approved for use in animal or poultry feeds as prevention or treatment of histomoniasis, coccidiosis, internal parasites, or for control of fly larvae in feces.

## Recent advances in methods of drug administration for animals


*John M. Bowen, DVM, PhD*


*JAVMA, Vol 185, No. 10, November 15, 1984*


Because of the variety of species treated by veterinarians, the need to treat large numbers of animals in relatively short periods, and the multiple dosage forms available, specialized drug delivery devices are useful in veterinary medicine to enable safe, efficacious, efficient, and economical therapy. Drug delivery devices may be divided into 2 general types: (1) Mechanical devices used to aid administration of a dosage form, eg, balling gun, and (2) control devices that regulate the rate of release of a drug to the animals, e.g., implant. Control devices include physical devices and formulations and may also serve to target the drug to a particular site in the body. Many advances have been made in the bioengineering aspects of controlled-release techniques, but economic factors limit the application of this technique in veterinary medicine.