Proceedings of the

1970 BEEF CATTLE CONFERENCE

October 29, 1970

Texas Tech University
Animal Science Department
Lubbock, Texas
and
Texas Tech University Research Center
Pantex, Texas

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1970 BEEF CATTLE CONFERENCE
Thursday, October 29, 1970
University Center Coronado Room

Morning Program
Presiding: Max Lennon

9:15-10:00	Registration and Coffee Ballroom
10:00-10:10	Sam Curl "Welcome to Texas Tech"
10:10-10:30	Bill Wohler "Infectious Reproductive Diseases in Cows"
10:30-10:50	Boyd Ramsey "Fat and Muscle Deposition Patterns in Cattle"
10:50-11:10	Coleman O'Brien "Estrus Synchronization of Cattle in Multiple Birth Studies"
11:10-11:55	Lavon Sumption "Beef Breeding for Profit--A Merry Mix-up"
11:55- 1:05	Lunch

Afternoon Session
Presiding: Dale Zinn

1:05- 1:25	Hollis Klett "Soybeans in Ruminant Rations"
1:25- 1:45	Lloyd Sherrod "Triticale in Livestock Rations"
1:45- 2:05	Robert Albin "Feedlot Waste Management Systems"
2:05- 2:30	Marion Scalf "Water Pollution Control in Cattle Feedlots"
2:30- 2:55	Coffee
2:55- 3:15	Mel Gray "Feedlot Waste Management in Kansas"
3:15- 3:40	Hugh Yantis "Feedlot Waste Management in Texas"
3:40- 4:00	Panel Discussion
4:00	Adjourn

1970 BEEF CATTLE CONFERENCE
WHO'S WHO

Dr. Lavon Sumption, Consulting Geneticist, Prairie Animal Breeding Enterprises, Lmtd., Edmonton, Alberta, Canada

Mr. Melville P. Gray, Kansas State Health Department, Topeka, Kansas

Mr. Marion R. Scalf, Treatment and Control Research Program, U. S. Department of the Interior, Federal Water Pollution Control Administration, Ada, Oklahoma

Mr. Hugh C. Yantis, Jr., Texas Water Quality Board, Austin, Texas

Texas Tech Faculty:

Dr. Samuel E. Curl, Interim Dean of Agricultural Sciences

Dr. William F. Bennett, Interim Assistant Dean of Agricultural Sciences

Animal Science Department:

Dr. Dale W. Zinn, Professor and Chairman

Dr. Robert C. Albin, Associate Professor and Chairman for Beef Cattle Conference

Mr. John H. Baumgardner, Professor

Dr. Samuel E. Curl, Professor and Interim Dean

Dr. Ralph M. Durham, Professor

Mr. Charles T. Gaskins, Assistant Professor

Mr. Keith R. Hansen, Animal Husbandman, Pantex

Dr. Frank A. Hudson, Professor

Dr. R. Hollis Klett, Professor and Superintendent of the Research Center, Pantex

Dr. A. Max Lennon, Assistant Professor

Dr. Keith D. Lind, Assistant Professor

Dr. Coleman A. O'Brien, Associate Professor

Dr. C. Boyd Ramsey, Associate Professor

Dr. Lloyd B. Sherrod, Associate Professor, Pantex

Dr. Leland F. Tribble, Professor

Dr. W. H. "Bill" Wohler, Associate Professor and Veterinarian

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Eli Lilly and Company, Greenfield, Indiana
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EFFECT OF ANTITHYROIDS IN FEEDS ON FERTILITY

C. A. O'Brien

Chesney and associates (8), in 1928, were first to report induced (endemic) goiter in animals fed natural food (cabbage). Since that time, numerous forages and feedstuffs have been found to produce goiter and impair thyroid function. Although not fully understood after more than four decades of intensive investigation, antithyroid (goitrogenic) agents, in sufficient quantity, are known to suppress metabolism, thyroid function, appetite, growth, fertility, reproduction, and will induce thyroid hypertrophy and hyperplasia. Interference with thyroid function suppresses synthesis of thyroid hormone (thyroxine) to impair animal health, neural and hormonal function, and reproductive processes sufficiently to depress livestock production (15). Inadequate supplies of thyroid hormone can cause loss of libido in the male (16) and females fail to cycle, and are infertile (19).

Animal species vary in their response to antithyroid agents (18), and some plant families and genera are decidedly more goitrogenic than others (13, 28, 31). Although antithyroid feeds are not presently a problem of animal producers in the United States, the introduction and expanded use of new strains of goitrogenic crops and increased use of meal processed from seed of those crops is steadily increasing (18).

Plants Producing Antithyroid Substances

The Cruciferae (mustard) family, particularly the Brassica (turnip) and Raphanus (radish) genera, are the most frequent causes of antithyroid problems in livestock fed natural forages and feedstuffs. Foods reported to be goitrogenic to man and animals under given conditions are uncooked (raw) rutabaga, cabbage, brussel sprouts, cauliflower, turnip, rape, kale and to a lesser extent peach, pear, strawberry, spinach, carrots (13, 31), beets, and white sweet clover (11). Numerous wild strains of the Cruciferae and to a lesser extent the Umbelliferae (carrot) and Compositae (lettuce) families antithyroid compounds. These plants are found in cropland and in native and improved pastures in quantities sufficient to adversely affect reproduction of animals grazed on these areas (9).

Antithyroids and Mechanisms of Action

Antithyroid substances (goitrogens) are antimetabolites which interfere with utilization of iodine by the thyroid gland (28, 32). The goitrogens serve to 1) depress the level of blood thyroxine, 2) increase pituitary gland synthesis of thyrotropic hormone (TSH), 3) enlarge the thyroid gland by excessive pituitary secretion of TSH, and 4) alter cellular structure of the thyroid (15, 30).

Four substances 1) thyroid hormone (thyroxine), 2) elemental iodine, 3) thiocyanate ion, and 4) antithyroid substances (thiocarbamides and sulfonamides) interfere with synthesis and use of the thyroid hormone and depress thyroid gland activity (6, 32). Other than a brief reference to certain other goitrogens, only thiocyanate and the antithyroid substances will figure in this discussion. Excess calcium in the diet has been implicated as a cause of goiter in man through its complexing action with iodine in the intestine (28). Nitrates in the diet can inhibit iodine "trapping" by the thyroid and discharge thyroid-stored iodine (35). As a consequence of nitrate toxicity, it is believed by some investigators that numerous field symptoms of livestock may be due to thyroid impairment and inability to convert carotene to vitamin A (3, 34).

Most studies confirm that antithyroids act to prevent synthesis of thyroid hormone; but, contrary to earlier theories, it is increasingly suggested that antithyroid agents alter extra thyroid metabolism to vary the degree of thyroxine influence on target tissues (20, 23). Any suppression of the thyroid gland reacts to suppress the entire enzyme system, particularly that of the oxidative enzymes and the cellular mitochondra (16).

Thiocyanate. Thiocyanate occurs in plants as a free ion or as a glucoside. It is a common ingredient of feedstuffs (9) and is especially abundant in the Cruciferae (mustard and turnip) and Umbelliferae (carrot) families (14). Thiocyanate is released in quantity from digestion of the cyanogenetic glucosides by detoxification of hydrogen cyanide (17, 32). Perchlorate, nitrate and other monovalent anions, like thiocyanate, will inhibit the thyroid from collecting and storing iodide (35), but supplemental dietary iodine will prevent goiter and relieve goitrogenic stress (30, 32).

It appears that thiocyanate will selectively interfere with or block iodide uptake and concentration in the thyroid and quickly releases iodide stored in the gland (10, 25). Thiocyanate does not interfere with the thyroid hormone synthesizing mechanism: 1) oxidation of iodide ion, 2) iodination of tyrosine, and 3) coupling (6). The mechanism of iodide blockage by thiocyanate and nitrate is not fully understood (10). Supplemental iodine and vitamins A and the B complex relieve the harmful effects of thiocyanate (9).

Thiocarbamide and aminobenzene groups. The thiocarbamide and aminobenzene groups are analogues of thyroxine. Members of both groups interfere with iodination of tyrosine and prevent synthesis of thyroid hormone and induce goiter. When thyroid gland synthesis of thyroxine is interrupted, blood thyroxine declines and the pituitary is stimulated to increase its secretion of thyrotropic hormone and, long continued, the thyroid enlarges and its structure is altered (6, 15, 32). Supplemental dietary iodine will not correct the goitrogenic action of these groups (25). Thiocarbamides, in the form of thiourea and thiouracils, typify the most active agents in production of endemic goiter. Aminobenzenes, as sulfonamides, present few problems to livestock production.

One of the most potent and frequently encountered antithyroid substances is oxazolidinethione, or goitrin (L-5-vinyl-2-thiooxazolidene). It is found in abundance in the seed and to a lesser extent in the vegetative portions of Brassica (turnip, rape, kale, cabbage, etc.) and Raphanus (radish) genera. Goitrin is not found as such in plants and seeds, but as a harmless thioglucoside, progoitrin. During digestion, progoitrin is hydrolized by the enzyme myrosinase into the goiter-producing goitrin. Cooking will destroy myrosinase to make the product safe for dietary consumption, unless the enzyme is reintroduced by other substances in the diet or by intestinal bacteria such as E. Coli (14). Isothiocyanates produce effects similar to oxazolidinethione but, in addition, appear to depress a number of metabolic functions (2).

Thiocarbamides and sulfonamides appear to inhibit synthesis of thyroid hormone by blocking oxidation of the iodide ion and inhibit iodination of tyrosine, coupling in the production of thyroxine, and scavanger action of the enzyme deiodinase. These goitrogens appear to have no effect on the mechanism of iodine collection and no direct effect on the thyroid, since hydrolysis of thyroglobulin and release of hormones into the circulation are not halted (29, 32). The true antithyroids act by reducing free iodine to iodide and make the iodide unavailable to the thyroid by preventing the oxidative process, but organically-bound iodine is not discharged from the gland. Antithyroid activity of these compounds may lie in their ability to inhibit the oxidizing enzyme systems (25, 32). It appears that iodide and thiourea compete for common metabolic pathways during their metabolism to alter and impede normal thyroid function (26). Other data suggest that the anti-thyroid substances and iodide compete for hydrogen peroxide and compete as substrates (6). Limited new data indicates that propylthiouracil inhibits deiodination of thyroxine and increases its rate of excretion (23).

Other aspects of antithyroid activity. The goitrogenic antimetabolites exert repressive influence over the entire endocrine system, particularly the glands, organs and hormones related to reproduction. Thyroid hormone appears to be essential for conversion of carotene to vitamin A (12, 34). Adequate dietary vitamin A is necessary for the maintenance of functional epithelial membranes and these are essential for sperm and ova production, and for embedding and attachment of the fertilized egg in the uterus (27). Researchers have found that dietary nitrate adversely affects the thyroid of sheep and cattle and produces goitrogenic and vitamin A deficiency symptoms (3, 24).

Effect of Antithyroid Feeds on Livestock

Rape production has increased manyfold in recent years, especially in Canada and Mexico. Expanded use of rapeseed meal (RSM) in livestock feeding presents the most immediate concern to domestic livestock producers. Fortunately, new methods of processing rape seed destroys myrosinase, the activating enzyme of goitrin (oxazolidone), the thiocarbamide substance in rape seed. Rapeseed meal approximates SOM in feeding value, but is less palatable. Ruminants appear to be less affected by goitrin than are poultry and swine. Rapeseed meal can successfully replace 25% of SOM, or may constitute not over 3% of the total ration for breeding and lactating swine (18, 21).

Kale, a member of the Brassica genus, has become a popular fall and winter grazing crop over the past 25 years. It exerts moderate goitrogenic effect and appears to influence fertility and conception. Conception rate in English dairy heifers on first service was 3 of 11 in the kale-grazed versus 7 of 12 in grass-grazed animals. Time in returning to estrus was affected in kale--38.8 days; grass--21.6 days (22). Other English investigators found that kale-grazed dairy cattle suffered depression in fertility in the winter breeding season (October-March) and milk production declined in cows fed heavy kale diets (4).

Sheep appear to be more affected by kale feeding than cattle. The appetite of kale-grazed ewes declined after five weeks, anemia developed, duration of estrus was shortened, copper and iodine metabolism was depressed and conception declined (33).

Australian researchers found milk from cows grazed on marrow cabbage (chou moellier) and on turnip weed (Rapistrum rugosum) was goitrogenic and fed to man and animal decreased iodine uptake by the thyroid (1). Other goitrogenic plants were hare's ear mustard, a common invader of wheat fields, and wild turnip found in native and improved pastures (9).

Cyanogenetic white clover, which is high in thiocyanate, was found to inhibit the conversion of inorganic iodide to organically-bound iodine and to produce goiter in sheep: it appeared not to influence growth or reproduction (11). Raw soybeans inhibit iodine absorption from the intestine as will the arachidoside-bearing red skin of raw peanuts (20). Linseed meal fed to pregnant ewes will cause goiter in lambs because of cyanogenetic glucoside, linamarin (7).

In confirmation of the repressive action of antithyroids on the thyroid gland to interfere with reproduction, thyroid gland removal (thyroidectomy) in ewes reduced prenatal lamb growth and increased the rate of reproductive failure in ewes (5). Hypothyroidism from any cause is associated with ovarian cysts and subnormal reproductive performance (19).

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FEEDLOT WASTE MANAGEMENT SYSTEMS[1,2]

Robert C. Albin

Numbers of feedlot cattle in the United States have increased dramatically during the last decade. Considering the twenty-two major cattle feeding states, fed cattle marketings have expanded from approximately 12 million head in 1959, to 17 million head in 1964, and to 23.7 million head in 1969. The growth of this industry has been in feedlots with a capacity of 1,000 head or more. The intensification in numbers of cattle per feedlot has been followed by numerous situations which have been magnified to the point of needing new concepts for optimum and efficient management. One of these areas is the handling and disposal of cattle feedlot waste. The volume of daily waste accumulation per animal has been observed to be as low as 2.4 lb. when feedlot cattle consumed an all-concentrate finishing ration to a reported 8.1 lb. for bovine wastes in general. McCalla and Viets (1969) stated that 10,000 head of cattle on a feedlot produce 260 tons of solid waste and 100 tons of liquid waste daily.

Incidences of ground water pollution and fish-kills which have been directly attributed to runoff from livestock feeding operations have been instances of concern. It is documented that the elimination of wastes as a discharge material generally intrudes upon a natural resource or someone's personal rights. The purposes of this paper were to review and evaluate the current cattle feedlot waste situation.

Pollutional. Pollution has been defined as any factor which adversely affects the historical beneficial or subsequent legitimate water uses. Pollution of water refers primarily to surface water, but pollution of underground water from cattle feedlots seems to be a definite possibility. The work of Gilbertson et al. (1970) indicated movement of pollutants into the soil under unpaved feedlots, but considerable nitrate movement in the buffer

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[1]Presented at a Symposium on Animal Waste Management, 62nd annual meeting of the American Society of Animal Science, University Park, Pennsylvania, August, 1970.

[2]Condensed from a paper submitted for publication in the Journal of Animal Science as ICASALS Contribution No. 85 entitled "Handling and Disposal of Cattle Feedlot Waste."

strips between test lots. Other information would support that contact surfaces are sealed by a film or slime layer which prevents seepage of water from feedlot surfaces, ponds, playa lakes, and dikes into the underground water supplies.

Grub et al. (1969) summarized data from various sources which indicated that the type of ration, size of cattle, concentration of cattle pen, slope and surface covering of the lot, depth of accumulation, and moisture content of the waste were some of the major factors affecting the composition and quantity of cattle feedlot waste and runoff. These papers varied somewhat with respect to actual numerical values for many of the parameters, but consistently agreed that runoff from cattle feedlots was concentrated and carried a high pollution potential.

Handling and Disposal Methods

Feedlot waste can be partitioned into liquid and solid elements. The liquid portion is generally observed as a component of the accumulated waste on feedlot surfaces, as runoff during periods of rainfall, or as the carrier in liquid handling systems. Solid waste can be found on the feedlot surface, as a suspension in runoff water, as sediment in retention ponds, or as a suspension in liquid handling systems. Systems currently being used or of potential application to cattle feedlot waste handling and disposal will be presented in this paper.

Land utilization. Application of feedlot waste to the land has been an accepted and common method of disposal. A general pattern of feedlot waste and runoff handling and disposal for Southwestern cattle feedlots is described as follows. Solid waste is often stockpiled within the cattle pen and used as a lounging area by cattle or in a central storage area near the feedlot. The material might be spread out to dry prior to stockpiling, in order to minimize burning and smoldering. The solid waste is then spread on fields as cultural practices and weather conditions permit. The waste is turned under or worked into the soil as soon as possible after spreading to reduce the chance of ground water pollution. Runoff water is trapped in retention ponds or dikes--then pumped into a field irrigation system as a mixture with well water, or into shallow lagoons or ponds for evaporation. Owens _et al._ (1969) discussed the physical and economic relationships of these runoff and disposal procedures. Wells _et al._ (1969b) have described the toxic effects of application of undiluted feedlot runoff to selected crops.

Liquid handling systems for animal waste have evolved with the development of confined livestock operations. Okey, Rickles and Taylor (1969) compared the relative economics of disposal of feedlot waste by selected wet and dry techniques. Their findings indicated that wet systems would be more expensive than those systems designed to handle solids. Liquid handling of feedlot waste would require adequate holding facilities to allow greater flexibility in the schedule for spreading. Liquid waste systems are generally holding and handling methods, with disposal of the liquid material by one or more of the methods to be discussed. Data for cattle feeding systems are limited, but the information reported for other livestock production units would indicate that disposal of liquid waste is being accomplished by spraying on the land with an irrigation system, spreading by flood irrigation, spreading on the land from bulk tank trailers equipped with a sprayer system or by application of the liquid waste under the soil. Gray (1969) illustrated the large variation in application rates of feedlot waste by indicating that as little as five tons per acre per year have been applied to as much as 300 tons per acre per year.

Anaerobic systems. An anaerobic system may be defined as any system where the final hydrogen acceptor in the reduction of organic carbon is organic material. The end-products of anaerobic decomposition are principally methane, carbon dioxide, and water.

Anaerobic digestion. The biological degradation efficiency of this process seems to be dependent upon the type of ration and animal. It has been demonstrated that beef cattle wastes can be treated by this method. Gases produced from this system contain between 50 and 70 percent methane. Field units have generally not been as successful as laboratory units and this difference has been attributed to the more complete mixing and more closely controlled temperature of laboratory tests. In some instances, low temperatures in cold climates have been responsible for failure and incomplete digestion. This type of treatment of municipal sewage (anaerobic sludge digester) is one of the most difficult systems to operate. The effluent from this process would generally require further treatment before release into the environment.

Anaerobic lagoons. Little information has been reported for cattle wastes. The main functions of anaerobic lagoons are to remove, destroy, and stabilize organic matter, but not necessarily to purify water. The advantage of this system lies with highly concentrated wastes. Considerable gas and odor production is evident near one of these systems. An anaerobic lagoon is similar in function to a single-stage, unmixed, unheated digester. Loading rates, pH, temperature, depth of the lagoon, and mixing must be carefully controlled. Taiganides (1968) reported that most anaerobic systems studied and used to date for livestock wastes have yielded disappointing results.

Aerobic systems. An aerobic system may be defined as any system where the final hydrogen acceptor in the oxidation of organic carbon is oxygen. The end-products of aerobic decomposition are principally carbon dioxide and water. Almost any degree of degradation can be obtained with this system since oxidation of animal waste is a function of time, oxygen availability, and organic carbon content. As with the anaerobic systems, final disposal of the effluent is generally the land. A variety of techniques are available for use in diffusing oxygen into the aerobic system. Most of the information available for these systems has been collected from hog wastes. Loehr and Agnew (1967) demonstrated that the effluent from an anerobic beef cattle waste system could be treated aerobically.

Aerobic lagoons. There are two basic types, the simple or oxidation pond and the mechanically aerated lagoon. The oxidation pond depends upon oxygen from the air and from algae production. Animal wastes have a high oxygen demand, requiring large surface areas and volumes. For example, a confinement unit holding 1,000 head of beef cattle would require an oxidation pond of at least 20 acres. If mechanical aeration were established, less land area would be required than with the oxidation pond.

Oxidation ditch. The oxidation or Pasveer ditch has received new attention with the advent of confined beef cattle feeding facilities. The system combines the aerobic lagoon concept with the addition of paddles for agitation of the solids. Excessive foaming has been reported with animal wastes, but odors were practically eliminated. Moore, Larson and Allred (1969) have reported using this method for stabilizing beef cattle wastes in a cold climate.

Other aerobic systems. An air aspirator system was being studied which involved drawing liquid manure (diluted) along a ditch with air inlet pipes into the suction tube, an activated sludge process and use of biofilters. These have been reported as common and well-studied municipal and industrial systems, but with major capital costs involved.

Anaerobic-aerobic system. This system utilizes a combination of anaerobic and aerobic systems for the treatment of effluent. Loehr (1969b) presented a paper with results from a field demonstration which investigated an anaerobic-aerobic treatment system for beef cattle feedlot waste water. Complete destruction of the pollutional characteristics of runoff water from beef cattle feedlots was not obtained. The effluent from this system could have been used for crop land application, but further treatment would have been necessary if final disposal would have been into surface water.

Aerobic composting. Aerobic composting is a method used for the stabilization of solid organic material. The usefulness of this system would seem to be that solid waste from beef cattle feedlots would be stabilized to a point at which the material would be odorless, insects would no longer be attracted to the mass, bacteria of putrification would no longer be active, coliform bacteria would no longer be detected, and a reduction of internal temperature would occur (Wells et al., 1969a). After composting, virtually all of the dry matter remains for further disposal, presumably to the land. In addition, provisions would need to be made for disposal of runoff water.

Complete treatment. Complete treatment of animal wastes would be required if the final effluent were to be discharged into or adjacent to surface water. The high degree of purity required by this means of disposal would be paralleled by larger and more expensive facilities for treatment.

Dehydration and/or incineration. Aerobic and anaerobic systems reduce the pollutional characteristics of animal wastes but do little to reduce the volume of material to be handled. Dehydration and/or incineration is an approach that would dramatically reduce the quantity of animal waste to be handled and the potential pollution of ground water. The available literature deals with the combustion of poultry wastes.

Nutrient recycling. The feeding of animal waste to livestock offers an interesting approach to waste management. This practice would utilize waste as a feedstuff, with the concept of materials reutilization being practiced. Anthony (1970) presented a paper summarizing the use of animal waste as a feed.

Miscellaneous methods. Some miscellaneous handling practices for animal wastes have been recorded, such as the addition of chlorine, lime, or chemical coagulants, or the use of trickling filters. Application of these methods to the disposal of cattle feedlot waste would appear to be of doubtful significance.

European methods. The systems reportedly used in Europe were generally based on small numbers of livestock per unit of land and were some modification of an aerobic system. With the increased concentration of beef cattle in feedlots in the United States, the value of European experiences may be limited.

Implications for the Future

Environmental pollution. Interest in the handling and disposal of cattle feedlot waste has occasionally been generated by a conflict between cattle feeders and society. The conflict could generally be stated as how the situation might be resolved in the best interests of the parties involved. Biniek (1969) presented a thought-provoking paper on the question of livestock production versus environmental quality. He pointed out that time may be limited to achieve equitable solutions to environmental pollution and that we must be adaptive, flexible, and innovative to master the challenge. Loehr (1968b) outlined some of the pollution hazards associated with livestock wastes which must have a solution. Clayton (1969) discussed animal waste in general and feedlot waste in particular, from the legislative point of view. He posed significant environmental problems in three major areas: 1) fish, other aquatic life, and recreational uses; 2) surface and subsurface water supplies; 3) land usages and esthetics. Miner et al. (1970) reviewed pollution control from feedlots and categorized the environmental problems associated with waste from this industry.

Research needs. Scalf and Witherow (1969) summarized research needs for feedlot waste management with an emphasis on the need for application of present technology and knowledge as a rapid, useful, and essential step toward future solutions of water quality problems. They proposed that a suitable method for the management of cattle feedlot runoff might be a combination of pretreatment in an anaerobic lagoon, treatment in an oxidation ditch or aerated lagoon, and final disposal on the land. Complete treatment in the aerobic system was proposed to be given attention in order that stream disposal might be applicable for the effluent.

A review of current research projects and areas for future research of beef cattle wastes in the Plains states was prepared by the Great Plains Agricultural Council (1969). This report recommended that research efforts be intensified in five areas: air pollution--from odors, ammonia, dust, and pathogens; land disposal--influence of extended application of manure upon soil integrity; pollution under feedyards--investigate deep percolation of nitrates, phosphates, and microorganisms; systems analysis--production methods related to disposal techniques, considering parameters of climate, construction, feed, and possible zoning restrictions or relocation; complete economic evaluation of current alternatives for waste disposal; and socio-legal implication--a well-defined approach to their solution.

Evans (1969) proposed plans for expansion or initiation of feedlot waste research in the areas of: microbial, chemical, and organic pollution of the atmosphere, soils, and surface and underground water supplies; development of systems for pollution control of runoff water and subsequent treatment of the contained runoff by aeration, activated microflora, or by precipitation of colloids; and field investigations of the effects of heavy manure applications on cropped and uncropped soils over a period of years. A later report indicated that some of these studies were being implemented (Evans, 1970).

King (1969) itemized several avenues that warranted research attention, some of which not previously mentioned were: the development of joint treatment and disposal facilities by several producers or sufficient treatment to enable the effluent to be handled by municipal treatment plants; seek potential uses for animal wastes; land use planning; and development of more detailed information on the relationship of wastes to agricultural production.

Loehr (1969a) tabulated most of the research areas mentioned, but with emphasis upon giving attention to the definition of problem areas, or types of research that were most likely to benefit from accelerated effort, and the investigation of trade-offs between technical improvements versus their effect upon waste management activities.

Webber and Lane (1969) indicated that before significant progress will be made in the disposal of animal waste, the nitrogen cycle must be quantitatively characterized.

Gilbertson (1969) and Hart et al. (1970) postulated from their findings that economics must be involved with each investigation concerned with pollution control from animal agriculture.

New concepts for the management of feedlot waste are receiving attention. A two-stage anaerobic digester is being studied as a refined approach to the treatment of feedlot waste. A system of complete flushing of the concrete surface of a 10,000 head commercial feedlot is ing used with disposal of the effluent in irrigation water for Midland Bermudagrass pasture. Covering feedlots with a roof would eliminate runoff water, leaving only the solid waste for management. Use of feedlot waste as a resource material offers a challenging approach, such as construction material, phosphoric acid treatment for specialized fertilizer, or as a substrate for single-cell protein production for man and animals. Biodegradation of manure by house fly larvae with subsequent feeding of the insects as a protein source to livestock has been investigated with poultry.

Summary

The exponential expansion of cattle feeding in the United States during the last decade has created many challenges, one of which is the handling and disposal of a by-product, feedlot waste. Feedlot waste can be categorized as solid or semi-solid waste and runoff water for most feedlots, or as a liquid suspension from confined feeding operations. The chemical and pollutional characteristics of feedlot waste are variable. Numerous handling and disposal systems are available for management of cattle feedlot waste. The waste disposal system for a commercial feedlot could be characterized as a function of several parameters, such as climate, type of ration and cattle, feedlot surface, and cattle and human population densities, with the solution stated in economic equivalents. Final disposal of feedlot waste has been the land in most instances.

The oxidation ditch and a combination of aerobic and anaerobic systems offer possibilities for feeding operations. Socio-industry relationships might require ultimate disposal of runoff and effluent into streams with dehydration and/or incineration of the solid waste. Use of feedlot waste as a resource material offers unlimited possibilities as a conservation approach to feedlot waste management. The need for research in feedlot waste management is urgent. Critical evaluations of handling and disposal systems for cattle feedlot waste are needed in areas of land use, socio-legal-industry relationships, environmental pollution, conservation, and economics.

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RELATIONSHIP OF VARIOUS MATING GROUPS TO PERFORMANCE AND CARCASS CHARACTERISTICS OF STEERS

K. D. Hansen and R. D. Furr

Increased emphasis is being placed on the relative performance of various crosses by the cattle feeding industry. This study was undertaken to determine the relative value of different mating groups when fed to slaughter weights under controlled conditions.

Procedure

Five mating groups of 15 head each were purchased from the same ranch with identical management backgrounds. The mating groups compared were: (1) Hereford x Hereford (H), (2) Angus x Hereford (AH), (3) Brown Swiss x 1/2 Hereford 1/2 Angus (BSHA), (4) Charolais x 1/2 Hereford 1/2 Angus (CHA) and (5) Charolais x Hereford (CH).

The calves were self fed for 173 days a ration containing: 84% milo, 10% cottonseed hulls, 4.3% cottonseed meal, 0.7% urea, 0.1% sulfur, 0.5% trace-mineral salt and 0.5% calcium carbonate. In addition, the ration furnished 2,000 I.U. vitamin A and 3.5 mg. aureomycin/lb. of feed.

Mating groups were evaluated and compared using feedlot performance, quantitative and qualitative carcass traits and return per head as main criteria.

Results and Discussion

Feedlot performance and carcass characteristics are presented in table 1. The mating groups incorporating Charolais into the cross gained 2.83 and 2.64 lb./day for CHA and CH, respectively, as compared to 2.56, 2.50 and 2.54 lb./day for the H, AH and BSHA, respectively. There was only slight variation in feed consumption between groups; therefore, CHA converted feed more efficiently with 7.55 lb. feed/lb. gain as compared to more than 8 lb. of feed/lb. of gain for all other groups. The same trend appeared when average daily gain and feed efficiency were placed on a carcass basis.

When groups were compared for carcass quality, the AH cross showed higher marbling and conformation scores, which dictated a higher overall carcass grade of 12.1 as compared to 11.6, 10.8, 10.9, and 10.3 for the H, BSHA, CHA and CH, respectively. Percent boneless closely trimmed primal cuts (determined using the U.S.D.A. equation) favored the CHA with 51.66% which was only slightly higher than the CH and BSHA at 51.62 and 51.38%, respectively. Over 1% difference was shown in primal cuts when CHA were compared to H and AH with 50.39 and 50.57, respectively.

TABLE 1. FEEDLOT PERFORMANCE AND CARCASS CHARACTERISTICS

Characteristics	Mating Groups				
	H	AH	BSHA	CHA	CH
No. head	15	15	15	15	15
Initial wt., lb.	587	591	562	536	534
Final wt., lb.	1029	1024	1002	1025	990
Days on feed	173	173	173	173	173
A.D.G., lb.	2.56	2.50	2.54	2.83	2.64
Feed consumption, lb.	21.02	21.30	21.16	21.36	21.41
Feed efficiency	8.22	8.51	8.33	7.55	8.12
Warm carcass wt.	660	660	638	660	645
Dressing percent (hot)	64.1	64.5	63.7	64.4	65.2
Carcass A.D.G., lb.[1]	1.88	1.87	1.84	2.05	1.97
Marbling[2]	5.0	5.4	4.5	4.4	4.3
Conformation[3]	13.0	14.0	12.2	13.1	13.0
L.E.A., sq. in.	12.62	13.24	12.88	13.08	12.98
Fat thickness, in.	.55	.59	.44	.38	.40
Liver abscesses, (%)	33.3	20.0	0.00	13.3	13.3
% Kidney fat	2.1	2.2	2.2	2.2	2.2
% Boneless closely trimmed primals (USDA)	50.39	50.57	51.38	51.66	51.62
Yield grade	2.9	2.8	2.4	2.3	2.3
Carcass grade (24 hr.)[4]	11.6	12.1	10.8	10.9	10.3

[1]Carcass gain calculated assuming initial dressing percent of 57.

[2]Slight = 4; small = 5, etc.

[3,4]Good = 10, Good + = 11, Choice minus = 12.

Table 2 shows cost and returns for each group on a per head basis. Even though the returns were high because of a favorable market period, the relative differences should be of interest. The CHA produced the highest return which was approximately 10% higher than the closest group (CH).

Summary

When five mating groups were fed for 173 days and feedlot performance, carcass characteristics and returns used as comparison criteria, Charolais cross steers gained faster, produced a higher percentage of boneless closely trimmed primal cuts and produced a higher net return per head. The Angus x

Hereford mating produced a higher quality carcass when marbling, conformation and carcass grade were used to determine quality.

TABLE 2. COST AND RETURNS

	Mating group				
	H	AH	BSHA	CHA	CH
Init. cost @ 29.50/cwt.	173.17	174.35	165.79	158.12	157.53
Feed consumed (tons)	1.818	1.843	1.830	1.848	1.852
Feed cost/head[1]	86.84	88.01	87.43	88.26	88.45
Med. cost/head	1.25	1.25	1.25	1.25	1.25
Total invest./head	261.26	263.61	254.47	247.63	247.23
Total return/head	336.83	337.49	323.85	334.71	326.61
Net returns	75.57	73.88	69.38	87.08	79.38

[1]Feed costs were calculated using actual cost of ingredients at the time the trial was conducted plus $8.00/ton yardage.

PROGRESS IN INDUCED TWINNING OF CATTLE

C. A. O'Brien

A continuing attempt to induce twinning in cattle by treatment with gonadal and gonadal-type hormones is in progress. Previous efforts to induce multiple birth have been unsuccessful (1, 2).

Methods and Materials

Twenty heifers, average weight 236.1 kg (520.4 lb.) were entered on test July 15, 1970. Estrus was suppressed (synchronized) by feeding 0.4 mg of progestogen (melengestrol acetate, MGA) in 2.27 kg of milo-CSM mixture over ensilage in two equal feedings daily for 20 days.

Five heifers in each of 3 groups were injected subcutaneously with 1,200 I.U. of pregnant mare serum (PMS, Gonadin) on days 10, 14, and 18 following the median (third) day of estrus following MGA withdrawal. A group of 5 heifers (the control) did not receive PMS. All animals, 4 groups, were injected with 2500 IU human chorionic gonadotropin (HCG, Follutein) in the jugular vein at second estrus and inseminated by AI methods. Estrus at insemination was determined by employing a vasectomized bull.

Results

One heifer cycled and was in estrus on day 5 of the 20-cay synchronization period. Two heifers were later detected as pregnant prior to beginning the trial.

Following withdrawal of the synchronizing agent, 10 heifers were detected in estrus (standing for other heifers) as follows: 1 on day 2, 7 on day 3, 1 on day 4, and 1 on day 6. Day 3, the median date of first estrus following synchronization with MGA, served as the base date for PMS treatment.

Eleven heifers were detected in estrus and inseminated; specifically 2 controls, 3 of the day-10 PMS treated, 2 of the day-14 PMS treated, and 4 of the day 18 PMS treated. Three of the 4 heifers in the day-18 PMS-treatment group were in estrus twice, 2 in a span of 2 days and 1 in 3 days from first to second estrus. All were reinseminated.

Summary

Twenty heifers, two were subsequently found to have been pregnant before initiation of the trial, were placed on trial July 15, 1970 in an effort to induce multiple births with gonadal hormones. Synchronization of estrus was achieved by feeding oral progestogen (MGA) for 20 days. Follicle growth was stimulated with subcutaneous injections of 1200 IU each of pregnant mare serum (PMS) at 10, 14 and 18 days following synchronized first estrus. Individual dosages of 2500 IU of human chorionic gonadotropin (HCG) were given to 11 heifers via the jugular vein at insemination in the second estrus following synchronization.

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ACCEPTABILITY OF DETOXIFIED CASTOR MEAL IN ALL-CONCENTRATE RATIONS BY FATTENING STEERS

Robert C. Albin, Sam Oatman and Dale W. Zinn

Forty-eight Hereford steers were allotted by weight to six pens for a 182 day feeding period. Three all-concentrate rations composed primarily of dry-rolled sorghum grain (table 1) were studied with treatment differences being nitrogen source: A-cottonseed meal; B-castor meal (<1:10 ricin dilution); and C-castor meal (<1:10) plus artificial flavoring. Cottonseed meal (41% crude protein) and detoxified castor meal (32% crude protein) were used to provide isonitrogenous rations at 11.9% crude protein. The ricin dilution factor is determined by the hemolytic effect of saline extracted ricin upon red blood cells. Means (lb.) for daily gain, feed consumption, and efficiency of feed utilization, respectively (table 2) were: A-2.33, 16.0, 6.87; B-2.13, 14.5, 6.81; and C-2.14, 14.1, 6.59. Daily gains and consumption were greater ($P<.05$) for A. Means for dressing %, fat thickness (in.), and carcass grade (good + = 9), respectively (table 2), were: A-61.9, .53, 9.4; B-60.9, .42, 8.0; and C-61.2, .36, and 7.9. Fat thickness was greater ($P<.05$) for A than C. Carcass grades and marbling scores favored A ($P<.05$). Mean (8 steers each) apparent digestibility coefficients (%) (table 3) for DM, OM, GE, and N, respectively, were: A-72.73, 75.06, 71.28, 69.19; B-72.85, 76.54, 70.16, 71.34; and C-73.23, 75.31, 70.55, 71.48. Mean digestibility comparisons were not statistically different ($P<.05$). Mean (3 steers each) daily N retention values (table 3) in gm. and % of N intake were: A-57 gm., 38.3%; and C-47 gm., 35.9%. Nitrogen retention values were not statistically different ($P<.05$). An individual feeding study (8 steers per treatment) revealed that neither acidulated cottonseed oil, molasses, nor artificial flavoring compounds were effective in alleviating the acceptablity factor associated with castor meal-supplemented all-concentrate rations.

TABLE 1. RATION COMPOSITION (%)

Ingredient	(A) CSM	(B) Castor	(C) Castor + flavor
Milo, dry-rolled	91.0	88.0	88.0
Cottonseed meal	6.0	--	--
Castor meal (1:10)	--	9.0	9.0
Premix (T-272)[a]	3.0	3.0	3.0
	100.0	100.0	100.0

[a]Premix Composition (lb.)

Ingredient	T-272	Castor	Provided Daily
Cottonseed meal	974.17	--	
Castor meal (1:10)	--	974.17	
Calcium carbonate	600.0	600.0	
Salt	400.0	400.0	
Vitamin A (325,000 IU/gm.)	1.13	1.13	(50,000 IU)
Stilbestrol (2 gm./lb.)	20.0	20.0	(10 mg.)
Chlortetracycline (50 gm./lb.)	4.7	4.7	(70 mg.)
	2,000.0	2,000.0	

TABLE 2. MEAN FEEDLOT PERFORMANCE AND CARCASS DATA

Item	(A) CSM	(B) Castor	(C) Castor + flavor
Feedlot data, lb.			
No. steers	16	16	16
Final live weight	915	880	878
Initial live weight	491	493	488
Daily gain	2.33	2.13	2.14
Feed consumption	16.0	14.5	14.1
Efficiency (feed/gain)	6.87	6.81	6.59
Carcass data			
Warm carcass weight, lb.	579	548	548
Dressing percentage	61.8	60.9	61.2
Fat over loin, in.	0.53	0.42	0.36
Quality grade	Good +	Good	Good
Marbling score	Slight +	Slight -	Slight -
Abscessed livers	1	0	1

TABLE 3. MEAN APPARENT DIGESTIBILITY COEFFICIENTS AND NITROGEN RETENTION VALUES

Item	(A) CSM	(B) Castor	(C) Castor + flavor
Digestibility Coefficients			
Dry Matter	72.7	72.9	73.2
Organic Matter	75.1	76.5	75.3
Gross Energy	71.3	70.2	70.6
Nitrogen	69.2	71.3	71.5
Nitrogen Retention			
Intake, gm.	149	--	131
Excretion, gm.	92	--	84
Retention, gm.	57	--	47
Retention, % of intake	38.3	--	35.9

INFERTILITY AND REPRODUCTIVE PROBLEMS INDUCED BY PLANT ESTROGENS

C. A. O'Brien

A number of plants, namely the legumes, produce estrogens in sufficient quantity to suppress fertility and alter reproductive efficiency when consumed in quantity (2, 13). Estrogenic substances in plants are essentially the same as the sex hormone synthesized by the ovarian follicle of vertebrate females. A moderate to high dietary intake of estrogen-bearing feedstuffs and the consequent ill effects upon reproduction can easily offset any advantages of increased forage production and higher protein content of the estrogenic plants.

Intensive investigation of the plant estrogen problem over the past 30 years has not completely resolved the difficulty of impaired production and severe economic losses sometimes imposed on the livestock breeder. Numerous interference factors have impeded the work of investigators in classifying estrogen-producing plants. For instance, estrogenic activity is not entirely dependent on the family, variety and strain of plant. Other factors affecting the estrogen content are environment, stage of plant growth, soil fertility and whether plants are fresh, dry or ensiled (8).

History of the Estrogenic Problem

Consumption of estrogenic feeds has no doubt imposed some degree of reproductive impairment on animals since earliest times. But it was not until the early 1940's that the problem reached sufficient magnitude to cause wide-scale concern in livestock circles.

As man grew in numbers and the demand for meat as food increased, intensive efforts to increase unit productivity of land were begun in the 1930's. Rated high on the list of agronomic potentials were new pasture crops; plants were improved in yield and protein content, and new strains were developed and adapted. Legumes assumed a special role in pasture improvement programs; especially in the improvement of forage quality and productivity and for improvement of soil fertility and soil tilth.

Unexpected difficulty with new varieties of forage plants soon developed, i.e., the high-producing forages proved in many instances to be high in estrogens and to cause serious reproductive disorders. Australian sheep were among the first animals reported affected. Numerous new pasture crops, especially the clovers, produced estrogenic compounds at levels sufficient to upset reproductive function and to cause serious economic losses; thus the Australian "clover disease" became a new impediment to optimal livestock production (2).

Influence of Plant Estrogens on Livestock Production

While the hyperestrogenic effect of plant estrogens is centered almost exclusively on the undesirable effects, it should be noted that a number of benefits are also recognized. These benefits include the "spring flush" in dairy cattle in which both quantity and quality of milk are improved (1). Another is increased growth rate and improved health of young animals from moderate but not dangerous levels of grass estrogens (4).

High levels of plant estrogens appear to exert no harmful effects on reproductive function of rams or bulls, but prolonged treatment of male rats induced feminization of the genital system (10). Female sheep vary in response, but characteristic responses are infertility with lambing percentages declining from 80 to as low as 10% (8). Ewes may suffer difficulty in parturition, incur prolapse of the uterus, suffer retention of fetuses, develop metritis and die in giving birth. Young ewes and open ewes frequently suffer mammary enlargement and produce milk. Many newborn lambs do not survive. Wethers, unlike rams, are prone to enlarged teats, mammary development and lactation, rectal prolapse and enlargement of the accessory sex glands (8). Sheep are especially sensitive to the estrogenic effect of subterranean clover: the effects are permanent (4, 13).

Adverse effects of plant estrogens upon cattle have been reported world-wide. Most frequent symptoms are infertility, nymphomania, swollen vulvas, swollen genital membranes, enlarged udders and cystic ovaries (8).

Nature of the Plant Estrogens

More than 50 species of plants are known to produce estrogenic effects in livestock or laboratory animals. Both bioassay and chemical analyses are used in making determinations (11). Clovers, especially the subterranean varieties, are the most potent estrogen producers, but a broad array of the plant kingdom produce estrogens in highly variable amounts. Among the more common plants producing estrogen in quantities sufficient to interfere with fertility and reproduction are alfalfa (12), soybean meal and hays (5), grass forage and hays (5), cereal forages (3), and grass and corn silage containing alfalfa (12).

The estrogen content of legumes reaches a maximum level in the flowering stage. In alfalfa, the maximal content occurs when the plant is in the bud to one-tenth bloom stage; it declines thereafter (12). Subterannean clover increases in estrogenic activity with repeated cuttings, continued heavy grazing (9), and in plantings grown on fertility-depleted soils (10). Grasses reach a peak in estrogen content in early spring and decrease following the early bloom stage (1). Estrogenic effect is lessened by drying, hay making and storage for six months or longer with the exception that red clover retains its estrogens for long periods following drying and storage. The estrogen content of plants and forage is affected by geography, season, variety, strain, cultural practices, stage of growth, time of day, rainfall and by the level and method of fertilization (3, 10).

At optimal levels in the diet, estrogens exert a beneficial effect upon tissues and organs, and accelerate cell division. In addition, estrogens influence growth, maturity, ovarian function including follicular growth and ova development, and regulate the estrous cycle and female mating behavior (10). In excessive amounts, estrogens induce swelling of the vaginal membranes and the uterine epithelium, stimulate excess function of the uterine glands to produce cysts, cause mammary enlargement and milk production, and cystic ovaries (8). It has been suggested that excess dietary estrogen will depress pituitary synthesis and or secretion of the gonadotropic and other hormones and suppress ova production (6).

The mechanisms by which estrogens suppress conception, although not fully understood, appears due to impeded transport of sperm and ova through the fallopian tubes, and failure of union of the gametes. Impeded sperm transport is attributed to small uterine cysts (cystic endometrium) and hypertrophy of the cervical and uterine mucus membranes (7).

Prevention and Control

Hyperestrogenicity can be controlled by removal of estrogenic substances from the diet or by reducing the effects by altered management. Managerial changes call for maximal use of grass forage when legumes are at peak levels of estrogen, making hay of legumes to reduce the estrogen level, fertilizing with superphosphate, and seeding to increase the grass content of predominately legume pastures (10). Other helpful practices are avoidance of overgrazing, maintenance of soil fertility and hay storage of six months or longer (3).

Conclusion

Since 1940, plant estrogens have become a serious limiting factor to fertility and reproduction. The symptoms of hyperestrogenicity occur most often in areas suited to the introduction of new forage crops, particularly the legumes. Clovers are the greatest offenders, especially the subterranean and red varieties. Alfalfas present a problem in some areas.

Active agents most often encountered are isoflavones, especially biochanin A and coumarin from white and ladino clovers (5). These are proestrogens that are converted into true estrogens in the rumen. Horses and other nonruminants are less susceptible to plant estrogens.

Control of the estrogenic problem is possible. Some of the methods employed include rotation grazing, making hay in the high estrogen season, increasing grass content of pastures and top-dressing pastures with superphosphate.

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A COMPARISON OF TWO PROCESSING METHODS FOR SORGHUM MILO IN ALL-CONCENTRATE RATIONS FOR GROWING-FINISHING RATIONS[a]

Robert C. Albin and Dale W. Zinn

The objective of this study was to compare two processing methods for sorghum grain (dry-rolled versus "Temper" treated and flaked) in an all-concentrate ration for growing-finishing steers.

Comparative Feedlot Trial

Forty-two Hereford steers were divided into four groups according to weight. One group of ten steers and one group of eleven steers were allotted to each of the two feeding treatments shown in table 1. Results of the feedlot trial are shown in table 2. To be noted is that the mean daily feed consumption and the resulting daily gain of the "Temper" treatment steers was lower ($P<.01$) than those steers consuming the dry-rolled treatment. Observation of the steers from the beginning of the study indicated that the "Temper" steers were consuming less feed and that the waste material on the "Temper" pen surfaces was somewhat higher in moisture. The study was continued for 84 days, at which time one of the "Temper" pens was weighed off test and placed on the "dry-rolled" ration. The second pen of "Temper" steers was changed to the "Dry-rolled" treatment after 98 days on feed.

It was felt that since the "Temper" treated grain had to be dried to near 14% moisture in order to be sacked for shipment, the product was not similar to steam flaked grain used in most feedlots where the moisture content at the time of feeding is generally higher. Too, the increased moisture in the pens seemed to indicate that the water metabolism of the steers was affected in some way. In order to test the hypothesis that the dried "Temper" grain affected water and feed consumption of the steers and thereby reduced the desirability of the ration, an individual feeding study was initiated.

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[a] "Temper" is the tradename for a chemical preparation used to enhance the steam flaking process for sorghum grain.

TABLE 1. COMPOSITION OF RATIONS FOR THE COMPARATIVE FEEDLOT TRIAL (POUNDS, AIR-DRY BASIS)

Item	Ration: Control	"Temper"
Sorghum milo, dry-rolled	910	-
Sorghum milo, "Temper"	-	910
Cottonseed meal	60	60
Premix T-272[a]	30	30
	1,000	1,000

[a]Premix composition

Ingredient	lb.
Cottonseed meal	974.17
Calcium carbonate	600.00
Salt	400.00
Vitamin A (325,000 IU/gm.)	1.13
Stilbestrol (2 gm./lb.)	20.00
Aureomycin (50 gm./lb.)	4.70
	2,000.00

TABLE 2. MEAN PERFORMANCE OF STEERS DURING THE COMPARATIVE FEEDLOT TRIAL (POUNDS)

Item	Ration: Dry-rolled milo		"Temper"		"Temper" to Dry-roll
Pen number	8[a]	10[a]	2[b]	5[c]	2[d]
No. of animals	10	11	11	10	11
Initial weight	488	485	490	486	557
Final weight[e]	673	689	581	645	615
Daily gain	2.21	2.43	1.21	1.63	4.11
Daily feed consumption	14.74	14.77	8.05	10.34	16.08
Efficiency (feed/gain)	6.68	6.08	6.65	6.36	3.91

Means for each treatment

	Dry-rolled milo	"Temper"
Daily gain[f]	2.32	1.42
Feed consumption[f]	14.76	9.20
Efficiency	6.38	6.50

[a]Based on 84-day performance.

[b]Based on 70-day performance.

[c]Based on 98-day performance.

[d]Performance of pen 2 after changing from "Temper" processed grain to dry-rolled grain--on test 14 days since the change.

[e]Arithmetically shruck four percent.

[f]Statistically different (P<.01).

Individual Feeding Study

Eight steers weighing approximately 600 pounds were randomly allotted to individual, 14' x 7' pens. Four feeding treatments (shown in table 3) were allotted to two pens each. Trial I consisted of a seven-day feeding period in which daily feed and water consumption were measured. The treatments were re-allotted to the pens for Trial II, which consisted of seven days. The data of these two trials are shown in table 4. Water was added to rations C and D, with 2% vegetable oil also added to ration D. The moisture content was approximately 7% higher in ration D than in ration B ("Temper" grain without water or fat added).

TABLE 3. COMPOSITION OF RATIONS FOR THE INDIVIDUAL FEEDING STUDIES (POUNDS, AIR-DRY BASIS)

Item	Ration			
	D4-A	D4-B	D4-C	D4-D
Sorghum milo, dry rolled	455	-	-	-
Sorghum milo, "Temper", flaked	-	455	420	409
Water	-	-	35	36
Cottonseed meal	30	30	30	30
Vegetable oil	-	-	-	10
Premix T-272	15	15	15	15
	500	500	500	500

The two trials were analyzed statistically as one experiment and no differences were detected ($P<.05$). However, toward the end of Trial I, it was noted that rations C and D were becoming moldy. In Trial II, vegetable oil was added to ration D at the time of mixing, but the required amount of water was added to rations C and D each day prior to feeding. Therefore, it is possible that the feed consumption data of Trial I were adversely affected in rations C and D due to the mold development. If this were true and one observes only the data of Trial II, the addition of water and vegetable oil to the "Temper" grain (ration D) stimulated feed consumption. When placed on a dry matter consumption basis, feed consumption was increased over the "Temper" grain without water (ration B) and over ration C (water only) by about

TABLE 4. MEAN DAILY FEED AND WATER CONSUMPTION OF STEERS IN THE INDIVIDUAL FEEDING STUDIES

Item	Ration			
	D4-A	D4-B	D4-C	D4-D
Dry matter, %	89.49	88.22	82.06	81.08
Trial I[a]				
Feed, gm. dry matter	4,859	1,510	2,001	2,466
Water, ml.	8,305	6,556	6,193	7,428
Total water/ml.[b]	8,876	6,758	6,630	8,004
Total water/dry matter, ml./gm.	1.83	4.48	3.31	3.25
Trial II[a]				
Feed, gm. dry matter	3,624[c]	3,765	3,355	4,322
Water, ml.	11,423	9,565	8,263	10,308
Total water, ml.[b]	11,849	10,068	8,996	11,316
Total water/dry matter, ml./gm.	3.27	2.67	2.68	2.62
Means, Trial I and II[d]				
Feed, gm. dry matter	4,242	2,638	2,678	3,394
Total water, ml.[b]	10,363	8,413	7,813	9,660
Total water/dry matter, ml./gm.	2.44	3.19	2.92	2.85

[a]Duration of 7 days.

[b]Water in feed plus drinking water.

[c]One steer only.

[d]Mean differences are not statistically different ($P<.05$).

19%. These would seem to be reliable comparisons since the ml. of total water consumed/gm. of dry matter was the same for all three rations, B, C, and D. These data would suggest that the "Temper"-treated flake was too dry and/or hard for optimum acceptance by the steers, since water alone did not effect increased consumption, but added moisture and vegetable oil improved acceptability. It was observed that the physical characteristics of the "Temper" treated flake were different in each ration, B, C, and D, which would support the aforementioned statement.

Conclusions

The data of this study would indicate that sorghum grain treated with "Temper" prior to flaking should not be dried to a moisture level deemed safe for storage in sacks, if it is to be fed to feedlot cattle.

a) Feedlot data indicated that 500 pound steers would not satisfactorily consume the dried "Temper"-treated milo grain in an all-concentrate ration at a desirable level to produce optimum feedlot gains.

b) Individual feeding studies would suggest that if drying is necessary, the addition of water and vegetable oil (2% of the ration) would change the physical characteristics of the dried "Temper" grain to a more acceptable form for feedlot cattle.

RESPONSE OF FEEDER STEERS TO CONTROLLED ENVIRONMENTAL PARAMETERS

Robert C. Albin, Sam E. Curl and Walter Grub

A series of investigations was planned to determine the physiological response of cattle to controlled environmental parameters. The test study reported herein was conducted to obtain preliminary performance and physiological response data and to evaluate the accuracy and reliability of newly-constructed environmental chambers.

Two environmental chambers and six Hereford steers were utilized in this experiment. The chambers, designed to control temperature, relative humidity, light, and ration parameters, were located within a sheet metal building which afforded some protection from outside conditions. The chambers consisted of insulated double-walled rooms which measured twelve and one-half feet in width and twelve feet in depth with seven feet ceilings. The chamber floors were made of concrete and sloped toward a central drain. Wooden slotted floor platforms partitioned into individual stalls by iron pipes were elevated above the concrete floor. Automatic waterers and feed troughs were attached to the platform floor. The steers were secured by head stanchions. Chamber temperature was regulated by a one-ton air conditioner and an electric duct heater.

This investigation was conducted under controlled (night and day) conditions of 83°F. average temperature, 56-61% relative humidity, and lighting of 1.3 foot-candles at steer level. All steers were fed a finishing ration containing 12% roughage (table 1). Water and salt were available _ad libitum_. The chambers were cleaned daily by flushing with water. The digestion study was conducted by using harnesses and bags for fecal collections.

Mean daily steer performance (table 2) was not significantly ($P<.05$) different between chambers. Low daily feed consumption (11.2 lb. per animal) resulted in low daily gains (1.29 lb. per animal). Water consumption averaged 3.52 gal. per animal in chamber 2. Mean digestibility coefficients (table 3) were not statistically ($P<.05$) different between chambers. Mean physiological responses of the steers (table 4) did not significantly ($P<.05$) differ between chambers or between daily observation times. Mean values recorded were as follows: body temperature, 102.8°F.; heart rate, 83; and respiration rate, 81. These data will be correlated with those of subsequent trials to determine the physiological response of steers to various controlled environmental conditions.

TABLE 1. RATION COMPOSITION FOR ENVIRONMENTAL CHAMBER EXPERIMENT I

Ingredient	% (air-dry)
Sorghum grain, dry-rolled	74.5
Cottonseed meal	7.25
Cottonseed hulls	6.0
Alfalfa hay, chopped	6.0
Beef tallow	3.0
Premix (T-272)	3.0
Calcium carbonate	0.25
	100.00

TABLE 2. MEAN DAILY STEER PERFORMANCE DURING 56-DAY FEEDING PERIOD INSIDE ENVIRONMENTAL CHAMBERS

Item	Chamber[a] 1	Chamber[a] 2	Mean
No. of steers	3	3	
Live weight, lb.	580	594	587
Gain, lb.	1.25	1.32	1.29
Feed consumption, lb.	10.9	11.4	11.2
Efficiency (feed/gain, lb.)	8.72	8.64	8.68
Water consumption, gal.	____[b]	3.52	____

[a]Parameter differences between chambers were not statistically significant (P<.05).

[b]Faulty water meter detected on day three of test.

TABLE 3. MEAN DIGESTIBILITY COEFFICIENTS FOR STEERS FED INSIDE ENVIRONMENTAL CHAMBERS[a]

Item	Chamber[b]		
	1	2	Mean
No. of steers	3	3	
Live weight, lb.	580	594	587
Feed consumption[c], lb.	9.2	10.0	9.6
Coefficients, %			
Dry matter	78.18	82.42	80.30
Organic matter	81.54	84.81	83.18
Gross energy	78.11	82.66	80.39
Nitrogen	75.62	80.42	78.02

[a]Digestion study conducted for the next seven days after the conclusion of the 56-day performance trial.

[b]Parameter differences between chambers were not statistically significant (P<.05).

[c]Dry matter basis, per head daily.

TABLE 4. MEAN PHYSIOLOGICAL RESPONSE OF STEERS FED INSIDE ENVIRONMENTAL CHAMBERS[a]

Item	Chamber[b]		
	1	2	Mean
No. of steers	3	3	
Rectal temperature, °F			
Morning	102.8	102.7	102.8
Evening	102.9	102.9	
Heat rate			
Morning	82	83	83
Evening	82	84	
Respiration rate			
Morning	82	81	81
Evening	82	80	

[a]Physiological responses were recorded during the last eight days of the 56-day performance trial.

[b]Parameter differences between chambers and between morning and evening observations were not statistically significant (P<.05).