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Effects of Reserpine (Serpasil) on Bloat

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EFFECTS OF RESERPINE (SERPASIL) ON BLOAT

BY

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This thesis is approved as a creditable, independent investigation by a candidate for the degree, Master of Science, and acceptable as meeting the thesis requirements for this degree; but without implying that the conclusions reached by the candidate are necessarily the conclusions of the major department.

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INTRODUCTION

Farmers and ranchers have been faced with the problem of bloat for many centuries. Thus far there has been little concrete evidence from research in determining the cause, finding a cure or a preventive for bloat.

Numerous preventives for bloat have been practically useless. Investigators have used oils and paraffins as prophylactic and therapeutic measures against legume bloat. Antibiotics have been used as preventatives with some success. Antifoaming agents have little effect and are of short duration.

Tranquilizers, a comparatively new group of compounds, have produced spectacular results in combatting stress conditions in animals. The ideal effect of tranquilizers is to achieve a reduction in anxiety, tension, and nervousness without evidence of obvious depression or sedation. Of all the tranquilizers studied, reserpine has been most extensively studied in the laboratory and in clinical use.

Tranquilizers work on the primitive parts of the brain, especially the hypothalamus and the reticular formation. These areas govern the basic life functions normally beyond voluntary control. These functions are kept in exquisite balance by two mutually antagonistic nervous mechanisms, the sympathetic and parasympathetic.

In the normal animal a majority of the rumen gases are lost by eructation and diffusion through the rumen wall into the blood

stream. In bloated animals, however, eructation is arrested. Although there are many postulations as to the reason for this arrest, none are completely satisfactory. The one most frequently accredited with preventing gaseous escape is that the cardiac orifice cannot open. If this is the reason then any compound that inhibits excessive neural stimulation might prove beneficial. Reserpine is a tranquilizer that does reduce muscular activity, or at least reduces excessive stress. Thus these experiments using reserpine are based upon the idea that maybe during grazing the cardiac orifice would remain placid enough so that the gas could escape. The information gathered in these experiments is described in the results.

REVIEW OF LITERATURE

Voluminous literature has been written on bloat. Most of the studies have been directed toward the etiology and post-mortem changes. Minor attention has been directed toward the physiological changes which occur during acute tympany.

Bloat is a disorder of ruminants that occurs in conjunction with many disease entities. When eructation is inhibited, the gas accumulates within the rumen in quantities sufficient to cause the animal severe distress. Normally, gas is eliminated by eructation, and by absorption into the blood stream.

Bloat is frequently classified as "acute" and "chronic". Acute bloat usually depends upon the nature of the feed, whereas chronic bloat results from an abnormal physiological state of the animal(18). This terminology is not altogether satisfactory since certain feeds such as ground hay and grain may lead to subacute bloat of more or less chronic nature (44). Acute bloat usually follows the ingestion of green legumes. Chronic bloat extends over a considerable period and is not dependent upon special feed conditions. This chronic condition might result from atony of the muscles involved in eructation or from a partial obstruction of the esophagus by enlarged mediastinal lymph glands (18).

Eructation depends upon the reflex opening of the cardiac orifice (42). The vagus nerve, which is parasympathetic, supplies excitatory fibers to the ruminant stomach (24). There is considerable evidence suggesting that ruminoreticular motility, rumination, and

eructation are dependent on intact nerves. When the vagus nerve is severed, the ability to eructate is lost and rumen motility ceases (31). Clark (14) concluded that the vagi are motor nerves to the rumen and reticulum. Although other research demonstrates that sectioning either the dorsal (29, 36, 65) or ventral (29, 36) vagal trunk has little apparent effect on these functions, total vagotomy abolishes all three (29, 36).

There is general agreement that eructation is normally associated with rumen contractions (20, 29, 65) and that the rate of eructation is increased by increasing intraruminal pressure (24, 50, 65). Fluoroscopy of sheep (28, 29), as well as visual examination through the open fistula of cattle (20), suggested that the reticulum was relatively empty and dilated prior to eructation, thus showing an exposed cardia.

The amount of cardia exposed was evidently critical. Weiss (65) found that cattle, positioned so that the cardia was submerged, were less able to eructate, and postulated that pressure receptors were located in the wall of the rumen, principally in the posterior dorsal blind sac, and that stimulation of these receptors initiated the eructation reflex.

Cole et al. (20) demonstrated that artificially increasing the pressure by forcing gas into the rumen was not alone responsible for belching. Under conditions of artificially increased pressure, belching occurred only during ruminal contraction, even though the pressure was greater during ruminal inactivity than the pressure associated with

belching under normal conditions. Wester (66) observed that eructation could occur in an animal with an open fistula and that an increased intraruminal pressure is not essential to initiate the reflex.

Clark and Weiss (16) were the first to observe that salivation rate increased following tactile stimulation around the cardia. The work of Ash and Kay (1) supports these results, although the latter found that stimulating a rather large area of the rumen produced similar results. The salivation rate increased during rumination when the rumen and reticulum were empty as well as full.

Although the existence of these reflexes appears to be well established, little is known about the type of receptors involved. Relatively little is known about the nerve receptors and reflex mechanisms associated with the digestive tract. Receptors sensitive to both distention and contraction have been demonstrated in the forestomach of the sheep and goat. Iggo (38) isolated five vagal fibers in sheep and five in the goat which were activated by these stimuli. He has also recorded impulses in afferent fibers of the cervical vagus in the anaesthetized goat during distention of the reticulum and rumen.

Dougherty *et al.* (27) have decerebrated sheep under anaesthesia. The cervical esophagus was exposed, the left rib cage was removed so stimulation of motor events could be reached. The following events (27) were recorded when carefully controlled stimuli were applied to the nerves:

1. Stimulation of the pharyngo-nerve caused contraction of the cranial esophageal spincter and varying parts of the

cervical esophagus. Sometimes the cervical part of the esophagus contracted to the midcervical region and sometimes down into the thoracic inlet.

2. Stimuli applied to the left recurrent nerve caused contraction of varying segments of the thoracic part of the esophagus. At times recurrent nerve stimulation elicited little motor activity and in other preparations there was considerable response extending to the midcervical region.
3. Stimulation of the dorsal vagus nerve caused contraction of the esophagus from the heart region to the cardia, extending on down the esophageal groove and involving the reticulo-omasal orifice.
4. In the twenty-odd sheep used in these experiments there was considerable variation in the limits of motor activity elicited when the various nerves supplying the esophagus were stimulated.
5. Curare abolished all motor activity of the esophagus when all of the nerves supplying the esophagus were stimulated electrically. It did not inhibit motor activity of the rumen and reticulum when the vagi were stimulated.
6. The pharyngo-esophageal, laryngeal recurrent and dorsal vagus nerves supply motor fibers to the esophagus and its spincters. They are components of the vagus nerves.
7. Curare inhibition of esophageal activity suggests that the

vagus (motor) fibres of the esophagus have some characteristics peculiar to the peripheral somatic system.

Intraruminal pressure is extremely variable. Olson (53) found that 15 animals that died from bloat had intraruminal pressures ranging between 40 and 125 mm. of mercury above atmospheric pressure with an average of 66 mm. of mercury. The pressure recorded within eight living bloated animals was between 50 to 70, with an average of 58 mm. of mercury. A pressure of 59.5 mm. of mercury was recorded by Cole and Kleiber (19) after an animal began staggering and just before it went down. Dougherty (25) recorded pressures between 72 and 75 mm. of mercury on three animals that had died. Animals that Olson insufflated with air had ruminal pressures up to 90 - 100 mm. of mercury with no ill effects except discomfort. Pressures of 110 mm. of mercury above atmospheric pressure were established by Dougherty (23) and maintained for five minutes in a rumen-fistula cow without permanent damage. By the use of a tympanometer, Cole and Kleiber (19) contend that when animals reach 60 mm. of mercury they are in serious condition.

There are, undoubtedly, considerable variations in the amount of pressure which individual cattle can withstand. The length of time an animal is forced to withstand a given pressure is an important factor in determining whether the pressure is fatal. Some animals become progressively more distressed although the pressure remains constant. Olson (52) found that sheep anaesthetized with nembutal

withstood pressures that approached 80 mm. of mercury before death occurred. Dougherty (23) established extreme pressures of air in anaesthetized sheep and maintained these high pressures for periods up to 20 minutes. There was a rise in blood pressure and an increase in heart rate, but the heart's action could not be stopped in this manner. Nichols (50) insufflated sheep with 5 to 10 pounds of pressure per square inch. This is approximately 262 to 524 mm. of mercury, which would be nearly three to six times the highest recorded pressures in cattle. Respirations ceased in a sheep following the introduction of water and carbon dioxide at five pounds of pressure into the rumen of six liters, and the animal collapsed. Relief of pressure resulted in recovery.

A marked difference between individual animals in their tolerance to the same gas insufflated at the same pressure has been shown in sheep by Dougherty et al. (30). In an experiment using a 40 per cent methane, 60 per cent carbon dioxide mixture, sheep A collapsed within three minutes with a pressure of 40 mm. whereas sheep B resisted a pressure of 80 mm. for five minutes before collapse. In both cases recovery was obtained by release of intraruminal pressure.

It has been suggested that ruminal gases may predispose cattle to bloat by inhibiting normal rumen function or by increasing intraruminal pressure (51). Dougherty (22) found that insufflation of the rumen to a pressure of 60 mm. of mercury with carbon dioxide, methane, carbon monoxide or hydrogen resulted in rumenatony, dyspnea, and shallow breathing, whereas insufflation with air caused no distress.

Distress is greatest with carbon dioxide and carbon monoxide and least with hydrogen. In later trials Dougherty et al. (30) increased

Mechanical interference with respiration and blood flow may be the cause of death during bloat. Olson (53) suggested that gas pressure in the rumen increases pressure against the diaphram, pressing against the vital organs such as the heart, lungs, and great veins. This not only prevents normal breathing, but also normal heart action, which may eventually result in death. Quin (56) states that abdominal distention especially evident in the left flank, was sufficient to immobilize the diaphram completely with the dome extending far forward into the thoracic cavity. The resultant asphyxia, combined with venous obstruction in the rumen from the posterior vena cava, is responsible for the acute death.

Dougherty and his co-workers (30) insufflated the rumen of sheep with oxygen, carbon dioxide, nitrogen, and a mixture of carbon dioxide (60%) and methane (40%). He found that an increase in intraruminal pressure produced a sharp rise in arterial (carotid) and venous (jugular) blood pressure, also, the cerebrospinal fluid pressure increased during insufflation and dropped when the intraruminal pressure was released.

When extreme air pressures were established in sheep for twenty minutes an increased heart rate and increased rise in blood pressure were noted without stopping the heart's action (23). Moore (47) also

found the greatest increase in heart rate, and a marked increase in systolic blood pressure when animals were severaly bloated. On one sheep, Dougherty and Meredith (29) through the use of an angiocardiograph determined whether raised intra-abdominal pressure or anterior displacement of the diaphram affected the circulation. They found no gross alteration of circulation or distortion of the great vessels when a pressure of 40 mm. of mercury was applied intraruminally.

Theories of the cause of bloat may be classified as physical, biochemical, hereditary, and relating to soil fertility and climate. Too much dense feed in the rumen, excessive formation of gas, altered surface tension and physical deficiency form the basis for the physical theories as to the cause of bloat. The biochemical theories are based on the presence of hydrogen cyanide, flavones and saponins in the ingesta. An allergy may also be involved in the cause of bloat.

The experimental production of bloat is not always possible. Several methods (18, 39, 54, 59) are available and should be a great impetus to studies relating to cause, prevention, and treatment.

Ellenberger in 1883 (33) demonstrated that bloat could be produced by sectioning of the vagi. Weiss (65) and Dracy and Jordon (31) did experiments on sectioning the left dorsal branch of the vagus on goats and sheep, respectively, producing distention and chronic bloat.

A number of workers (41, 46, 48, 54) have been able to produce bloat by drenching with juice expressed from legumes. Parsons (54) produced bloat with 32 ounces of alfalfa juice or ladino clover juice. Thomas (60) stated one pint of legume juice will produce bloat in cattle and will kill sheep.

The physical condition of feeds is a factor in bloat production. Mead and Goss (45) reported bloat on a non-roughage diet for cattle. McCandlish (43) encountered bloat when milk was the sole diet for calves. Mead et al. (44) found 21 mild cases of bloat on a ground hay and grain ration as compared to one for unground hay and grain. The same hay was used in proportion to grain giving proof that the physical condition of the feed is an etiological factor in bloat.

Cole et al. (21) found succulent, immature alfalfa eight to fourteen inches high, produced bloat when pastured, the most severe bloat being produced when animals were deprived of hay for 48 hours. Severe bloat was produced by feeding alfalfa tops in the barn (44).

There are unexplained variations in individual susceptibility among animals, not dependent on food intake (44). Moore (46) found considerable variation among animals as to susceptibility to bloat. Cole et al. (21) and Mead et al. (44) found that very few lactating dairy cows are entirely free of bloat if kept on bloat-provoking pastures for any length of time.

Several authors (3, 9, 17, 20, 37, 40, 53, 58, 63) have discussed various methods of preventing and treating bloat. Until the cause or causes of bloat have been definitely established and a dependable remedy found that will prevent bloat under all conditions, livestock farmers will be faced with it for centuries to come.

The use of mature grass-dominant pastures is the best insurance against bloat. There is wide agreement (25) that pastures containing

less than 50 per cent clover may be considered safe, but in New Zealand (40) pastures containing 25 to 30 per cent clover have produced bloat. The safe proportion, however, will always be difficult to define as it will depend on the palatability of associated grasses and the selective grazing habits of the animals.

Extensive studies have been conducted on feeding hay before pasturing (21). Overnight feeding of alfalfa hay did not always prevent bloat. Coarse alfalfa was more effective than fine-stemmed, leafy alfalfa. Overnight feeding of Sudan hay was found to be completely effective. Barley straw was found to be insufficient for preventing bloat when fed overnight (44). Feeding of hay just before turning stock out to pasture does not appear to be a reliable method for control on dangerous pasture.

Cole et al. (20) believed that bloat results from a lack of sufficient fiber of a prickly nature to initiate belching, suggesting that enough roughage of a coarse, stemmy nature be included in the diet to overcome this deficiency or to prevent excessive eating of succulent foods lacking in fiber.

Dispersing foam is a logical method for preventing bloat. The administration of antifoaming agents by Johns (40) and Reid (58), before feeding clover prevented frothy bloat. These agents were administered as drenches or mixed with small amounts of dry food and gave complete protection from bloat for the succeeding two hours. An antifoaming agent must be maintained in the paunch over the whole period during which the animal is eating bloat-producing herbage.

As foaming is a probable cause of bloat, antifoaming agents seem to be reliable means of control. Clark and Weiss (16) suggested spraying pastures with a weak solution of proprietary antifoaming agent. Reid (58) and Johns (40) in New Zealand have successfully developed a method of pasture spraying for bloat control using emulsified vegetable oil sprays.

Weathering presents a problem in oil spraying (40). Results should not be expected for more than 48 hours. Sprayed pastures may be a little unpalatable at first, but cows quickly become used to it. No taint occurred in milk or cream after grazing sprayed pastures, but contamination is possible.

The use of antibiotics for the prevention of bloat has been under study for several years (3, 4, 40). Barrentine et al. (3, 4) reported that penicillins were effective in preventing bloat. It was found that 50 to 75 mg. of procaine penicillin protected steers from bloat for one to three day periods. The dosage used in New Zealand (40) has been 100,000 to 200,000 units of procaine penicillin given orally at intervals of two or three days. Aureomycin, terramycin, bacitrocin, and streptomycin were ineffective in doses up to 300 milligrams. A 40 per cent reduction in the incidence of bloat in sheep and 70 per cent reduction in the incidence of bloat in steers was noted by feeding a penicillin-salt mixture. Some potency of the mixture was lost from licking, rain and contamination.

The administration of kerosene, turpentine, vinegar, and mineral oil (15, 35, 57, 61) have been used for bloat treatment. These

are now considered unsuitable (40), for example, kerosene puts the animal off its food, while vegetable turpentine causes intense irritation of the mouth, adversely affects the animals appetite, and is a cumulative poison. Silicones are efficient foam breakers but have proved to be quite unreliable for the relief of bloat animals.

Tranquilizers, a comparatively new group of compounds, have produced spectacular results in combatting stress conditions in animals. The tranquilizers are compounds that reduce anxiety, agitation, or emotional turmoil without anaesthesing the animal.

Numerous tranquilizer drugs have been marketed in recent years. The American Medical Association (49) has classified them accordingly:

I. Antihistamines
   A. Psychotherapeutic antihistamines
      a. Hydroxyzine (Atarax) hydrochloride

II. Central Nervous System Depressants
   A. Nonselective Depressants
      1. Analgasics
      2. General anesthetics
      3. Hypnotics and sedatives
   B. Selective Depressants
      1. Anticonvulsants
      2. Antihistamines (as above)
      3. Antitussives
      4. Central muscle relaxants (skeletal muscle relaxants), nonsedative
         a. Mephenesin (Avosyl, Dioloxol, Kinavosyl, Lissenphen, Mephenesin, Mepherol, Mephson, Myoten, Myoxane, Oranixon, Prolax, Saserol, Sinan, Spasmolyn, Tolansin, Tolosate, Toloxyn, Toloerol, Tolulox, Tolyspaz)
         b. Mephenesin carbamate (Tolseram)
      5. Central muscle relaxants (skeletal muscle relaxants), sedative
         a. Meprobamate (Equanil, Miltown)
         b. Phenaglycodol (Ultran)
         c. Promoxolane Dimethylane

6. Central parasympathetic suppressants
   a. Benactyzine (Suavitil) hydrochloride
7. Central sympathetic suppressants, phenothiazine
   a. Chlorpromazine (Thorazine) hydrochloride
   b. Mapazine (Pacatol) hydrochloride
   c. Perphenazine (Trilafon) hydrochloride
   d. Prochlorperazine (Compazine) maleate
   e. Promazine (Saparine) hydrochloride
   f. Triflupromazine (Vesprin) hydrochloride
8. Central sympathetic suppressants, Rauwolfia derivatives
   a. Alseroxylon (Rauwiloid)
   b. Deserpidine (Harmony)
   c. Rauwolfia (Raudixin, Rauserpa)
   d. Rescinnamine (Moderil)
   e. Reserpine (Rauloydin, Raurine, Reserpine, Reserpoid, Roxinoid, Sandril, Serpasil, Serpiloid)

III. Central Nervous System Stimulants
   a. Methylphenidate (Ritalin) hydrochloride
   b. Pipradrol (Meratran) hydrochloride

IV. Miscellaneous Agents
   a. Azacyclonol (Frenquel) hydrochloride

Various experiments (2, 5, 6, 10, 11, 12, 32, 34, 55, 62, 64) have been conducted with tranquilizers on different phases of both animal and human welfare. Many have provided favorable results, others none at all. More work must be done to obtain complete information on their possibilities.

A study of the action of tranquilizers on the brain has been handicapped because of imcomplete understanding of the functions of the brain. They act on the most primitive parts of the brain, especially the hypothalamus and the reticular formation. The basic life functions normally beyond voluntary control, such as awareness, hunger, and thirst are governed by these areas. These functions are kept in exquisite balance by two mutually antagonistic nervous mechanisms, the sympathetic and parasympathetic (6).

Because of the animal behavior and response to environmental situations, the dog and monkey have been studied. These seem to be the most desirable species in which to discern the finer degrees of alteration in behavior and attitude produced by a subtly-acting depressant agent.

Reserpine is effective orally and parenterally. Its action varies in intensity from species to species. Reserpine shows a latent period of from one to two hours before the drug effect is seen, whether administered by the oral or intravenous route (55).

Reserpine (5) has a peculiar sedative and hypnotic effect. This differs from any other known substance having a "central nervous system" depressant activity, a lowering of arterial blood pressure accompanied by bradycardia, some respiratory inhibition, stimulation of peristalsis, miosis, relaxation of the nictitating membrane, and an effect on the temperature-regulating center.

Reserpine slows the pulse rate to a greater or lesser degree, depending on the species of animal involved (5, 55). In the dog a significant degree of bradycardia has been observed (55). Atropine is effective in restoring the heart rate to normal.

Large doses of reserpine had a repressant effect on respiration of all animals studied, while acutely lethal doses produced a centrally conditioned cessation of breathing (5, 55). Anaesthesia rendered the animal more sensitive to reserpine.

Generally reserpine lowers the body temperature. At a high environmental temperature, body temperature increases slightly, suggesting depression of the temperature-regulating mechanism (5, 55).

Reserpine stimulates intestinal activity in most animals. Fairly large doses may give rise to diarrhea (5, 55). It stimulates intestinal motility, especially in the lower parts of the intestine in an anaesthetized rabbit (49). The action of reserpine has been only partially elucidated, with many questions unsolved.

Weight increase has been mentioned in some clinical reports (8, 10, 11, 34) and is usually regarded as being related to improvement in appetite. This is sometimes accomplished by fluid retention. A widespread and increasing availability of tranquilizers suggests that they may play an important part in enabling mankind to cope with the increasing complexities of life.

EXPERIMENTAL

The research presented herein was conducted in two parts. A preliminary experiment was performed to determine a dosage level that could be injected intramuscularly into animals without detrimental effects, and the main experiment was conducted to determine the effect of a tranquilizer on bloated dairy cattle.

Preliminary Experiment

The preliminary experiment was conducted to observe the effects of tranquilizer, and to determine a dosage that could be used in dairy cattle without injury or deviation from the normal functions of the body. Three group phases were conducted. Three cows and one heifer composed each group. The groups were matched as nearly as possible according to weight of the animals composing them.

One group of animals served as controls. The other groups received the tranquilizer reserpine (Serpasil[1]). One group received .250 mg. per 100 pounds of body weight and another group received .300 mg. per 100 pounds of body weight of the same tranquilizer. The tranquilizer was administered intramuscularly into the shoulder area.

The animals all received the same management throughout the experiment. During the day the animals were pastured on succulent alfalfa and were rotated onto new pasture approximately every two days. The alfalfa was eight to fourteen inches high with a thick

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[1]The tranquilizer "Serpasil" was supplied by CIBA Pharmaceutical Products, Inc., Summit, New Jersey.

stand for rapid ingestion. The animals were removed from pasture at night to increase the possibility of bloat. At all times the animals had free access to salt and water.

Recordings were made of heart rate, respiration rate, rectal temperature, weight of animals, and other variables. Heart rate, respiration rate and rectal temperature were recorded before and after pasturing. Milk from lactating cows was discarded because of unknown complications which may be present (13). The animals were weighed at the beginning of the experiment and twice a week thereafter. The weights were taken prior to pasturing and at approximately the same time each day. Injections of tranquilizer were made immediately after the morning recordings. The animals were put on pasture at approximately 9:00 a.m. and taken off at approximately 4:00 p.m.

The heart rate was taken by counting the beats per minute with the aid of a stethoscope and stop watch. The respiration rate was obtained by counting the inhalations per minute. The rectal temperatures were obtained with a rectal thermometer.

Bloat was detected by visual inspection and by palpation of the triangular area of the left flank. Three degrees of bloat were recorded: slight, marked, and severe. Heart rate, respiration rate, and rectal temperature were taken. The cow was then injected with .250 mg. per 100 pounds of body weight of reserpine (Serpasil). Results were taken and recorded at fifteen minute intervals until the pressure subsided.

During the course of the day, one observer watched for any symptoms. Once signs of distress or deviation from the normal were noted the results were recorded. General observations of the animals were also recorded.

Daily maximum and minimum air temperatures, precipitation, and weather conditions were obtained from Mr. A. A. McMillan, a volunteer weather observer at Brookings, South Dakota.

Major Experiment

The major experiment was performed to determine the effect of tranquilizers on bloat, the effects upon the animal, and what effect, if any, as a preventative for bloat at a certain level.

The animals used in the study were Holsteins, Guernseys, and Brown Swiss. Nine animals were used in the control group. Four were lactating cows, three were dry, and two were heifers. The tranquilized group consisted of ten animals; four lactating cows, four dry cows, and two heifers.

The animals on tranquilizer received .033 mg. of reserpine (Serpasil) per 100 pounds of body weight. The tranquilizer was administered intramuscularly into the shoulder area. Injections were made daily, immediately after the morning readings were recorded.

Attempts to produce bloat were made by putting animals on succulent alfalfa pasture during the day. Fields with thick stands of immature alfalfa eight to fourteen inches high were selected and rotated approximately every two days. The animals were allowed to

graze from approximately 9:00 a.m. until 4:00 p.m. At night the animals were kept off pasture to increase the incidence of bloat. At all times the animals had free access to salt and water. The lactating cows received four pounds of ground oats per day before and after pasturing.

Data were obtained on the following: (a) heart rate, (b) respiration rate, (c) rectal temperature, (d) weight of animals, (e) milk production, (f) weather, and (g) sequence of events on bloated animals receiving tranquilizer. The heart rate, respiration rate, and rectal temperature were taken before and after pasturing. Animal weights were taken before pasturing at the beginning of the experiment and once a week thereafter.

Respiratory rates were taken by counting the inhalations per minute. A stethoscope and stop watch were used to determine heart rate. A rectal thermometer was used to obtained rectal temperatures. Milk production records were taken at the morning and evening milkings, and the milk was discarded.

Visual inspection and palpation of the triangular area of the left flank were used to detect bloat. Three degrees of bloat were recorded: slight, marked, and severe. Some control animals that bloated were returned to the barn and given time to relax so as to obtain results from bloat rather than from the walk to the barn. Heart rate, respiration rate and rectal temperature were taken. The animals were then injected with .250 mg. of reserpine (Serpasil) per 100 pounds of body weight. Readings were taken at five minute intervals until the animals returned to normal.

One calf not on the experiment was slightly bloated and given one mg. of reserpine (Serpasil) per 100 pounds of body weight and records taken.

Throughout the pasturing periods at least one observer was in the field. Whenever bloat was anticipated, several persons were present or on call in order to remove bloated animals and treat them. Animals that were bloated were returned to the barn where further observations could be made and animals treated.

Daily maximum and minimum temperatures as well as precipitation, and weather conditions were obtained from Mr. A. A. McMillan, a volunteer weather observer at Brookings, South Dakota. Additional weather observations were taken during the pasturing periods.

RESULTS AND DISCUSSION

The results of this experiment are recorded and discussed in two parts. The first part deals with determining the amounts of tranquilizer that the animals could withstand. The second or major part of this section deals with the effects of tranquilizer as related to the bloated animal.

Preliminary Experiment

The preliminary experiment demonstrated that daily intramuscular injections of the tranquilizer reserpine (Serpasil) at a dosage of .250 mg. and .300 mg. per 100 pounds of body weight was harmful to the animals. The average heart rate, respiration rate, and rectal temperature after five days of tranquilizer are presented in Table I. This average is only for five days because the dosage was found to be too large and was reduced to one-half. The rectal temperature increased .4 degrees in Lot III as compared to Lots I and II before pasturing. The heart rate increased slightly while the respiration rate decreased slightly in Lots II and III.

Recordings made after pasturing show an increase in heart rate, respiration rate, and rectal temperature compared to the controls. The heart rate increased five and two beats per minute in Lots II and III respectively as compared to the controls. The respiratory rate increased 10 and 20 respirations per minute in Lots II and III respectively as compared to Lot I. In Lot II the rectal temperature had increased 1.0 degrees while Lot III increased 1.4 degrees compared to the controls of Lot I.

TABLE I. AVERAGE HEART RATE, RESPIRATORY RATE, AND RECTAL TEMPERATURE OF ANIMALS AT VARIOUS LEVELS OF TRANQUILIZER AFTER FIVE DAYS OF ADMINISTRATION

	Before Pasturing			After Pasturing		
	HR	RR	RT	HR	RR	RT
Lot I, Controls	53	36	100.9	68	44	101.8
Lot II, .250 mg.*	57	29	100.9	73	54	102.8
Lot III, .300 mg.*	60	30	101.3	70	65	103.2

*Milligrams per 100 pounds of body weight
HR = Heart rate per minute
RR = Respiratory rate per minute
RT = Rectal temperature

The daily heart rate, respiration rate, and rectal temperature before and after pasturing are shown on Tables II, III, and IV for each lot. On the fourth day after injection heifer 198 in Lot II showed signs of being uncoordinated. The animal was weak on her hind legs and showed ataxia.

On the fifth day, animals injected with tranquilizer were standing with their heads horizontal, eyes practically closed, tongues out and foaming at the mouth, while gasping for air. These animals had lost their appetites and those that ate had trouble swallowing and did so as if in pain. A rumbling sound was noted when they were eating. The animals were given a ration of equal parts of corn and oats to test their appetites. Only the control group ate all their feed. Diarrhea and frequent urination was noted in the animals receiving tranquilizer. The animals were easily approached in the field and

were hard to drive, showing little sense of pain, as demonstrated by the use of an electric probe.

TABLE II. AVERAGE HEART RATE, RESPIRATORY RATE, AND RECTAL TEMPERATURE OF CONTROL ANIMALS IN LOT I*

Date	Before Pasturing			After Pasturing		
	HR	RR	RT	HR	RR	RT
8-19-60	54	29	100.9	80	58	101.9
8-20-60	58	36	100.1	60	38	101.4
8-21-60	55	44	101.2	64	46	101.4
8-22-60	49	35	101.1	70	38	102.5
8-23-60	49	37	101.2	68	40	101.9
8-24-60	55	30	100.8	75	47	101.9
8-25-60	58	29	100.9	63	54	101.6
8-26-60	54	27	100.6	74	44	101.5
8-27-60	51	29	100.8	68	56	101.9
8-28-60	60	17	100.5	60	46	101.8
8-29-60	49	18	100.2	82	43	102.1
8-30-60	50	34	100.9	71	60	102.1
8-31-60	57	55	100.9	55	78	101.5
9- 1-60	56	62	100.9	86	75	102.0
9- 2-60	61	50	100.9	70	64	-----

*Four animals in this lot
HR = Heart rate per minute
RR = Respiratory rate per minute
RT = Rectal temperature

TABLE III. AVERAGE HEART RATE, RESPIRATORY RATE, AND RECTAL TEMPERATURE OF ANIMALS IN LOT II RECEIVING VARIED AMOUNTS OF TRANQUILIZER*

	Before Pasturing			After Pasturing		
Date	HR	RR	RT	HR	RR	RT
8-19-60	65	26	100.5	92	48	102.2**
8-20-60	59	28	101.2	71	52	102.2**
8-21-60	57	37	101.3	68	57	102.5**
8-22-60	65	26	100.6	73	54	103.2**
8-23-60	40	28	100.8	62	58	103.8**
8-24-60	50	27	100.7	62	60	103.9***
8-25-60	47	15	100.3	59	60	103.9***
8-26-60	52	17	100.1	59	44	101.9/
8-27-60	41	16	100.4	59	56	101.8/
8-28-60	48	16	100.0	54	59	101.2/
8-29-60	47	15	100.6	66	40	102.1//
8-30-60	47	20	100.9	65	83	102.8//
8-31-60	49	53	101.1	62	104	103.5//
9- 1-60	48	51	101.2	59	96	103.6//
9- 2-60	50	41	100.8	71	77	-----//

*Four animals in this lot
**Received .250 mg. of reserpine per 100 pounds of body weight
***Received .125 mg. of reserpine per 100 pounds of body weight
/No injection given
//.050 mg. of reserpine received per 100 pounds of body weight

TABLE IV. AVERAGE HEART RATE, RESPIRATORY RATE, AND RECTAL TEMPERATURE OF ANIMALS IN LOT III RECEIVING VARIED AMOUNTS OF TRANQUILIZER*

Date	Before Pasturing			After Pasturing		
	HR	RR	RT	HR	RR	RT
8-19-60	72	30	101.3	85	58	102.5**
8-20-60	65	33	101.2	70	49	102.3**
8-21-60	62	37	101.7	68	46	103.1**
8-22-60	53	23	101.5	65	93	104.2**
8-23-60	46	26	100.6	61	78	103.7**
8-24-60[a]	54	20	100.4	48	48	103.5***
8-25-60[b]	56	16	100.1	55	41	101.4***
8-26-60	47	15	99.9	50	31	100.3✓
8-27-60[c]	55	16	100.7	55	58	102.6✓
8-28-60[c]	55	15	100.5	60	21	102.4✓
8-29-60[c]	51	23	100.9	61	37	102.1✓
8-30-60[c]	38	16	101.2	61	69	102.3✓
8-31-60[c]	59	44	101.1	66	62	101.6✓
9- 1-60	51	51	101.3	61	87	102.3✓
9- 2-60	57	51	101.0	73	67	-----✓

*Four animals in this lot
**Received .300 mg. of reserpine per 100 pounds of body weight
***Received .150 mg. of reserpine per 100 pounds of body weight
✓No injections given
[a]Records of two animals
[b]Records of one animal
[c]Records of three animals

Figures 1 and 2 depict the condition of the animals the fifth day of the experiment. Symptoms previously described were readily distinguished in the tranquilized animals.

The animals received .125 mg. and .150 mg. of reserpine (Serpasil) per 100 pounds of body weight in Lots II and III respectively, after five days on experiment. Results similar to those explained previously were noted, thus the injections were discontinued after two days. In Lot III, heifer 221 laid down in the field on August 23,

1960 and could not be driven up for 36 hours. Heifer 189 laid down and could not be driven up. She died fifteen days later on September 7, 1960. Cow 213 laid down August 25, 1960 and was down for approximately 36 hours before getting up. An electric probe and assistance from personnel were used to persuade the animals to rise. The animals showed a state of sedation which, 24 to 36 hours later, disappeared.

On August 29, 1960, Lot II received .050 mg. per 100 pounds of body weight of tranquilizer. Before pasturing, the heart rate, respiration rate, and rectal temperature showed little variation (Table V). After pasturing, the lot receiving tranquilizer had a lowered heart rate of 11 beats per minute and an increase of 16 respirations per minute. The rectal temperature in the tranquilized group increased 1.1 degrees over the control group. Again symptoms as previously mentioned were observed and injections discontinued. Animals in Lot III were not given tranquilizer because of their poor condition.

TABLE V. AVERAGE HEART RATE, RESPIRATORY RATE, AND RECTAL TEMPERATURE OF ANIMALS FROM AUGUST 29, TO SEPTEMBER 2, 1960

	Before Pasturing			After Pasturing		
	HR	RR	RT	HR	RR	RT
Lot I, Controls	55	44	100.8	73	64	101.9
Lot II, .050 mg.*	48	46	100.9	62	80	103.0

*Milligrams per 100 pounds of body weight

Left Animal Control, Right Animal Received Tranquilizer

Heifer 189 Received Tranquilizer

Figure 1. Condition of the Animals the Fifth Day of Receiving Reserpine (Serpasil)

Control Animal on the Right, Remaining Animals Received Tranquilizer

Control Animal on the Right, Remaining Animals Received Tranquilizer

Figure 2. Condition of the Animals the Fifth Day of Receiving Reserpine (Serpasil)

The injections of tranquilizer, even when only one-half of the original dosage was used, increased rectal temperature. This indicated a residual effect of the tranquilizer, reserpine. The increase in rectal temperature was one reason for the lack of appetite. Because of this lack of appetite the animals lost weight during the experiment as shown in Table VI. The animals lost weight during the first week of the experiment. This loss partly resulted from the animals not being pastured at night. The next weighing showed no loss or gain in the control group but a loss of weight in Lots II and III. On August 26, 1960, three animals were averaged in Lot III as one animal was down due to sedation of reserpine. When comparing the weights of the three animals to the same animal of the previous weighing, there was a loss of only seven pounds. Records of average body weights for the remainder of the experiment are not listed because of the difficulty in obtaining accuracy. This difficulty was due to animals lying down in the field during weighing periods. Their lying down in the field was caused by the sedative effect of the tranquilizer.

TABLE VI. AVERAGE BODY WEIGHTS OF ANIMALS RECEIVING RESERPINE (SERPASIL)*

	8-19-60 Initial wt. lbs.	8-22-60 lbs.	8-26-60*** lbs.
Lot I, Control	1154	- 32	0
Lot II, .250 mg.**	1242	- 58	- 15
Lot III, .300 mg.**	1105	- 60	- 71****

*Four animals in each lot
**Milligrams per 100 pounds of body weight
***One-half of original dosage given for two days prior to readings
****Record based on three animals

There were no cases of bloat in Lot III. On August 22, 1960 there was one case of slight bloat in Lot I and one case of slight and one case of severe bloat in Lot II. One case of severe bloat was recorded in Lot I on August 23, 1960. No other cases of bloat were observed during the experiment. Rain on the following day and periodically thereafter, as presented in Table VII, may have been the cause for the lack of any more bloat. It can also be seen from comparing Table VII to Tables II, III, and IV that as the air temperature rose so did the respiration rate, but that the respiration rate was higher in the animals receiving reserpine.

Cow 781 with severe bloat was returned to the barn from the field and injected intramuscularly with .250 mg. of reserpine per 100 pounds of body weight. These results are shown on Table VIII. The heart rate, and respiration rate were lowered somewhat with a

TABLE VII. MAXIMUM AND MINIMUM TEMPERATURES, PRECIPITATION, AND WEATHER CONDITIONS*

Date	Temperaturesin °F. Max.	Min.	Precip.	Weather Conditions
8-19-60	87	63		Clear
8-20-60	80	62		Fair
8-21-60	85	64		Fair
8-22-60	87	66		Fair
8-23-60	91	64		Partly cloudy
8-24-60	88	59	1.38	Partly cloudy
8-25-60	85	57	2.15	Partly cloudy
8-26-60	83	50		Partly cloudy
8-27-60	76	54	.45	Cloudy
8-28-60	90	59	.35	Cloudy
8-29-60	77	53		Clear
8-30-60	79	62		Clear
8-31-60	89	64		Clear
9- 1-60	92	70		Partly cloudy
9- 2-60	91	71		Fair

*Data obtained from Mr. A. A. McMillan, Volunteer Weather Observer, Brookings, South Dakota.

rise in rectal temperature. The animal did not begin belching until six minutes after the injection was made. She continued to belch approximately every minute from then on until ruminal pressure had returned to normal. The rectal temperature began to return to normal within 45 minutes and was normal 60 minutes after the time of the injection.

Major Experiment

Two groups of animals were used to determine what effect tranquilizers had on the occurrence of bloat. The dosage used was based on the preliminary experiment with the idea of preventing bloat without detrimental effects on the animal or producing observable

changes in the animal. The control animals that bloated were given a dosage that was near the amount recommended to produce sedation.

TABLE VIII. SEQUENCE OF EVENTS, HEART RATE, RESPIRATORY RATE, AND RECTAL TEMPERATURE OF COW 781 WITH SEVERE BLOAT ON AUGUST 23, 1960

Time	HR	RR	RT	Remarks
4:18	88	43	101.5	Normal reading before injection
4:20				Injected with .250 mg. of reserpine per 100 pounds of body weight
4:26				Belched, severe bloat
4:27				Belched
4:29				Belched
4:30				Belched
4:31				Belched
4:32				Belched
4:33	68	40	102.1	Belched
4:35				Micturated and defecated, and belched
4:36				Belched, marked bloat
4:37				Belched
4:38				Belched
4:40				Belched
4:42				Belched, slight bloat
4:46				Belched
4:48	84	48	102.0	
4:49				Belched
4:54				Belched
5:03	88	36	101.7	Ruminal pressure normal
5:18	76	40	101.2	
5:33	60	32	101.4	

Averages were obtained for heart rate, respiration rate, and rectal temperature before and after pasturing for animals on control and those receiving .033 mg. of reserpine (Serpasil) per 100 pounds of body weight. The experiment was conducted between September 12,

and October 2, 1960. The results are presented in Tables IX and X. The data reveal no appreciable differences between the control group and those receiving the tranquilizer at .033 mg. per 100 pounds of body weight.

TABLE IX. AVERAGE HEART RATE, RESPIRATORY RATE, AND RECTAL TEMPERATURE OF CONTROL ANIMALS*

	Before Pasturing			After Pasturing		
Date	HR	RR	RT	HR	RR	RT
9-12-60	65	25	101.1	77	32	101.5
9-13-60	63	21	101.1	71	31	101.7
9-14-60	53	16	100.5	70	38	101.5
9-15-60	50	21	100.9	70	32	101.6
9-16-60	52	20	100.3	64	34	101.6
9-17-60	50	16	100.8	58	34	102.2
9-18-60	---	No readings recorded		---		
9-19-60	51	15	100.5	67	27	101.8
9-20-60	52	16	100.1	66	27	102.1
9-21-60	49	16	100.3	67	20	101.5
9-22-60	51	17	100.3	71	17	101.2
9-23-60	57	16	100.5	61	24	101.5
9-24-60	48	16	100.6	63	20	101.5
9-25-60	50	15	100.0	60	21	101.7
9-26-60	49	12	100.4	71	21	101.6
9-27-60	49	16	100.2	62	21	101.2
9-28-60**	60	18	100.4	67	21	101.0
9-29-60	47	10	100.0	68	23	101.6
9-30-60	49	12	100.0	67	26	101.5
10-1-60	50	13	100.0	76	23	101.6
10-2-60	48	12	100.4	75	25	101.7
Ave.	52	16	100.4	68	26	101.6

*Nine animals on control
**Animals broke into alfalfa pasture at night
HR = Heart rate per minute
RR = Respiratory rate per minute
RT = Rectal temperature per minute

TABLE X. AVERAGE HEART RATE, RESPIRATORY RATE, AND RECTAL TEMPERATURE OF ANIMALS THAT RECEIVED .033 MILLIGRAMS OF TRANQUILIZER PER 100 POUNDS OF BODY WEIGHT*

	Before Pasturing			After Pasturing		
Date	HR	RR	RT	HR	RR	RT
9-12-60	64	26	101.2	71	36	101.8
9-13-60	71	19	101.0	70	32	101.8
9-14-60	49	16	100.7	69	41	101.7
9-15-60	51	17	100.7	65	32	101.9
9-16-60	51	17	100.3	64	36	101.8
9-17-60	48	16	100.7	61	27	102.1
9-18-60	----- No readings recorded but injections given -----					
9-19-60	54	13	100.5	61	24	101.8
9-20-60	56	17	100.4	69	28	102.1
9-21-60	50	16	100.8	64	17	101.6
9-22-60	51	13	100.1	64	15	101.4
9-23-60	58	14	100.8	62	17	101.5
9-24-60	47	11	100.2	60	21	101.7
9-25-60	49	12	100.3	60	23	101.7
9-26-60	49	13	100.6	67	23	102.1
9-27-60	53	11	99.9	60	18	101.6
9-28-60**	58	16	100.6	62	19	101.4
9-29-60	49	12	99.9	59	16	101.0
9-30-60	49	10	100.3	62	20	102.1
10-1-60	48	11	100.0	67	18	101.7
10-2-60	49	12	100.8	70	22	102.1
Ave.	53	15	100.5	64	24	101.7

*Ten animals receiving reserpine
**Animals broke into alfalfa pasture at night

Animals that had bloated received calculated dosages of tranquilizer which are listed in Tables XI, XII, XIII, XIV, XV, and XVI showing heart rate, respiration rate, and rectal temperature that were recorded every five minutes. A sequence of events was also recorded on the animals until the pressures had subsided.

TABLE XI. SEQUENCE OF EVENTS, HEART RATE, RESPIRATORY RATE, AND RECTAL TEMPERATURE OF HEIFER 198 WITH SEVERE BLOAT ON SEPTEMBER 13, 1960

Time	HR	RR	RT	Remarks
11:20				Micturated, takes short grunts with each breath. Shows discomfort, kicking continuously.
11:22	96	20	102.0	Injected with .250 mg. of reserpine per 100 pounds of body weight.
11:23				Belched
11:27	80	24	101.8	
11:30				Belched
11:31				Belched
11:32	80	32	101.6	Belched
11:37	80	40	101.6	Belched and again in ½ minute
11:39				Belched
11:40				Belched, little kicking
11:41				Belched and again in ½ minute
11:42	80	38	101.8	Belched
11:45				Belched
11:46				Belched
11:47	80	32	102.0	Belched
11:48				Belched, kicking stopped
11:49				Belched
11:51				Belched, marked bloat
11:52	80	36	102.0	Belched
11:54				Belched
11:55				Belched
11:56				Belched
11:57	80	36	102.1	Belched
11:58				Belched, slight bloat
11:59				Belched
12:01				Belched
12:02	76	38	101.9	
12:03				Belched
12:04				Belched
12:05				Belched
12:07	64	36	101.9	
12:09				Belched
12:12	56	36	101.6	
12:17	60	24	101.6	
12:22	52	24	101.4	
12:27	56	24	101.3	
12:32	60	24	101.1	Ruminal pressure normal

Heifer 198 bloated severely and was injected with .250 mg. of reserpine after being brought into the barn. After the injection, the animal began to show a reduction in anxiety, tension, and nervousness, followed by a release of ruminal gas pressure by belching. The tranquilizer began to take effect approximately 20 minutes after the injection as depicted in Table XI. The rumen pressure began returning to normal in approximately 40 minutes. The heart rate, respiration rate, and rectal temperature returned to normal in approximately 50 minutes after the injection. As the ruminal pressure decreased, the frequency of the belches was reduced and later subsided.

Table XII shows effects after injecting reserpine into cow 220 with marked bloat. Frequent micturitions and defecations were observed in this animal which were not noted in other cases. No belching was observed prior to the injection. Belching began after the injection and continued until the animal showed no signs of distress ordinarily observed in bloat.

The heart rate and respiration rate dropped slightly after the injection and remained fairly constant for 35 minutes. The heart rate then increased from 68 to 80 beats per minute returning to normal one hour and 25 minutes after the injection. The respiration rate increased from 40 to 52 respirations per minute and then returned to normal. An increase from 101.8 to 102.4 degrees in rectal temperature was noted 30 minutes after the injection of tranquilizer. The rectal temperature returned to normal in one hour and 25 minutes. In

approximately one and one-half hours the animal showed no signs of bloat. The heart rate, respiration rate, and rectal temperature was normal.

TABLE XII. SEQUENCE OF EVENTS, HEART RATE, RESPIRATORY RATE, AND RECTAL TEMPERATURE OF COW 220 WITH MARKED BLOAT ON SEPTEMBER 13, 1960

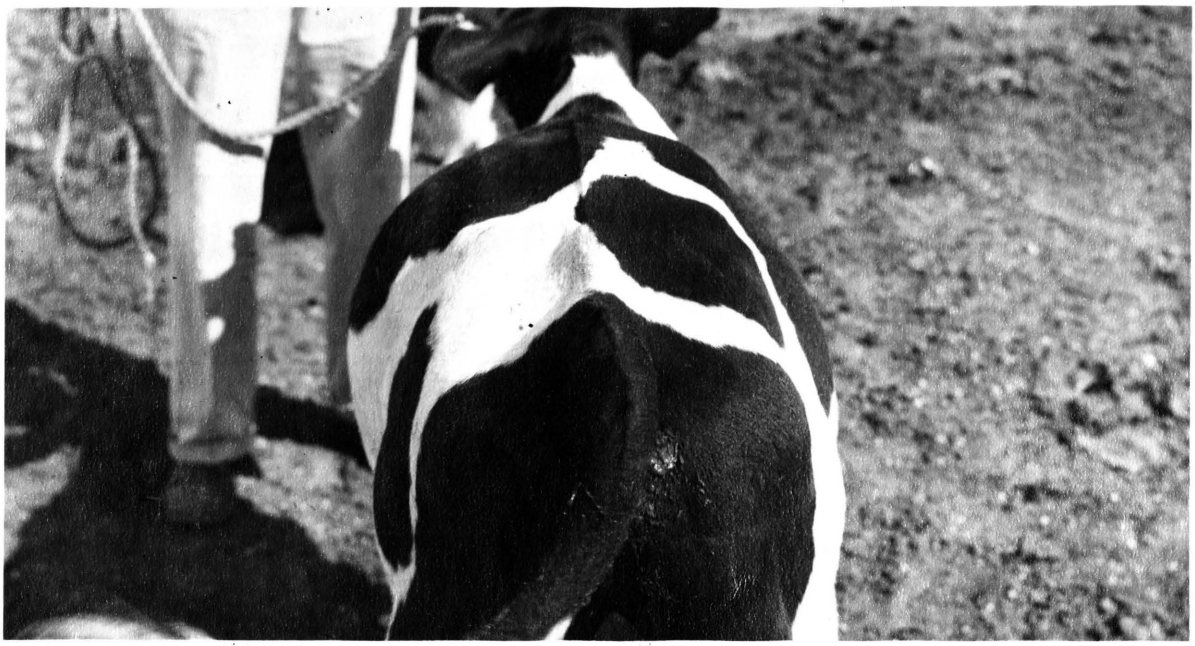
Time	HR	RR	RT	Remarks
11:55				Bloated, not too much discomfort. Micturated and defecated. No belching in beginning - no labored breathing observed.
11:56	76	52	101.8	Injected .250 mg. of reserpine per 100 pounds of body weight.
12:01	72	44	101.8	
12:06	68	40	101.8	Belched and again in two minutes.
12:11	68	40	102.0	
12:16	68	40	102.1	Belched three times in next five minutes.
12:21	68	44	102.2	Uneasy
12:26	68	44	102.4	Defecated
12:31	68	44	102.1	Micturated and defecated
12:36	76	44	102.0	Defecated and belched twice in five minutes.
12:41	80	40	101.9	Micturated, slight bloat
12:46	76	44	102.0	Defecated and belched twice in five minutes, then laid down.
12:51	76	44	101.8	Micturated, defecated and belched.
12:56	80	52	101.4	Belched and micturated
1:01	80	40	101.9	Belched approximately every 2½ minutes.
1:06	76	40	102.0	Micturated
1:11	72	40	101.6	Belched approximately every minute, defecated.
1:16	72	44	101.2	Belched approximately every 45 seconds.
1:21	60	40	101.1	Belched, ruminal pressure normal.

Table XIII shows the reaction of reserpine in calf 2380 with slight bloat. The calf received one mg. of reserpine per 100 pounds of body weight. A similar reaction was observed as was previously mentioned on heifer 198 and cow 220. Figure 3 shows the animal before injection of tranquilizer and 40 minutes after. The animal shows some fill of the rumen after returning to normal but the rumen pressure had subsided.

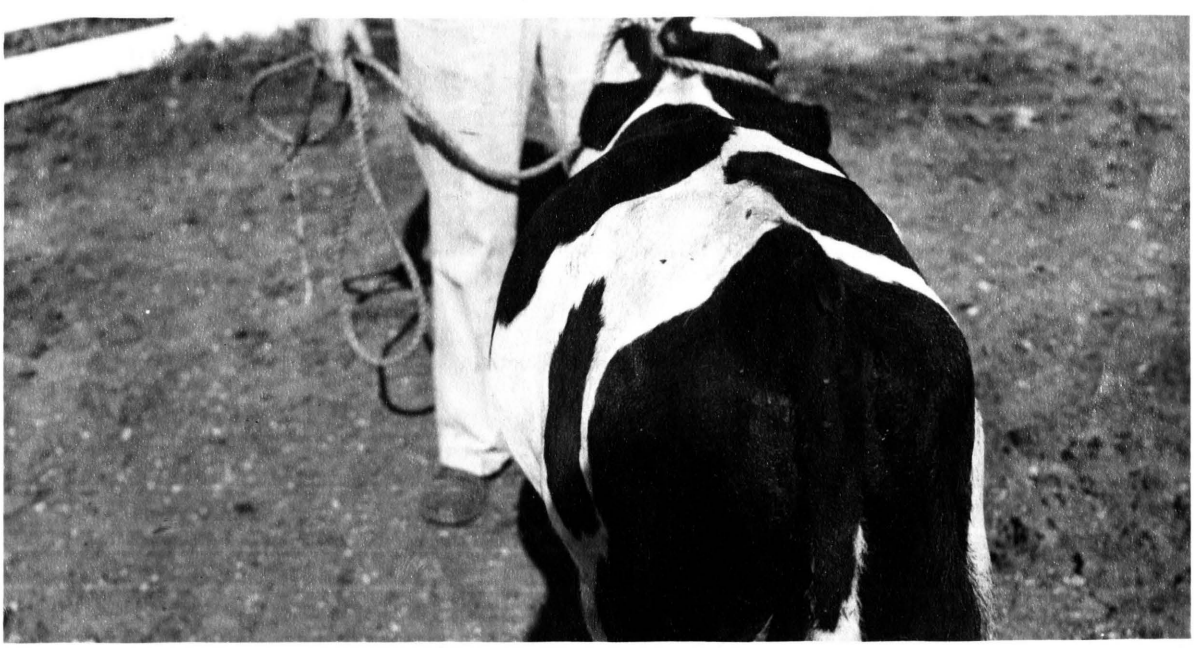
TABLE XIII. SEQUENCE OF EVENTS, HEART RATE, RESPIRATORY RATE, AND RECTAL TEMPERATURE OF CALF 2380 WITH SLIGHT BLOAT ON SEPTEMBER 15, 1960

Time	HR	RR	RT	Remarks
2:20	158	80	103.8	Injected with 1 mg. of reserpine per 100 pounds of body weight. Belched approximately every 2½ minutes until normal. Frequent micturition.
2:25	124	80	103.9	
2:30	124	92	103.9	
2:35	118	92	103.9	
2:40	118	88	104.0	
2:45	122	88	103.6	
2:50	124	92	103.1	
2:55	124	88	103.2	
3:00	116	80	103.1	Ruminal pressure normal

Table XIV referring to heifer 198 with marked bloat and Table XV on cow 167 with severe bloat describe a similar response as has been previously stated. After being injected with .250 mg. of reserpine per 100 pounds of body weight, heifer 198 with marked bloat showed a decrease in heart rate from 88 beats per minute to a normal of 60 beats per minute. The respiratory rate also dropped from 48 to 36 respirations.



Before Injection of Reserpine (Serpasil)



40 Minutes After Injection

Figure 3. Slight Bloat in Calf 2380 Receiving 1 mg./100 Lbs. of Body Weight of Reserpine (Serpasil)

per minute. The rectal temperature increased from 102.0°F. before injection, to a high of 102.4°F. after the injection. The rectal temperature then returned to normal. During this 40 minutes after the injection of tranquilizer the animal had released the gas by belching and showed no observable sign of bloat.

TABLE XIV. SEQUENCE OF EVENTS, HEART RATE, RESPIRATORY RATE, AND RECTAL TEMPERATURE OF HEIFER 198 WITH MARKED BLOAT ON SEPTEMBER 15, 1960

Time	HR	RR	RT	Remarks
1:10	88	48	102.0	Injected with .250 mg. of reserpine per 100 pounds of body weight. Belched approximately every 2½ minutes until normal.
1:15	84	44	102.1	
1:20	84	44	102.4	Micturated
1:25	76	44	102.4	
1:30	76	44	102.4	
1:35	76	44	102.0	Slight bloat
1:40	76	44	101.8	
1:45	68	42	101.8	
1:50	64	36	101.7	Ruminal pressure normal
1:55	52	36	101.4	
2:00	60	36	101.4	

There is a difference in degree of tolerance among animals to the same dosage of tranquilizer. Heart rate, and respiration rate returned to normal but rectal temperature increased and stayed above normal for cow 167 with severe bloat as shown in Table XV. The release of gas by belching was accomplished in approximately the first 20 minutes. The rectal temperature remained high for the next 50 minutes while heart rate and respiration rate returned to normal.

This increase is probably an effect of tranquilizer and not a physiological condition caused by bloat.

TABLE XV. SEQUENCE OF EVENTS, HEART RATE, RESPIRATORY RATE, AND RECTAL TEMPERATURE OF COW 167 WITH SEVERE BLOAT ON SEPTEMBER 17, 1960

Time	HR	RR	RT	Remarks
5:00	72	36	102.5	Injected with .250 mg. of reserpine per 100 pounds of body weight.
5:05	80	44	102.6	
5:10	72	32	102.6	Belching
5:15	76	32	102.8	Belching
5:20	72	32	102.7	Belching
5:25	80	32	102.7	Ruminal pressure normal
5:30	72	24	102.7	
5:35	68	24	102.7	
5:40	72	28	102.5	
5:45	68	24	102.5	
5:50	68	24	102.5	Rectal temperature probably staying up because of tranquilizer injection.
5:55	72	24	102.2	
6:00	76	24	102.1	
6:05	72	24	102.4	
6:10	64	24	102.2	
6:15	64	24	102.5	

Cow 781 with severe bloat frequently micturated and defecated with continuous kicking (Table XVI). There was frequent belching to release rumen gas at first with a gradual decline. The heart rate was high and irregular with a gradual return to normal. Respiration rate increased slightly and then returned to normal. As previously noted, after an injection of reserpine the rectal temperature increased and then decreased, which is a typical effect of reserpine.

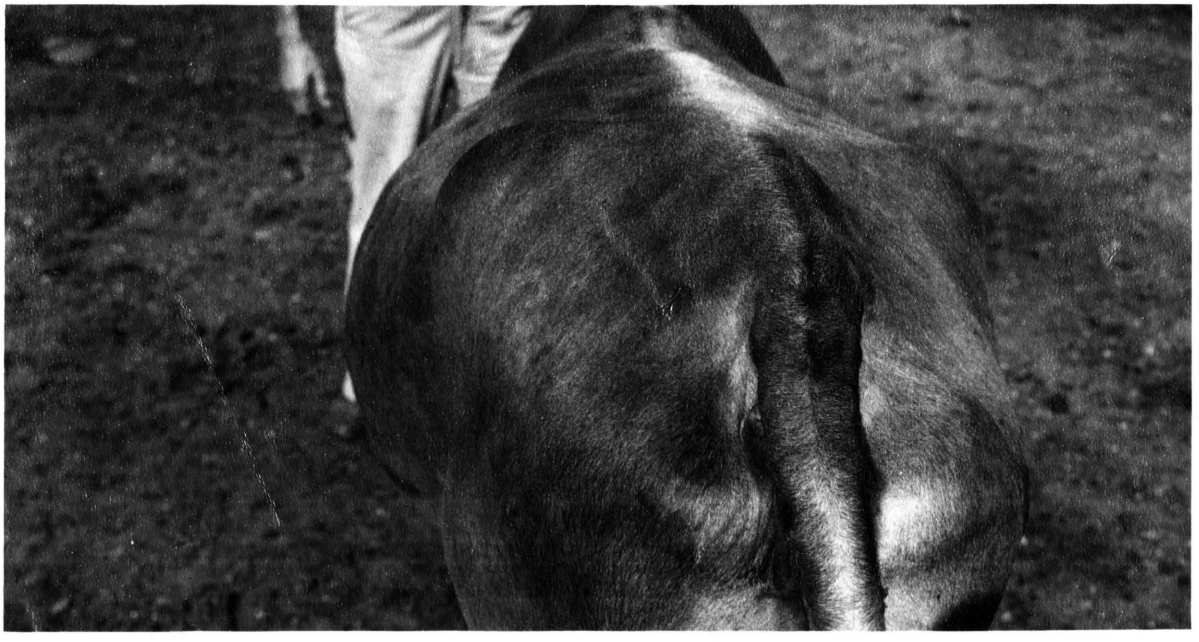
Figure 4 shows the animal before injection and after rumen pressure subsided, 47 minutes after the injection.

TABLE XVI. SEQUENCE OF EVENTS, HEART RATE, RESPIRATORY RATE, AND RECTAL TEMPERATURE OF COW 781 WITH SEVERE BLOAT ON SEPTEMBER 17, 1960

Time	HR	RR	RT	Remarks
3:00	112	40	101.3	Frequent micturition and defecation. Kicks continuously. Injected with .250 mg. of reserpine per 100 pounds of body weight.
3:05	136	40	101.8	Belching
3:10	132	44	101.9	Frequent belching
3:15	116	40	102.2	Frequent belching
3:20	92	44	102.2	Frequent belching
3:25	92	44	101.9	Belching, marked bloat
3:30	104	44	101.7	Belching
3:35	96	32	101.6	Belching
3:40	104	32	101.8	Belching
3:45	100	32	101.8	Slight bloat
3:50	100	32	101.8	Occassional belching
3:55	92	32	101.8	Ruminal pressure normal
4:00	84	32	101.8	
4:05	84	32	101.8	
4:10	80	32	101.7	
4:15	80	32	101.7	
4:20	72	28	101.7	
4:25	72	28	101.2	

The weight of the tranquilized group and the control group are essentially the same (Table XVII). The weight drop in the control group on October 1, 1960 is due to cow 781 dying of bloat after breaking out of dry lot at night. The animals showed a gain in weight of one pound when comparing the weights of the eight animals on October 1, 1960 with the same eight animals on September 24, 1960. Essentially

Before Injection of Reserpine (Serpasil)



47 Minutes After Injection

Figure 4. Severe Bloat in Cow 781 Receiving .250 mg./100 Lbs. Body Weight of Reserpine (Serpasil)

there was no difference in weight between the control group and the tranquilized group receiving .033 mg. of reserpine (Serpasil) per 100 pounds of body weight.

TABLE XVII. AVERAGE BODY WEIGHTS OF ANIMALS RECEIVING RESERPINE (SERPASIL)

	9-12-60 Initial wt. lbs.	9-17-60 lbs.	9-24-60 lbs.	10-1-60 lbs.
Controls*	1132	1053	1066	1039***
Tranquilized**	1121	1072	1055	1102

*Nine animals on control
**Ten animals received .033 mg. of reserpine per 100 pounds of body weight
***Cow 781 died of bloat on September 28, 1960

The milk production as shown in Table XVIII, was the same in the control and tranquilized group. Bloating did not affect milk production to any degree because severely bloated cows were removed from the field and as pressure subsided rumination returned to normal. On September 28, 1960, cow 781 died of bloat after breaking into an alfalfa pasture at night. Thus the three remaining cows constituted the control group. Since the effect of tranquilizers on milk is not completely understood, and the effect of this milk on humans in unknown, the milk was discarded (13).

The occurrence and degree of bloat is shown in Table XIX. There were more instances of bloat in the tranquilized group at the beginning of the experiment with no bloat observed after the seventh

day. Incidence of bloat was scattered throughout the experiment in the control group. There were more cases of slight and severe bloat in the control group than the tranquilized group, but more with a marked degree of bloat in the tranquilized group than in the control group. Approximately the same number of cases of bloat in the control group as in the tranquilized group were noted.

TABLE XVIII. AVERAGE MILK PRODUCTION*

	Controls**			Tranquilized**		
Date	A.M.	P.M.	Total	A.M.	P.M.	Total
9-12-60	10.63	9.15	19.78	13.50	8.50	22.00
9-13-60	11.88	7.63	19.51	11.88	8.38	21.26
9-14-60	14.63	7.35	21.98	14.05	7.33	21.38
9-15-60	14.38	8.25	22.63	14.00	7.89	21.89
9-16-60	13.28	7.03	20.31	14.15	8.20	22.35
9-17-60	13.23	9.60	22.83	13.68	7.18	20.86
9-18-60	12.89	8.50	21.39	13.65	7.63	21.28
9-19-60	11.85	9.75	21.60	11.78	9.08	20.86
9-20-60	12.89	8.15	21.04	13.38	8.00	21.38
9-21-60	13.00	8.65	21.65	12.88	8.50	21.38
9-22-60	12.50	8.38	20.88	12.70	8.00	20.70
9-23-60	12.15	9.50	21.65	13.15	8.38	21.53
9-24-60	12.78	6.75***	19.53	13.38	6.25***	19.63
9-25-60	14.43	11.25	25.68	12.38	7.25	19.63
9-26-60	10.38	8.75	19.13	10.38***	9.00	19.38
9-27-60	12.13	7.90	20.03	13.00	7.50	20.50
9-28-60/	12.80	8.43	21.23	13.65	9.00	22.65
9-29-60	10.17	8.33	18.50	13.00	9.00	22.00
9-30-60	13.17	7.67	20.84	13.00	7.95	20.95
10-1-60	11.67	6.67	18.34	12.50	8.25	20.75
10-2-60	12.50	7.33	19.83	13.50	7.85	21.35
Ave.	12.54	8.34	20.87	13.03	8.05	21.13

*All readings are in pounds
**Four cows in each group
***One cow in heat
/Control cow 781 died of bloat during the night

Weather conditions have some effect on the incidence of bloat. A comparison of weather data (Table XX) to the incidence of bloat (Table XIX) shows that after a rain no bloat was recorded. It had rained on September 17, and 19, with no bloat recorded the following days. No bloat was recorded on September 21 when it rained periodically throughout the day. The following day only one incidence was recorded.

More bloat is recorded during high temperatures than lower temperatures. The warm temperatures induce rapid growth of alfalfa. This thick stand of alfalfa made possible rapid ingestion. The amount of gas formed depends upon the total feed consumed (20). Bloat can be produced because of the inability to expell the gas as rapidly as it is produced from the large intake of food.

TABLE XIX. OCCURRENCE AND DEGREE OF BLOAT OF NON-TRANQUILIZED AND TRANQUILIZED ANIMALS

	Controls					Tranquilized				
	Animals on	Animals	Degree of Bloat			Animals on	Animals	Degree of Bloat		
Date	Pasture	Bloated	Slight	Marked	Severe	Pasture	Bloated	Slight	Marked	Severe
9-12-60	9	-	-	-	-	10	-	-	-	-
9-13-60	9	1	-	1	-	10	4	-	3	1
9-14-60	9	-	-	-	-	10	2	1	1	-
9-15-60	9	4	-	3	1	10	3	1	2	-
9-16-60	9	4	4	-	-	10	3	-	3	-
9-17-60	9	4	2	-	2	10	4	2	2	-
9-18-60	9	-	-	-	-	10	-	-	-	-
9-19-60	9	2	2	-	-	10	1	1	-	-
9-20-60	9	-	-	-	-	10	-	-	-	-
9-21-60	9	-	-	-	-	10	-	-	-	-
9-22-60	9	1	-	1	-	10	-	-	-	-
9-23-60	9	-	-	-	-	10	-	-	-	-
9-24-60	9	-	-	-	-	10	-	-	-	-
9-25-60	9	1	1	-	-	10	-	-	-	-
9-26-60	9	1	1	-	-	10	-	-	-	-
9-27-60	9	-	-	-	-	10	-	-	-	-
9-28-60	8*	-	-	-	-	10	-	-	-	-
9-29-60	8	-	-	-	-	10	-	-	-	-
9-30-60	8	-	-	-	-	10	-	-	-	-
10-1-60	8	-	-	-	-	10	-	-	-	-
10-2-60	8	-	-	-	-	10	-	-	-	-
Totals	-	18	10	5	3	-	17	5	11	1

*Cow 781 died of bloat at night

TABLE XX. MAXIMUM AND MINIMUM TEMPERATURES, PRECIPITATION, AND WEATHER CONDITIONS

Date	Temperatures in °F.* Max.	Min.	Precip.*	Weather Conditions*	Additional Observations
9-12-60	63	37		Partly cloudy	Partly cloudy
9-13-60	73	40		Fair	Clear, warm
9-14-60	69	52		Fair	Clear, warm
9-15-60	76	48		Fair	Clear, warm
9-16-60	79	55		Partly cloudy	Cloudy, warm
9-17-60	80	50	.55	Partly cloudy	Cloudy, humid
9-18-60	61	49		Cloudy	Cloudy, cool
9-19-60	52	41	.42	Cloudy	Cloudy, cool
9-20-60	73	47		Clear	Rained previous night
9-21-60	86	59	.75	Raining	Rained periodically during day
9-22-60	62	43		Cloudy	Chilly
9-23-60	61	45	.10	Drizzle	Misty, raining, and chilly
9-24-60	54	49	.04	Cloudy	Cool
9-25-60	67	39		Clear	Clear, warm
9-26-60	70	50		Fair	Fair
9-27-60	68	35		Fair	Fair
9-28-60	67	42	.02	Partly cloudy	Fair
9-29-60	64	36		Cloudy	Rained previous night
9-30-60	60	39		Cloudy	Cool
10-1-60	54	44		Cloudy	Cool
10-2-60	68	34		Clear	Clear, warm

*Data obtained from Mr. A. A. McMillan, Volunteer Weather Observer, Brookings, South Dakota

SUMMARY AND CONCLUSIONS

A review of literature pertaining to the problems of bloat prevention and treatment indicated a new approach was necessary. A reduction in anxiety, tension, and nervousness during bloating was a possible solution. Tranquilizers which are relatively new compounds have a quieting effect. Reserpine (Serpasil) has been most extensively studied in the laboratory and in clinical use.

Reserpine exerts a sedative effect in dairy animals when injected daily intramuscularly at levels from .050 mg. to .300 mg. per 100 pounds of body weight. Side reactions resulted in distress as shown by heads being horizontal, eyes practically closed, tongues out, and foaming at the mouth. The animals lost their appetites, produced a rumbling sound when they were eating, and had frothy feces.

Evidence of depression was observed in one animal the fourth day after receiving .250 mg. of reserpine daily. The animal was weak on her hind legs and demonstrated ataxia. A dosage of .250 mg. and .300 mg. caused depression in some animals from 24 to 36 hours, but then disappeared and the animal returned to normal. At these high levels of residual effect of reserpine was observed.

A daily dosage of .300 mg. per 100 pounds of body weight was toxic in one case and the animal died after being down for 15 days.

Daily dosage levels of .050 mg. to .300 mg. increased rectal temperature but had no consistent effect on heart rate or respiration rate. Levels of .033 mg. had no effect on rectal temperatures, heart rate, or respiration rate.

Reserpine injected intramuscularly at .250 mg. per 100 pounds of body weight into bloated animals reduced tension, anxiety and nervousness, and increased eructation.

There was no effect on milk production when administered at a level of .033 mg. per 100 pounds of body weight.

Immediately following a rain the incidence of bloat was lowered. Days with high temperatures showed more bloat, which may be due to the luxuriant growth of alfalfa.

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