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LABORATORY REPORT NO. 327

COMPARISON OF THREE RATIONS IN MILITARY SCOUT DOGS UNDER MODERATE THERMAL STRESS

FT. BENNING FIELD STUDY

by

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PATHOLOGY DIVISION

SEPTEMBER 1971

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U. S. ARMY
MEDICAL RESEARCH &
NUTRITION LABORATORY

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To determine whether Standard Item dog foods (dry) would provide sufficient nutrients to permit military working dogs to maintain body weight and work efficiently in warm climates, 3 rations were compared in German Shepherd dogs undergoing Army Scout Dog Training at Ft. Benning, Ga., during July, Aug., and Sept., 1968. The rations were the two Standard Item dry dog foods and a specially-formulated dry ration (MSD).

Weight loss occurred in half of the dogs which completed 12 weeks of training. However, as a group, those dogs fed MSD gained weight while those fed the two Standard Item diets lost weight. At least 50 kcal. absorbed per pound of body weight/day were required to prevent weight loss.

MSD contains approximately 50% more calories as digestible energy, and each of its macronutrients (protein, fat, carbohydrate, dry matter) was 10-20% more digestible. Thus, not only does MSD contain more calories but its overall digestibility was 94%, compared with 80% for the Standard Item rations.

A ration having the palatability and nutrient characteristics of MSD is strongly recommended for military dogs.

Moderate to high ambient temperature (75-99°F) especially when combined with high relative humidities (95-75%) are poorly tolerated by dogs. In this study, effects ranged from death to milder forms of heat exhaustion. When even slightly overheated, many dogs were inattentive to instruction and were easily distracted (e.g., by shade). Nearly all dogs consumed less on the hottest days.

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SEPTEMBER 1971

Project Number: 3A062110A830 Biosensor Systems

Work Unit Number: 061 Nutritional Aspects of Military Dog Performance: Ft. Benning Field Study

COMPARISON OF THREE RATIONS IN MILITARY SCOUT DOGS UNDER MODERATE THERMAL STRESS FT. BENNING FIELD STUDY

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ABSTRACT

This study was to determine whether Standard Item dog foods (dry), purchased under Federal Specification, would provide sufficient calories to permit working military dogs to maintain weight and work efficiency. Many commanders and veterinarians caring for such dogs had reported loss of weight and insufficient stamina especially in warm, humid climates, e.g., S. E. Asia and Ft. Benning, Ga.

Sixty dogs from a dog class at the Scout Dog Training School, Ft. Benning, Ga., were arranged into groups of 20. One group was fed a specially formulated high calorie, highly-digestible dry ration, Military Stress Diet 198 (MSD); the other two groups each received one of the two Standard Item dry dog food products, one supplied by the Sturdy Dog Food Co., (Sturdy), one by Quaker Oats Co., (Gaines). The dogs were trained in the usual manner during a 12-week training cycle in July, August and September to maximize the effects of heat.

Information was sought in three general areas: food intake and weight performance, relative digestibility and nutrient value of the rations, and some effects of heat.

MSD was clearly superior to the Standard Item rations. The dogs ate less of it and gained weight while those on the other diets lost weight. MSD contained approximately 50% more calories per weight as digestible energy, and each of the components measured by proximate analysis (protein, fat, carbohydrates, ash, dry matter) was more digestible by 10-20%. Digestibility of MSD was 94% as compared to 80% for the other two diets.

A ration having the digestibility and caloric density of MSD is strongly recommended for standard procurement for military use, either for special situations or for routine use. Two pounds/day of the Gaines product would be required to provide caloric balance, but the dogs in this study ate only 1.7 lbs/day. The Sturdy product is not recommended for military use due to low acceptability by the dogs and low digestibility.

At least 50 kcal/lb of body weight/day must be absorbed under the conditions of this test for these dogs to maintain body weight.

Heat exhaustion among the dogs was evident, especially early in the training period. During road marches, approximately 10% of the animals were unable to maintain thermal equilibrium when the ambient temperatures were in the 80's and relative humidity 50-75%. The "working temperature" under these conditions for most dogs was 103-105F. Those dogs not equilibrating continued to increase body temperature above 106F; they became weak and ataxic, could not keep up and had to be rested and "wet down" to reduce their temperature. Occasional animals would collapse with temperature over 107F. One died, after achieving a temperature above 108F. Hyperthermia decreased the dogs' responsiveness to handlers and undoubtedly decreased training efficiency as well as scouting performance.

FOREWORD

Where applicable in conducting the research described in this report, the investigator(s) adhered to the "Guide for Laboratory Facilities and Care" as promulgated by the Committee on the Guide for Laboratory Animal Facilities and Care, of the Institute of Laboratory Animal Resources, National Academy of Sciences - National Research Council.

The authors are deeply indebted to MAJ John McCune, OIC, Scout Dog Det., 197th Infantry, and to COL George E. Ritter, OIC, Veterinary Det., Ft. Benning, Ga. The interest and enthusiastic support of these officers and their staffs were vital contributions to successful completion of this study. More tangibly they provided facilities, and when available, manpower, as well as advice and on-post liaison of innumerable kinds.

SP5 Edward Ellis did the work of two men throughout the study, as NCOIC and Chief Laboratory Technician for the field team. His resourcefulness, reliability, and cheerful manner made his contribution all the more remarkable.

The dog handlers, already hard pressed by their training program, were admirable in their patience with our intrusions. They were always cooperative and eager to help.

The Chemistry Division, USAMRNL, performed most of the chemical analyses reported, and Mrs. Pearl Van Natta, Administrative Division, USAMRNL, provided the statistical analyses. A special vote of thanks is due Mrs. Alda Jean Kuemmerlin, Administrative Division, and Mrs. Donna Lewis, Food Hygiene Division, for the many hours of typing entailed in drafting this report and its tables.

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BODY OF REPORT

Work Unit Number: 061 Nutritional Aspects of Military Dog Performance. Ft. Benning Field Study

INTRODUCTION

The value of dogs to military operations has been amply documented (1,2). In 1968 some 5000 dogs were in use by the U. S. Forces, and more were desired. The Department of Defense accepts dogs of the German Shepherd breed, recruited from the civilian-owned dog market. These animals reflect the collective characteristics, including defects, represented by the civilian dog population. Rigorous screening for acceptance as military dogs results in rejection of approximately 50% of the animals presented (3). The inadequacies of the current dog supply and the recognized potential of a superior detector dog prompted the development of a research program to produce dogs especially for military duty, with capabilities far beyond that of the present dogs. This research program was established as Project No. 3A025601A830 in Program Element 6.21.56.01A, line 17A, of The Army Surgeon General's RDTE Program FY 1968-1973. It includes selective canine breeding, behavioral evaluation and veterinary research, to produce a sensor dog having superior physical, sensory and behavioral characteristics.

Despite careful selection and training, and notwithstanding the recognized great value and utility of today's military dog, operational reports and individual observations indicated that substantial numbers of dogs did not perform at the levels anticipated (2,4). Commanders in the Republic of Viet Nam reported that the military dog lacked endurance when engaged in operations (1,2). Severe weight loss had also been seen (4). In CONUS, weight loss and lack of endurance have been observed in Army and Air Force dogs required to work in warm, humid climates. Veterinary officers caring for these dogs suspected that the cause was nutritional in origin and that the ration offered these dogs was of insufficient caloric density.

Current feeding practices for military dogs have evolved from experience. The basic rations fed are procured under Fed. Spec. NF 170e: Feed, Dry, for Dogs, and D 20692B: Dog Food, Canned. These specifications are based primarily on the 1962 National Research Council (NRC) publication No. 989, "Nutritional Requirements of Dogs." This publication is concerned with requirements for 15-30 lb., "normally active" dogs and is not directed toward requirements of larger (average approximately 70 lb.) military working dogs. Caloric requirements for military dogs have not been determined. ARADCOM Regulation No. 190-12, 2 September 1966, "Military Police ARADCOM Sentry Dog Program," Chapter 2, Section VI, paragraph 34a, states: "the normal ration is 2 lbs. of dry food and one pound of horsemeat with natural juices per day."

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The caloric density of dog food purchased for military use varies from 500 to 1600 Calories/lb. (1.1 to 3.5 kcal./gm). The lower figure represents the wet-type canned food. The dry foods in common use range from approximately 1200-1600 kcal./lb. The Federal Specification for dog food does not set limits for caloric density and permits a broad variety of ingredients. The uncertainty of optimal nutritional requirements for working military dogs combined with the spectrum of ingredients permissible under the specification provides very little assurance that these dogs are being offered proper rations.

Since the military dog is a valued operational asset, and more and better dogs are to be produced, the need for some definition of their specific nutritional requirements is obvious.

In man it is established that energy requirements are higher in a hot environment (5). The 1968 revision of the calorie allowances published by the NRC suggests that the food requirement be increased rather than decreased for men performing work at high temperatures (5,6). In one study it has been shown that an increase in temperature, with or without an increase in relative humidity, raises the caloric requirement of the military dog (7).

Whether standard dog rations are suitable to sustain operations in hot humid environments was questioned, with primary doubt about caloric density (4). Other probable factors which could limit endurance and maintenance of weight include intercurrent disease, dehydration, electrolyte depletion, and poor thermal acclimation.

In an earlier approach to this problem, the U. S. Air Force, working with a manufacturer of commercial dog food, had developed a special, calorie-dense experimental ration, Military Stress Diet 198 (MSD). Limited experience with this new product had led Air Force investigators to conclude that MSD should be made available as a standard item.

The present study was designed to compare two Standard Item dry-type dog foods, and MSD, in dogs undergoing normal training in a warm and humid environment. The U. S. Army Scout Dog Detachment at Ft. Benning, Georgia, was selected for the study since Scout dogs training there during summer consistently exhibited weight loss and marginal stamina.

The subjects in this study were dogs assigned to Class 1-69 at the Scout Dog Detachment and were to be trained during July, August and September 1968. The class was one in a continuing training program, 12 weeks per class, which produces "Scout Dog Teams" - a dog and its handler - which have trained together to detect enemy personnel or materiel, booby traps, and lost or wounded friendly personnel.

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Facilities and Typical Training Cycle

For the first two weeks, the dogs were housed in a permanent kennel area, in individual runs approximately 4'x10', containing a wooden dog house which is elevated some 18". The house provided shade both inside and beneath but there was no roof over the run. Individual runs were side-by-side, the common wall being concrete block for the lower 4 feet. Chain-link fence was used for the rest of the run. Two "banks" of 8 - 12 such runs faced each other across an 8 - 12 ft. corridor. The floor for the entire area was a concrete slab. Ample running water was available.

In 1968 there were five such kennels at Ft. Benning located in an open area containing several large trees. The kennels and concrete slabs were partially shaded but were very hot during afternoons.

Training during the first two weeks was conducted primarily in the kennel area, in an open field. Dogs were out as early as 0600 hrs. and were drilled in basic obedience ("come," "sit," "stay," etc.), with vocal and hand signals. This work was repetitious but not physically demanding and was performed as much as 5-6 hours per day with frequent breaks.

After the first two weeks dogs and men were moved to outdoor bivouac areas where men lived in pup tents and dogs were tethered nearby. The bivouac areas were wooded, with abundant shade. Dogs were tethered so they could not reach each other. The handlers constructed makeshift shelters for their dogs, using poles and shelter halves or ponchos, etc., as protection from rain. Specific scouting procedures were taught from such field bivouac areas for the remaining 10 weeks.

For the two weeks of basic obedience, and continuing through the first 2 or 3 weeks of "scouting procedures" in the field, the dogs and men underwent road marches of 2-5 miles, two or three per week to assist in physical conditioning of the dogs. Portions of each march were conducted at double time. The marches were the most strenuous facet of the training program (excluding brief activity in an obstacle course).

The "scouting procedures" field training was a series of repetitious patrols along routes prepared with a variety of "enemy" personnel and material. The dog was expected to sight, scent or hear the object and "alert" - (the alert is some physical change which the handler "reads.") The alert is different for each dog and often different in the same dog depending on the type and intensity of the stimulus. The handler attempts to learn to translate the alert into location and distance of the object, and, if possible, whether it is man or materiel.

Routes for these patrols comprised all manner of terrain and were varied regularly. The work was conducted at a slow walk and was not

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physically strenuous. Most training patrols utilized two dogs, on a route which ultimately returned to the point of origin. One team lead, scouting; the other brought up the rear, in reserve, and not scouting. At the midpoint of the route, the teams were exchanged, the second handler placed the leather "work" collar on his dog and the did the scouting for the return portion. (When not actually scouting, these dogs wear a "choke-chain" type collar). The entire patrol required 15-40 minutes, with each dog "working" half of it.

There were 6-15 dog teams per squad, dependent upon the class size and number of instructors. During the training patrols, the dogs not actually on patrol were held on leash at the point of origin of the route being scouted. A particular point was frequently the focus for several patrol routes, and once all teams had scouted the first route, they would scout the other routes. In this way, each dog team could "work" 2-4 routes per morning and afternoon, requiring some 30-60 minutes of actual "work" time. An equal time was spent in reserve on a patrol. The rest of the time, while waiting at the point of origin, was spent repeating basic obedience drill, grooming, and study of manuals by the dog handlers.

Certain consistent husbandry procedures were performed daily, whether in kennel or in the field. After his own breakfast, the handler emptied his dog's water pail and cleaned his dog's kennel (or stake-out area). After assembling his uniform and dog equipment for the day's activity, he reported with his dog to the assembly area for training. After work, one hour was devoted to grooming and resting the dog prior to feeding. The grooming and rest usually occurred between 1500 - 1600 hrs., and feeding was accomplished between 1600 - 1700 hrs. The feeding hour was occupied with mixing of feed and later with washing the feed pans, cleaning the kennel area for the day, and leaving the pail of drinking water full. The food was left before the dogs for 30 minutes during this hour. and uneaten food was removed at the end of the period.

The 9th week of training was devoted to night operations, so schedules were adjusted by approximately 12 hours. The last week (12th) included an Operational Readiness Test, and veterinary examination of the dogs for POR qualification.

The dog teams of Class 1-69 were being trained against a specific numerical requirement, and this study represented considerable imposition upon the already hard-pressed cadre as well as the students. Training of these dogs was a high-priority mission so this study was designed, upon consultation with members of the cadre, to minimize interference with training. Probably the largest concession to the training schedule was in offering a standard amount of food to each dog, the food measured volumetrically. It was not practical in the field to weigh each ration individually or to provide additional food free-choice when individual dogs ate all of the standard amount

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MATERIALS AND METHODS

1. DOGS

The class consisted of 86 dogs initially. They were German Shepherd phenotypes, 2-3 1/2 years old, ranging in weight from 55 - 89 pounds; 85% were males, the remainder neutered females. The dogs had been obtained through the dog procurement section of Lackland Air Force Base, San Antonio, Texas. After an "in-processing" period of a few weeks to a few months (depending upon presence or absence of minor medical or administrative delays), they were supplied to the Scout Dog Detachment in response to a standard requisition. Thus, the dogs had arrived at Ft. Benning after a short period of "service" in military facilities.

Sixty of the 86 dogs were selected by a table of random numbers for inclusion in this study. They were further alloted to one of 3 subgroups of 20, based on body weight; the distribution of individual weights in each subgroup was arranged to provide a representative sample with respect to weight (same mean, range and variance). All dogs were in good health at the beginning of the study and, particularly, none was obese.

Each dog in the class was paired with an enlisted handler-trainee. These men had recently completed their Basic Combat Training and the 12-week course was their Advanced Individual Training. In most cases the men had not volunteered to be Scout Dog handlers. The dog and handler constitute a "dog team," and once paired they normally remain together during training and subsequent duty. Should one of the pair be disqualified for some reason, the other would be paired with a new "teammate" and undergo training again as a team.

2. DOG FOOD

Three rations were used, each fed exclusively to one of the three groups of 20 dogs. One was the special formula, "Military Stress Diet 198" (MSD), produced by Hill Packing Co., Topeka, Kansas. The other two were the currently available standard item Dry Dog Food products being procured under Fed. Spec. NF 170e, one made by Sturdy Dog Food Co. (Sturdy) and the other by Quaker Oats Co. (Gaines).

A sufficient quantity of these rations to supply the entire study was procured at one time. The Sturdy and Gaines were supplied directly from the Atlanta General Depot, and each product came from a single lot. The MSD was provided by the manufacturer as a single lot. Packaging and packing were similar, commercial domestic pack, 50 lb. multivall bag.

3. MEASUREMENT OF BODY WEIGHT

The dogs were weighed weekly on a trailer-mounted Ferguson-Banks Stock Scale which was "calibrated" prior to each use with a 5 lb. test

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weight. The scale beam was calibrated in full pounds. (The dog handlers usually record weight of dogs, food, etc. in Aviordupois so this system was used.)

4. MEASUREMENT OF FOOD CONSUMPTION

The dogs were offered a fixed amount of their respective ration each day: 1.9 lbs. each for those in the MSD Group, 2.2 lbs. each for the other two groups. As a practical procedure in the field, each dog's daily ration was determined volumetrically with a previously-tared measuring cup.

Daily food consumption was determined for each dog by deducting the weight of food not consumed from the standard amount offered. The food was available to the dogs for 30 minutes. The dog handlers were asked to pick up any uneaten food which was spilled and return it for weighing. Model Y-5 Precision Balances, dial type, calibrated in ounces, were used for weighing food (and feces).

There were several sources of error in the determination of food consumption. First, food was offered in fixed amount and therefore the upper limit for consumption was fixed. Second, there was undoubtedly some variation in the "standard" amount offered, and lastly the uneaten portions may not have been returned completely if some were spilled, or the weight included bits of leaves, dirt and twigs added to that which was picked up. In each of these instances, the errors were judged to be small in magnitude compared to the heterogeneity of the group and the individual variations in food intake.

5. HEMATOLOGY AND SERUM CHEMISTRY

Samples of venous blood were obtained weekly from each dog. Blood was drawn prior to beginning the day's work (0600 - 0800) and in many cases after the work day as well. Those specimens for packed cell volume and differential count were preserved with EDTA and refrigerated (ice chest in the field) until the laboratory analyses were completed several hours later in the laboratory of Martin Army Hospital, Ft. Benning. For chemical analysis, the blood was centrifuged immediately (generator-driven centrifuge in the field) and the serum frozen on dry ice as soon as it was separated and labelled. These specimens were then mailed to Chemistry Division, USAMRNL, for analyses.

6. INTESTINAL PARASITES

Each dog was examined initially and monthly for intestinal parasites by standard centrifugation of a suspension of feces.

7. BALANCE STUDY

At the end of the 12-week training cycle, 4 dogs from each diet group, selected randomly, were placed in individual steel metabolism cages and

a balance study was performed for a period of five days. A marker of red carmine dye was fed to each dog with the last meal prior to initiation of the study. Food intake for the next 5 daily meals was measured as during the preceding weeks, and all feces produced after those colored by the marker were collected. A similar marker was fed with the fifth meal and indicated the last feces to be collected. Urine was collected and preserved. The dogs remained in the cages 24 hours per day.

A similar "pilot" study had been performed a month previously, using 2 dogs on each ration. These 6 dogs were not part of Class 1-69 and were not in training at the time.

8. ANALYSIS OF FOOD, FECES AND URINE

Each of the 3 rations was sampled monthly; a 400-gm composite sample of each was frozen and analyzed for protein, fat, moisture, carbohydrate by difference, total energy (bomb calorimetry), Na, K, Ca, and P.

For the balance studies, feces were collected at least twice daily, each dog's output placed in individual plastic bags, weighed and frozen immediately. At the end of the 5 - day feeding period the feces for each dog were thawed, combined with distilled water (2 parts water and 1 part feces by weight), and mixed, using an electric blender. Aliquots of 100 grams each were then frozen and sent to MRNL for proximate analysis and bomb calorimetry. All the dogs fed MSD had mushy, unformed stools; their frequency of defecation was not increased.

Urine was collected quantitatively, measured, acidified to pH 2.0 with HCl, and frozen. Aliquots of 100 ml were sent to MRNL for determination of nitrogen, Na, P, Cl.

9. ESTIMATION OF WATER CONSUMPTION

The dogs' sources of water included a 10-quart steel bucket in the kennel run (or accessible to the tethered dog in the field), an extra canteen carried by the handler, and "fast-running" streams. Each handler was provided a small notebook in which to record his dog's water consumption each day. Water from streams was to be offered in the canteen cup.

Relative hydration of the dogs was also estimated from their clinical appearance, serum refractive index, and packed-cell volume.

10. BODY TEMPERATURE

The dogs' temperature was recorded under various conditions using clinical rectal thermometers. Squad leaders and dog handlers were provided with thermometers and instructed in their use. The investigators

used similar thermometers, as well as a Yellow Springs temperature meter coupled to a rectal probe by 5 meters of light wire, enabling continuous monitoring of body temperature of individual dogs during road marches.

A small telemetry set, constructed by Biocon, Inc., Culver City, California, and consisting essentially of a portable 2-channel (stereo) cassette tape recorder and miniature transmitters for temperature and heart rate (actually EKG), was used on some dogs but was not available early enough for extensive use. The small transmitters were attached to a light harness about the dogs' chest, with bipolar EKG electrodes pasted to the sternal midline, and a rectal probe inserted. A 12" antenna was secured to the harness. Inexpensive individual FM receivers picked up the transmitter output as an audible "whine," with frequency proportional to temperature on one, and to heart rate, on the other. Range was at least 100 meters. The receivers were coupled by cable to the stereo recorder, one signal into each channel. For analysis, the audible taped signal was "demodulated" (modulated by the transmitter) by special devices which were built into the recorder's speakers, one for each channel. The taped signal could thus be displayed on an oscilloscope or used to drive a meter or chart writer after the display mode had been calibrated.

11. AMBIENT TEMPERATURE AND HUMIDITY

Hourly temperature and relative humidity were provided by the 16th Weather Squadron, Det. 10(MAC), Ft. Benning. Their readings were made at a point near the post airfield. Investigators compared those values with temperatures taken in the field at the site of training and found the differences to be negligible.

12. CHEMICAL ANALYSES

a. Automated analyses were performed for many of the determinations, using an Autoanalyzer® (Technicon, Tarrytown, N. Y. 10591) and methods adapted by the manufacturer. Total protein (8), glucose (9), urea nitrogen (10) cholesterol (11), sodium (12), potassium (13), calcium (14), phosphorous (15), and chloride (16), were determined in this way.

b. Proximate analyses were performed by standard methods (17).

c. The Paar Oxygen Bomb was used for calorimetry.

d. Total lipids were determined by a turbidimetric method (18).

All specimens were received frozen and stored until the end of the study. When all specimens of a given kind had been received, they were analyzed in a single "run," minimizing day-to-day variation.

RESULTS AND DISCUSSION

1. FOOD ANALYSIS

Analyses of the three rations are compared in Table 1. Composite samples were taken from the stock remaining toward the end of each month, hence 3 values for each ration. The monthly variation in specific analyses for each ration reflects sample variation and the reproducibility of the tests but probably not time-dependent change.

The analyses reveal the Sturdy and Gaines products to be quite similar in content. MSD contains approximately three times as much fat, some 60% as much carbohydrate, slightly more moisture and less ash. It contains about 19% more calories. According to the manufacturer the fiber content is low.

2. ATTRITION OF DOGS FROM THE TEST

The weights of the 60 dogs at the beginning of the study varied considerably. To minimize the effect of initial weight, dogs were alloted to each subgroup of 20 so each subgroup would be similar to the others with respect to body weight of the dogs. Considerable scatter in the data on food consumption and weight performance was anticipated. Twenty dogs per group was the largest number which could be managed by the investigators.

One factor not anticipated was continual attrition of test dogs from the groups. Attrition began on the 3rd day and continued at a fairly uniform rate through the 70th day! Each group was affected approximately equally; of the original 20 each, the MSD group finished with 10 dogs, the other two with 8 each. The rate of loss from each group is plotted in Fig. 1.

Unless specifically stated otherwise, all results of this study are dicussed with reference to only those dogs which completed the study. The data on the animals which were dropped from training prior to completion of the study serve to reinforce the conclusions, however, since they are essentially similar.

Nearly all the dogs which "dropped out" did so because of administrative or medical actions involving their handlers, resulting in loss of training time and forcing the team to be "recycled" with a subsequent class. An occasional dog was judged to be progressing too slowly to keep pace with the class and thus was recycled; occasional ones were hospitalized with fight wounds and had to be recycled.

3. FOOD CONSUMPTION

The amount of food eaten by each dog was tabulated for 80 of the 84 days of the study. On three of the days, heavy rain at meal time precluded

accurate weighing of uneaten portions, and the initial day's values were invalidated by a change in the method by which each ration was measured.

Daily food consumption was erratic for all rations throughout the study, most dogs tending to follow individual cycles of eating more and then less. Of all meals offered during the 80 days of the study, only 23% were consumed completely. Weekly food consumption by each dog is listed in Tables 2-4A, and the total eaten per week by each diet group is summarized in Table 5. Included in Table 6 is the total eaten by each dog over the entire 80 days. In each of these tabulations it is obvious that the group eating the Gaines product consumed more (1.73 lbs/meal) than did those on Sturdy and MSD (1.48 and 1.40 lbs/meal). These numbers are overall means compiled by the dogs which completed 12 weeks (80 days) on the respective rations.

Mean food consumption per meal for each group was compared by analysis of variance, followed by the Neuman-Keuls procedure (19). The average food consumption per meal was significantly greater at the 95% level for Gaines than for either Sturdy or MSD; there was no difference between the latter.

The erratic eating pattern of many of the dogs was somewhat of a surprise. A minority of them, perhaps 20%, consistently ate approximately the same amount daily. Most, however, were unpredictable. On particularly hot and humid days, few dogs ate their "customary" amount.

To examine the relation between food consumption by individual dogs, and the weather, single and multiple correlation coefficients were determined among the following, for each day: food eaten, average temperature and humidity for the 24 hr. period (hourly readings), maximum temperature for the day, maximum humidity for the day, average temperature during the working day (0600-1800 hr.), average humidity during the same period, temperature at feeding time, and humidity at feeding time. The procedure confirmed that there were statistically significant correlations between amount consumed and the various temperatures, often to the 99% level. The causative implications of this correlation are necessarily conjectural since nearly every day was hot, and certainly other factors influenced food consumption.

Fig. 2 is a schematic profile of temperature and humidity experienced at Ft. Benning during the study. One important point which it contains is the seemingly ill-chosen time for feeding the dogs - - - often the hottest portion of the day! The training schedule is restrictive, of course, and the time selected must be compatible with many facets of the entire program

4. WEIGHT PERFORMANCE

The body weight of each dog is listed in Tables 7A-7C for each week of the study, and in Table 6 are the mean weight of each dog (average of all weighings) and the net change in weight for each dog which completed 12 weeks.

Change in body weight was the datum of principal interest, but its analysis is confounded by the small number of dogs which completed the study, by the heterogeneity of their initial weights, and by the large difference in mean initial weight between the Gaines group and the other two groups. This latter difference is significant at the 95% level.

Inspection of Table 6 reveals an obvious trend despite the aforementioned complications. most of the MSD group gained weight during the study while most of the dogs in both other groups lost weight.

To determine whether the size of the dog (particularly of the Gaines group) may have influenced subsequent weight performance, the mean weight of each (over the entire study) was plotted against the dog's change in weight (final weight minus initial weight). There was no evidence of regression on mean weights, supporting the thesis that the smaller dogs were not necessarily more likely to lose weight than gain.

There was a large variation in pounds gained or lost among individuals even within each group. Nevertheless, the mean change in weight was positive (3.7 lbs.) only for the MSD group; it was negative for the Sturdy group (-1.6 lbs.) and for the Gaines group (-2.19 lbs.). A one-way analysis of variance showed these mean changes to be different ($P < .01$). The Neuman-Keuls procedure confirmed that it was the MSD group which was different (larger) at the 99% level; the other two groups were not statistically different from each other.

5. BALANCE STUDY

Two separate studies were performed in which net nutrient intake was compared with fecal excretion to obtain an approximation of the relative digestibility of the three rations. Urinary excretion was to be included but occasional contamination of collected urine by feces invalidated that portion of the study.

A pilot study was conducted 14-18 August, using 2 dogs on each ration; these dogs were not from Class 1-69, but were dogs awaiting assignment to a class. They were place on the test rations for 7 days prior

to the 5 days during which food intake and fecal output were measured. This portion of the test was to be a trial run to develop feeding and cleaning procedures which would be compatible with the facilities and staff available and the temperment of the dogs.

The data resulting from the pilot run were so similar to those of the later definitive one on the dogs from Class 1-69 that they are included, without further comment, as the "A" addendum to Tables 8 - 10.

After completion of the training cycle the dogs of Class 1-69 were returned from the field to the kennel area for one week while the handlers were given leave, prior to movement of the teams to their respective duty assignments. During 5 days of this period (24-28 September 1968) 4 dogs from each diet group were confined to metabolism cages and their feces were collected. In Table 8 are listed the total quantities of food eaten and feces produced by each of the 12 dogs.

There was large variation in amount of food consumed, even within groups, as there was throughout the entire 80 days.

There was also large variation in amount of feces produced. Most marked, however, is the relatively small amount of feces produced by those dogs on MSD, especially in relation to the weight of food consumed.

Table 9 contains the result of bomb colorimetry and proximate alysis of feces. Feces from dogs eating MSD were slightly higher in protein and fat and lower in carbohydrate than feces from dogs eating the other rations.

Digestibility of the three rations was estimated using the quantity consumed and feces produced by each dog (Table 8), the feces analysis from Table 9, and the September food analysis from Table 1. The percent retained of each component was calculated, and expressed as a digestibility coefficient in Table 10. Here the MSD emerges as considerably better utilized than the other two rations: some 93% of the energy is utilized, as opposed to approximately 80% for the others, 88% versus 79% for protein, etc.

6. CALORIC INTAKE

The mean value (digestibility coefficient) for each ration, as determined by the four dogs in each group, was used to calculate calories absorbed by all dogs in the respective groups (amount eaten x kcal/lb of food x % absorbed). The number of calories absorbed by each dog per day is listed in Table 6. This number, divided

by the dog's mean body weight, yields an estimate of each dog's approximate caloric intake per pound of body weight. The mean weight (average of all weekly weighings) and the calories absorbed/pound of body weight are also listed in Table 6.

The dogs absorbed some 51 kcalories per pound of body weight from MSD, 45 from Gaines and only 34 from Sturdy. The dogs absorbing 51 kcal/lb of body weight experienced weight gains (3.7 lb/dog) while both 45 kcal/lb and 34 kcal/lb resulted in weight losses. The difference in weight was highly significant, statistically, as seen in the section on Weight Performance.

Comparing mean calories absorbed/lb of mean body weight, an analysis of variance followed by the Neuman-Keuls procedure showed the 34 kcal absorbed/lb of Sturdy to be significantly lower ($P<.01$) than either the 45 from Gaines or the 51 from MSD. There is no difference between the latter.

Qualitatively, the dogs on MSD appeared in better condition also. This impression was conveyed primarily by their sleek, shiny haircoats while the other dogs' coats tended to be dull and dry. The difference most probably resulted from the large difference in intake of fat.

7. CLINICAL LABORATORY DATA

Biweekly levels of serum constituents for each dog completing the study are tabulated in Tables 11-21. These data were analyzed to detect differences among diet groups, among weeks of training (changes with time), and, for some, between specimens obtained before work (AM) and after work (PM). The data were subjected to analysis of variance and to the Tukey test of means (19).

A. Results: The levels of serum constituents are described individually below: the following conclusions emerge:

1. Dogs fed MSD had significantly higher ($P<.001$) total serum lipids than dogs fed Sturdy or Gaines (Table 20), as well as elevated serum cholesterol. Table 21 and Figures 3 and 4.

2. There was no significant difference ($P=.05$) attributable to diet in serum sodium, potassium, chloride, calcium, phosphorous, total protein, urea nitrogen, and glucose (Tables 11-18), or in packed cell volume Table 21.

3 There was a striking and seemingly paradoxical "time-of-day" effect on packed cell volume (pcv): the PM values for each dog were usually lower than the respective AM values. The mean PM values were significantly lower (P .05). Table 21.

4. There was a similar significant "time-of-day" effect on urea nitrogen (BUN), the PM mean being significantly lower than the AM mean. Table 17.

5. There was no consistent pattern of change with time in any of the parameters, no "training effect." There were weeks when the mean for one or another parameter was significantly different ($P < .05$) from its mean on other weeks but these variations were without apparent pattern and remain unexplained. All the values were within biologically normal range.

B. Individual Serum Constituents

1. Sodium (Table 11). Range 139-165 mg/100 ml, grand mean 147 ±6.1 mg/100 ml. There is no difference among the means of the diet groups or among individual dogs. The mean for all dogs for the initial value (Week 0) and for Week 4 is significantly greater than that for Weeks 6, 8, 10, 12: that for Week 2 is greater than for Week 6.

2. Potassium (Table 12). Range 4.0-6.7 mg/100 ml, grand mean 5.0 ±.54 mg/100 ml. Statistically there were no differences in these values except the mean for all dogs for Week 12 was significantly lower than that for Weeks 2, 4, 6, at $P < .05$

3. Chloride (Table 13). Range 110-138 mg/100 ml, grand mean 121.7 ±5.5 mg/100 ml. The only significant variations in chloride level occurred between the mean for all dogs on Week 4 (greater than Weeks 12, 10, 8 and 6) and Week 2 (greater than Week 10 and Week 12).

4. Calcium (Table 14). Range 7.8-13.0 mg/100 ml, grand mean 10.4 ±.73 mg/100 ml. The mean for all dogs for Week 2 was greater than that for Week 0 (initial value), Week 6 and Week 12, and Week 4 was greater than Week 6.

5. Phosphorous (Table 15). Range 2.7-8.0 mg/100 ml, grand mean 4.6 ±.96 mg/100 ml. Again the only significant differences were between means for all dogs, for various weeks: the initial value (Week 0) was lower than each of the succeeding weeks, except it was not different from the final week (Week 12); the Week 2 mean was greater than each of the other Weeks' mean.

6. Total Protein (Table 16). Range 4.5-8.2 gm/100 ml, grand mean 6.43 ±.57 gm/100 ml. There were no differences in serum protein among the dogs except the mean for Week 4 was greater than that for Weeks 8, 10 and 12.

It is of interest to note that the mean value for a number of these serum consituents was significantly elevated in the Week

2 specimen, leading to the suspicion that dehydration of the dogs may have been a factor that day (despite the blood's being drawn in the early morning, prior to the start of the work day). However, serum protein was not elevated in the Week 2 specimens, a strong indication that some other explanation is required for the elevated Week 2 electrolyte levels.

7. Blood Urea Nitrogen (actually, plasma urea nitrogen). Table 17. Range 10-43 mg/100 ml, grand mean 19.9 ±6.7 mg/100 ml.

There was no difference in BUN among dogs fed different diets, i.e., no "diet effect." But analysis of these BUN data reflect the futility in attempting to identify all sources of variation. The statistical techniques are sensitive and precise; the numbers manipulated are resultants of indeterminable interactions. In this case, while there was no overall "diet effect," the following significant differences among weekly means emerged: The Week 2 mean for MSD-fed dogs was higher than the Week 2 Gaines, the Week 6 MSD, Sturdy and Gaines, and the Week 8 MSD and Sturdy. The Week 10 mean for dogs fed Gaines was significantly higher than the Week 6 mean for dogs fed Sturdy. To further confuse the question, there were numerically significant differences between AM and PM levels, for 2 weeks: on Week 8, the AM mean for all dogs is significantly higher ($P < .05$) than the PM mean, and for Week 10 the opposite is the case! Taken individually, the AM and PM levels don't differ for the other weeks, but when all AM values are compared to all PM values, the AM values are significantly higher. As with the other blood chemistry, distinguishing fact from artefact in these sporadic oscillations of individual values is not possible in this study.

8. Glucose (Table 18). Range 59-129 mg/100 ml, overall mean 86.6 ±11.2 mg/100 ml.

There was no overall diet effect on glucose level, no weekly effect, and no interaction between weeks and diet. There was no overall time-of-day effect or interaction between diet and time-of-day. When means for all dogs were compared for Weeks 2, 6, 8, 10 (Weeks 0, 4, 12 incomplete), the AM mean for Week 2 is significantly higher than the PM mean, and Week 10 is the opposite. The PM mean for Week 10 is also significantly higher than the Week 2 or Week 6 PM mean.

9. Cholesterol (Table 19). Range 111-324 mg/100 ml, grand mean 195.6 ±11.0 mg/100 ml. For analyses, only 5 dogs in each of the MSD and Sturdy groups had complete data (AM and PM), and they for only four of the weeks. These results showed no significant differences between the diet groups, among the four weeks or between the AM and PM means. However, selection of only these data for statistical analyses apparently prejudiced the real diet effect.

When all the data in Table 19 were considered, the dogs fed MSD clearly had higher serum cholesterol levels than did those fed the Sturdy or Gaines ration. The range most frequently observed in the latter groups of dogs was 160-179 mg %, while the peak frequency for the MSD-fed dogs occurred in the 200-219 mg % range. The frequency distribution of the observed values is plotted in Figure 3. These data reveal only 3% of the values for the MSD group to be below 220 mg %, while Sturdy and Gaines-fed dogs had 90% and 93%, respectively, below 220 mg %.

In Figure 4A are plotted mean serum cholesterol values for each diet group as a function of time. The initial value for each of the 3 groups is similar, clustered around 170 mg %. (Refer to Table 19 for precise values and number of observations per mean. Only AM values were plotted in Figure 4A.) By the end of two weeks, however, there is a great increase in serum cholesterol in the MSD group and this differential persists for the length of the study.

10. Total Lipids (Table 20) Range 433-1070 mg/100 ml, grand mean 677.18 ±110.2 mg/100 ml

For comparison, there were complete data for 7 dogs from each group, including AM and PM values for 3 weeks. There was a clearly significant difference among the diet groups ($P < .001$); the Neuman-Keuls procedure revealed that the MSD mean was significantly greater than those of the two other diet groups. The latter were not different from each other. There was no difference among the 3 weeks or between the 2 times of day. Mean serum lipid values for each group are plotted in Figure 4B as a function of time (the plotted data derive from AM values, Table 20). As with the cholesterol data, there is an early and persistent increase in total serum lipid level in the dogs fed MSD. (Plasma or serum from dogs fed MSD was always opalescent to heavily turbid, even when taken in the AM, some 15 hours after the most recent meal.) The long-term effects of lipemia and cholesterolemia of this degree deserve some consideration.

11. Packed Cell Volume (Table 21). Range 36-56%, grand mean 45.08 ±3.7%

Analysis of PCV was performed on values from 8 dogs per group, for 5 weeks, AM and PM. The results showed significant differences among the means of the weeks (Week 10 greater than Week 4 or 6, $P < .05$) and between the times of the day, AM greater than PM. The differences among the means of the diet groups were not significant.

The weekly differences are inexplicable; the daily difference, which was consistent and apparent during the field work, was not anticipated.

NOT REPRODUCIBLE

Since AM specimens were taken prior to work, and PM samples were taken immediately after work, some hemoconcentration in PM blood might have been expected. Speculation as to cause of the seeming AM hemoconcentration would include splenic disgorgement of RBC's in the excitement incident to preparation for the day's work, and by evening maximal volemia as a consequence of the day's physical and thermal stress. Certainly there was no hemoconcentration in the PM.

8. EFFECTS OF ENVIRONMENTAL TEMPERATURE (HEAT)

The physical dispersion of the group of dogs being studied, and the several types of terrain being traveled simultaneously by the different squads comprising Class 1-69, made it impossible to observe closely all of the dogs under all conditions. Rectal temperatures of the dogs were taken by handlers on many occasions, especially during road marches, and by the investigators as often as possible, using mercury clinical thermometers.

Dogs which showed signs of tiring were brought to the investigators' attention. These dogs were observed more closely during road marches and scouting procedures, and their rectal temperatures were monitored with a Yellow Springs probe and meter equipped with a 15 ft. lead.

Because this aspect of the study was relatively unstructured, the results are presented as general conclusions in narrative form. Approximately 30 temperatures were recorded daily, perhaps half representing multiple readings in several dogs.

Rectal temperatures of dogs at rest were found to range from 100-103F (38-40C) with most between 101-102F (approximately 39C). Temperatures tended to be lower when taken by the dog's own handler in a quiet environment than when the dog was presented to one of the investigators and restrained.

Rectal temperatures for most dogs during work ranged from 101 to 105F, varying considerably because of such variables as the pace of work, the terrain, availability of shade, and the ambient temperature and humidity. On hotter and more humid days (as dogs' temperatues tended to increase past approximately 102-103F) the dogs showed heightened interest in shade, and a disinclination to spontaneous physical activity.

On road marches, the dogs achieving temperatures of 104-105F did so within one hour on several occasions, and maintained this temperature for the remaining hour or so of the march. Most dogs did not exceed 104F. The dogs with rectal temperatures 104-105F still appeared strong and alert.

A small percentage of dogs (10% in initial few road marches) achieved rectal temperatures of 105F (40.5C) in less than an hour and continued to increase their hyperthermia. It was these dogs which weakened, staggered and collapsed with temperatures of 106-108F (41-42C). With one exception, they made satisfactory recoveries after treatment. Treatment usually consisted of immersion in the nearest stream, or failing that, soaking with whatever water was available, and rest in shade. Certain of the dogs were more susceptible and weakened early on most marches, with higher temperatures than their classmates.

During the course of this study, it was not possible to determine whether these susceptible dogs had some objective characteristic which would identify them as heat sensitive. It should be possible to devise a performance test and to establish acceptable limits of performance under defined conditions of thermal stress.

One dog, not in the ration group, succumbed to heat exhaustion after driving the Yellow Springs meter to 108F (42C), its maximum position.

Figures 1 & 2 depict generally the ambient temperature and humidity during the study, representing all of July and August and the first week of September. Wind speed data are absent but the wind was usually less than 5 knots.

Figure 1 reflects the more common situation, relatively clear weather, which tended to be uncomfortably hot: on most of these days the relative humidity (RH) during working hours (0600 - 1800) was not excessive. These conditions prevailed approximately 70-75% of the days.

Figure 2 represents the other common weather pattern, encountered on overcast and/or rainy days: there were 15 of these during the study period. On these days, excessive humidity complicated the uncomfortably high temperatures, resulting in important heat hazard. These days produced most of the heat "casualties" among the dogs. (Such days occurred between 9 - 12 July and again around the 19th, early in the training period, and therefore before acclimation was complete. On the 19th, 7 of 51 dogs were treated for heat exhaustion during a road march, the largest number for any day. Average temperature for the period 0700 - 1600 that day was 81F, average RH was 69%.)

It was obvious that environmental heat and humidity had a deleterious effect on the dogs. Not only did extreme cases become casualties during road marches, but many dogs, with body temperatures in "working range," e.g., 103-105F, performed poorly during scouting procedures. The dogs

were listless and inattentive despite the handlers' best efforts. On numerous occasions, attempts by the dog to seek shade were "misread" as an "alert" by the handler.

A limited amount of data are available on canine performance in hot environments (20-24). These data show unmistakably that dogs do not tolerate heat well and would predict that ambient conditions such as those encountered in this study pose significant challenge to the dog's thermal equilibrium. While the conditions were not life-threatening to most dogs, the dogs' basic responses to thermal stress were put in motion and the dogs consequently tend to avoid physical exertion, attempt to avoid direct sunlight, and most pant at rapid rates, sacrificing some body water (but very little sodium chloride) in the process.

Since preservation of thermal equilibrium is so basic a physiologic drive in homotherms, it is understandable that this behavior may supersede the dogs' newly-acquired scouting skills or their attention to training, i.e., as they encounter heat stress, their performance necessarily deteriorates.

The data presented in refs. 20-24 were reiterated by us (25):

a. Dogs do not tolerate heat as well as people do. Dogs are incapacitated by conditions that man can tolerate.

b. Humidity is a very important factor (more so than in humans) and becomes limiting at higher ambient temperatures.

c. Dogs can acclimate to heat to some degree.

d. Once the dog is acclimated, very little can be done to further improve his performance in hot environments.

e. Replenishment of body water at frequent intervals (e.g., hourly) probably is the most potent procedure in maintaining endurance.

f. The importance of electrolyte supplements in the management of heat exhaustion (and its prophylaxis) has not been established.

g. In hot environments, the rate of heat dissipation appears to be the limiting factor in the dog's ability to maintain thermal equilibrium.

h. In hot environments heat dissipation is almost exclusively evaporative cooling via panting over moist oropharyngeal mucosa.

The following examples from the literature convey some of the limitations of the canine species in thermal stress:

a. (Ref. 20) A resting dog was confined in an environment of 110F, 65% RH. After 2 hours its rectal temperature had increased from 100.5F to 105.0F and after 3 hours, to 107F.

b. (Ref. 22) Dogs at rest in 100F, 90% RH had their rectal temperature increase from 101F to 104F after 2-1/2 hours.

c. (Ref. 23) Dogs were run at 3.6 mph, 17° incline in temperate environment of 76F, 53% RH. Running endurance was a function of heat dissipation. Some ran for 2 hrs., having developed rectal temperatures of 104-105F after only 30 minutes, and maintained that temperature; others developed rectal temperatures of 107-108F after 30-60 minutes and had to be stopped. How quickly these incapacitating temperatures would be reached in temperatures above 85F and 50% RH is conjectural.

These examples and the cited references do not define the limits of the dog's ability to work in hot environments. Until such information is available, it is prudent to recognize that performance will be compromised by heat, and when military operations are unavoidable, the dogs must be given every advantage possible. Crucial among these would appear to be frequent access to drinking water, unrestricted airway and oropharyngeal mucosa, and gradual exposure to the hot working conditions.

A question frequently asked by the cadre and handlers was whether clipping the dogs' hair would be beneficial. Clipping would expose the skin to sunburn and other trauma, and very little thermal benefit would be derived from this procedure. The resting dog's pulse rate (and body temperature, and metabolic requirements) increase above normal at about 95F if RH is 75%, and at 105F when humidity is 25% (9). But dogs' skin temperature is 94F normally. At ambient temperatures above this level, no heat can be lost into the environment by radiation (and the dog doesn't sweat to evaporate moisture from his skin except for small areas on footpads and nose). At ambient temperatures below 94F, bare skin would radiate some heat out into the environment, but the quantitative benefit would be minimal unless there was a substantial difference between skin temperature and air temperature. If there were, the air temperature would be sufficiently low that heat stress would not be a problem (e.g., below about 70F).

At ambient temperatures approaching 90F (which virtually exclude loss of heat by radiation from skin), the dog's heat dissipating mechanism is restricted to panting warm air (body temperature) over very wet oropharyngeal mucosa, evaporating that moisture and thus

cooling the mucosa to that degree. As ambient [illegible] increases, evaporative efficiency decreases, heat loss [illegible], and panting becomes faster and faster.

The dog is very resistant to respiratory alkalosis and can tolerate rapid and wide excursions of blood pH and pCO_2 (24). But ultimately alkalosis will follow hyperventilation, leading to weakness and collapse.

Intuitively, one would expect a chronically heat-stressed dog to suffer loss of appetite, and this may well underlie the weight loss observed under these conditions. The present study did not include temperate-climate controls for amount of food eaten, to evaluate this. Within the temperature ranges experienced, however, food consumption was correlated (inversely) to a significant degree with environmental temperature.

CONCLUSIONS

1. Moderate to high ambient temperature, especially when combined with high to even moderate relative humidity, is poorly tolerated by dogs. Under the conditions of this study, effects ranged from death due to heat exhaustion to milder forms of heat exhaustion. When even slightly overheated, many dogs were inattentive to instruction and easily distracted (e.g., by shade).

2. Weight loss (approximately 3% of starting weight) occurred in half the dogs which completed 12 weeks of training. Under conditions of this study, it was not possible to correlate efficacy of training with weight performance.

3. The group of dogs fed MSD gained weight, while those fed Standard Item rations lost weight.

4. MSD contains approximately 50% more calories as digestible energy, and all of the macronutrients (protein, fat, carbohydrate and dry matter) were more digestible by 10-20%. Not only does MSD contain more calories, but overall digestibility was 94%, compared to 80% for the Standard Item diets.

5. Under the conditions of this study, at least 50 kcal <u>absorbed</u> per pound of body weight per day were required to prevent weight loss.

6. A diet having the palatability and nutritional characteristics of MSD is strongly recommended as a diet for military dogs. Its high digestibility and relatively concentrated form provide greater

assurance that dogs will receive adequate nutrition when nutritional requirements are high (strenuous work) or when appetite is diminished for any reason.

7. The Sturdy Dog Food product cannot be recommended as an adequate ration for military dogs due to its low digestibility and relatively poor palatability to the dogs.

8. To the extent compatible with military requirements, training and other operations involving dogs should be planned with cognizance that dogs do not tolerate heat as well as humans. Opportunity for the dogs to acclimate by gradual exposure should be provided; ample drinking water should be available frequently; muzzles, choke chains and other impedements to unrestricted panting should be minimized; and housing and rest areas should be selected to take advantage of shade.

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TABLE 1

Food Analysis, Gm/100 Gm*

Ration	Date	Protein	Fat	Carbohydrate	Moist.	Ash	Kcal/100 Gm	Na*	K*	Ca*	P*
MSD	July	28.60	24.88	31.97	9.49	5.06	542.1	353	934	796	658
	Aug	28.80	23.70	31.66	10.80	5.04	531.0	343	909	841	671
	Sept	27.58	24.39	33.25	9.62	5.16	538.4	312	966	822	694
	mean	28.33	24.32	32.29	9.97	5.09	537.2	336	936	820	674
STURDY	July	28.40	8.41	48.63	7.12	7.44	444.9	343	1163	1218	1280
	Aug	28.18	7.73	46.81	9.68	7.66	428.4	278	1154	1062	1230
	Sept	28.15	7.78	48.56	7.97	7.54	431.0	349	1044	1187	1230
	mean	28.24	7.97	48.00	8.26	7.55	434.8	323	1120	1156	1247
GAINES	July	25.98	8.30	52.37	6.73	6.62	439.9	536	899	1209	1132
	Aug	26.84	8.07	50.38	7.23	7.48	438.9	540	878	1261	1191
	Sept	26.03	7.60	51.17	8.76	6.44	424.7	503	852	1041	1080
	mean	26.29	7.99	51.31	7.57	6.85	434.5	530	876	1170	1134

* Na, K, Ca and P are in mg/100 Gm

TABLE 2

Food Consumption Per Dog (lbs/wk)
Dogs Completing 12 weeks - MSD *

Dog No.	4	8	13	19	24	29	32	42	55	56
Week 1 **										
No. Meals	4	4	4	4	4	4	3	4	4	4
Total lbs.	7.91	9.35	8.48	9.16	9.35	9.35	5.67	9.35	9.35	9.35
Week 2										
No. Meals	7	7	7	7	7	7	7	7	7	7
Total lbs.	10.40	12.95	12.85	12.95	8.07	12.95	9.68	12.95	11.67	11.33
Week 3										
No. Meals	7	7	7	7	7	7	7	7	7	7
Total lbs.	7.05	11.98	7.23	11.53	5.99	9.96	5.47	10.29	3.80	9.16
Week 4										
No. Meals	7	7	7	7	7	7	7	7	7	7
Total lbs.	11.15	11.15	10.18	13.09	10.18	13.09	8.67	10.86	7.11	11.48
Week 5										
No. Meals	7	7	7	7	7	7	7	7	7	7
Total lbs.	10.41	10.41	9.64	11.66	10.15	12.15	11.72	12.40	5.98	9.60
Week 6										
No. Meals	7	7	7	7	7	7	7	7	7	7
Total lbs.	10.22	10.22	11.15	11.59	6.92	12.72	9.78	10.97	8.98	11.21
Week 7										
No. Meals	7	7	7	7	7	7	7	7	7	7
Total lbs.	10.46	10.46	10.79	8.73	9.93	13.09	11.27	11.10	6.65	10.23

* Maximum possible for 7 day week = 13.3 lbs.
** Values exceeding 1.9 lb/meal (MSD) or 2.2 lb/meal (Gaines) result from incompletely standardized feeding procedure during initial few days.

TABLE 2 - Food Consumption Per Dog (lbs/wk) - Dogs Completing 12 weeks - MSD * (Continued)

Week 8										
No. Meals	7	7	7	7	7	7	7	6	7	7
Total lbs.	9.10	9.10	9.64	11.85	10.12	13.09	8.75	10.04	9.83	10.87
Week 9										
No. Meals	7	7	7	6	7	7	7	7	7	7
Total lbs.	10.30	10.30	12.62	6.98	7.61	12.10	10.69	7.50	8.85	[illegible].06
Week 10										
No. Meals	7	7	7	6	7	7	7	7	7	7
Total lbs.	11.11	11.11	10.13	9.94	10.16	11.61	10.26	10.45	10.45	11.07
Week 11										
No. Meals	7	7	7	7	6	7	7	7	7	7
Total lbs.	10.85	8.85	10.52	11.03	8.73	13.09	10.22	11.22	11.22	9.73
Week 12										
No. Meals	6	6	6	6	6	6	6	6	6	6
Total lbs.	9.23	9.23	7.05	8.91	7.29	11.22	9.23	7.84	7.84	7.79

* Maximum possible for 7 day week = 13.3 lbs.

TABLE 2A

Food Consumption Per Dog (lbs/wk)
Dogs Not Completing 12 weeks - MSD

Dog No.	9	16	36	38	40	50	51	52	59
Week 1 *									
No. Meals	4	4	4	3	4	4	3	4	3
Total lbs.	9.35	5.78	9.35	7.17	9.35	7.06	3.57	8.54	5.68
Week 2									
No. Meals	7	7	5	6	7	7	6	5	7
Total lbs.	12.95	5.28	8.48	6.93	12.95	7.33	6.37	8.78	7.75
Week 3									
No. Meals	7	7	7	7		7		7	7
Total lbs.	13.09	4.04	6.91	5.82		5.43		7.23	8.17
Week 4									
No. Meals	7	7	7	7		7		7	7
Total lbs.	13.09	6.66	10.80	11.97		7.08		9.36	6.51
Week 5									
No. Meals	7		7			7			
Total lbs.	11.28		9.97			4.86			
Week 6									
No. Meals			7			7			
Total lbs.			9.66			8.89			
Week 7									
No. Meals			7			7			
Total lbs.			8.18			6.17			
Week 8									
No. Meals			7			7			
Total lbs.			10.07			9.81			
Week 9									
No. Meals			7			7			
Total lbs.			11.27			8.56			
Week 10									
No. Meals			7						
Total lbs.			8.13						

* Values exceeding 1.9 lb/meal (MSD) or 2.2 lb/meal (Gaines) result from incompletely standardized feeding procedure during initial few days.

TABLE 3
Food Consumption Per Dog (lbs/wk)
Dogs Completing 12 weeks - STURDY *

Dog No.	2	10	15	18	22	46	47	58
**Week 1 **								
No. Meals	3	3	3	3	3	3	4	3
Total lbs.	3.75	2.56	3.29	6.41	5.12	3.16	6.41	5.36
Week 2								
No. Meals	7	7	7	7	7	7	6	7
Total lbs.	9.35	8.57	8.00	12.23	9.87	8.09	8.64	7.44
Week 3								
No. Meals	7	7	7	7	7	6	7	7
Total lbs.	11.19	7.77	9.38	10.26	11.95	24	8.24	6.40
Week 4								
No. Meals	7	7	7	7	7	7	7	7
Total lbs.	8.31	11.35	10.78	9.67	13.14	7.45	12.99	8.74
Week 5								
No. Meals	7	7	7	7	7	5	7	7
Total lbs.	6.68	12.09	11.95	11.00	14.03	4.98	11.11	8.80
Week 6								
No. Meals	7	7	7	7	7	7	7	7
Total lbs.	11.05	9.68	10.97	11.47	12.36	7.09	8.05	7.55
Week 7								
No. Meals	7	7	7	7	7	4	7	7
Total lbs.	12.07	9.88	9.54	12.27	13.13	6.56	7.93	9.24
Week 8								
No. Meals	7	7	7	7	7	7	7	7
Total lbs.	11.12	11.51	13.83	11.76	13.92	8.67	11.73	9.13
Week 9								
No. Meals	7	7	7	7	7	7	7	7
Total lbs.	10.64	11.76	12.71	13.42	14.46	7.52	6.50	7.98
Week 10								
No. Meals	7	7	7	7	7	6	7	7
Total lbs.	8.64	10.11	11.47	10.33	11.50	4.68	10.60	7.22
Week 11								
No. Meals	7	7	7	7	7	7	7	7
Total lbs.	12.61	12.75	14.06	13.48	14.25	9.03	12.35	9.23
Week 12								
No. Meals	6	6	6	6	6	6	6	6
Total lbs.	7.63	11.22	12.36	11.01	12.36	8.24	11.51	6.37

* Maximum possible for 7 day week = 15.4 lbs.

** Values exceeding 1.9 lb/meal (MSD) or 2.2 lb/meal (Gaines) result from incomplete standardized feeding procedure during initial few days.

TABLE 3A

Food Consumption Per Dog (lbs/wk)
Dogs Not Completing 12 weeks - STURDY

Dog No.	1	25	26	28	30	31	39	48	53	54	60
Week 1*											
No. Meals	3	2	2	4	4	3	3	4	3	3	3
Total lbs.	3.33	3.11	3.16	4.54	10.32	2.98	4.97	6.65	3.95	3.79	5.75
Week 2											
No. Meals	7	7		7		7	7	6	7	7	7
Total lbs.	8.69	7.92		10.64		13.02	6.62	7.62	6.13	11.83	12.71
Week 3											
No. Meals	7	7		7		7	7		7	7	
Total lbs.	6.83	6.61		9.21		8.17	7.79		4.74	11.48	
Week 4											
No. Meals	7	7		7		7	7		7	7	
Total lbs.	8.61	8.56		10.61		10.69	10.16		6.62	11.86	
Week 5											
No. Meals	7			7		7	7			7	
Total lbs.	14.42			11.07		12.31	10.61			13.04	
Week 6											
No. Meals				7		7	7			7	
Total lbs.				10.87		12.48	11.72			12.35	
Week 7											
No. Meals				6		7	7			6	
Total lbs.				9.92		13.39	10.81			12.36	
Week 8											
No. Meals						7	7				
Total lbs.						13.29	13.33				
Week 9											
No. Meals						7	7				
Total lbs.						14.42	11.43				
Week 10											
No. Meals							7				
Tc lbs.							12.74				

* Values exceeding 1.9 lb/meal (MSD) or 2.2 lb/meal (Gaines) result from incompletely standardized feeding procedure during initial few days.

TABLE 4

Food Consumption Per Dog (lbs/wk)
Dogs Completing 12 weeks - GAINES *

Dog No.	7	14	21	27	35	37	45	57
Week 1 **								
No. Meals	3	3	4	3	3	3	3	4
Total lbs.	4.48	5.41	10.09	6.49	5.59	6.34	6.38	12.31
Week 2								
No. Meals	7	7	7	7	7	7	7	7
Total lbs.	5.75	10.22	13.89	11.67	11.26	11.17	10.02	14.42
Week 3								
No. Meals	7	7	7	7	7	7	7	7
Total lbs.	5.05	9.36	13.29	9.96	10.23	9.97	6.34	12.85
Week 4								
No. Meals	7	7	7	7	7	7	7	7
Total lbs.	5.52	9.36	14.42	12.72	11.40	13.61	9.64	14.42
Week 5								
No. Meals	7	7	7	7	7	7	7	7
Total lbs.	5.80	10.23	14.42	12.19	13.78	12.47	10.84	14.42
Week 6								
No. Meals	7	6	7	7	7	7	7	7
Total lbs.	5.86	8.63	14.42	11.20	13.85	11.47	9.65	14.42
Week 7								
No. Meals	7	7	7	7	7	7	6	7
Total lbs.	9.17	11.73	14.42	11.46	12.48	11.21	9.03	8.84
Week 8								
No. Meals	7	7	7	7	6	7	7	7
Total lbs.	9.37	12.50	13.55	11.38	11.06	12.01	11.16	14.42
Week 9								
No. Meals	7	7	7	7	7	7	7	6
Total lbs.	9.83	9.87	14.42	11.87	12.72	13.22	11.89	12.36
Week 10								
No. Meals	7	7	7	7	7	6	7	7
Total lbs.	11.05	12.13	14.42	13.46	12.82	11.35	12.22	14.42
Week 11								
No. Meals	7	6	6	7	7	7	7	7
Total lbs.	10.79	10.93	12.36	13.96	13.74	14.14	11.07	13.84
Week 12								
No. Meals	6	6	6	6	6	6	6	6
Total lbs.	9.37	10.55	12.23	11.01	11.16	12.08	11.15	12.36

* Maximum possible for 7 day week = 15.4 lbs.
** Values exceeding 1.9 lb/meal (MSD) or 2.2 lb/meal (Gaines) result from incompletely standardized feeding procedure during initial few days.

TABLE 4A

Food Consumption Per Dog (lbs/wk)
Dogs Not Completing 12 weeks - GAINES

Dog No.	3	5	6	12	17	23	33	34	43	44	49
Week 1 *											
No. Meals	3	3	3	3	3	3	4	2	3	3	3
Total lbs.	4.68	7.77	6.85	5.00	4.44	6.66	9.21	6.87	6.90	6.75	7.00
Week 2											
No. Meal	4	7	7	7	7	7	7	7	7	6	
Total lbs.	6.40	13.82	12.74	9.79	8.20	10.29	12.64	11.86	12.23	10.36	
Week 3											
No. Meals			7	7	7	6	7	7	7	7	
Total lbs.			13.8	8.11	7.99	7.04	12.75	12.46	11.75	5.24	
Week 4											
No. Meal			7	7	7	7	7	7	7		
Total lbs.			11.12	9.29	11.32	9.67	13.38	13.90	13.15		
Week 5											
No. Meals			7	7		7		7	7		
Total lbs.			11.61	9.53		10.18		14.05	13.28		
Week 6											
No. Meal				7							
Total lbs.				10.11							
Week 7											
No. Meals				7							
Total lbs.				12.81							
Week 8											
No. Meals				7							
Total lbs.				10.69							
Week 9											
No. Meals				7							
Total lbs.				12.68							

* Values exceeding 1.9 lb/meal (MSD) or 2.2 lb/meal (Gaines) result from incompletely standardized feeding procedure during initial few days.

TABLE 5

Food Consumption Per Group
All Dogs - Weekly Totals

Week	1 *	2	3	4	5	6	7	8	9	10	11	12
MSD Incomplete												
lbs. eaten	66.12	76.82	50.69	65.47	26.11	18.55	14.35	19.88	19.83	8.13		
No. Meals	33	57	49	49	20	14	14	14	14	5		
lb/meal	2.00	1.35	1.03	1.34	1.31	1.33	1.03	1.42	1.42	1.62		
MSD - 12 weeks												
lbs. eaten	87.32	115.80	82.16	104.68	101.55	101.47	98.48	103.34	96.55	103.78	103.09	85.90
No. Meals	39	70	70	70	70	70	70	69	69	69	69	60
lb/meal	2.24	1.65	1.18	1.49	1.45	1.45	1.41	1.50	1.40	1.50	1.49	1.43
STURDY Incomplete												
lbs. eaten	52.55	85.18	54.83	67.20	61.45	47.42	46.48	26.62	25.85	12.74		
No. Meals	34	62	49	49	35	28	26	14	14	7		
lb/meal	1.55	1.37	1.12	1.37	1.76	1.69	1.79	1.90	1.85	1.82		
STURDY 12 Weeks												
lbs. eaten	36.06	72.21	69.13	82.43	80.64	78.22	80.62	91.17	84.95	74.55	97.76	80.70
No. Meals	26	55	55	56	54	56	53	56	56	55	56	48
lb/meal	1.39	1.31	1.26	1.47	1.49	1.40	1.52	1.63	1.52	1.36	1.75	1.68
GAINES Incomplete												
lbs. eaten	72.13	102.57	78.52	81.83	45.37	23.39	14.81	10.69	12.68			
No. Meals	33	66	55	49	28	14	7	7	7			
lb/meal	2.19	1.55	1.43	1.67	1.62	1.67	2.12	1.53	1.81			
GAINES 12 Weeks												
lbs. eaten	57.09	88.40	77.55	91.36	94.15	89.50	88.34	95.45	96.18	101.87	100.83	89.91
No. Meals	26	56	56	56	56	55	55	55	55	55	54	48
lb/meal	2.20	1.58	1.38	1.63	1.68	1.63	1.61	1.74	1.75	1.85	1.87	1.87

* Values exceeding 1.9 lb/meal (MSD) or 2.2 lb/meal (Gaines) result from incompletely standardized feeding procedure during initial few days.

TABLE 6

Summary of Food Intake and Body Weight
Dogs Completing 80 Days

Ration Group; Dog Number	Body Wgt.[1] lbs. $\bar{x}$	Food Eaten Total lbs.	No. Meals Eaten	lbs/meal $\bar{x}$	Kcal absorbed[2] per day	Kcal absorbed[2] per lb.[3]	Body Wgt. Δ lbs.[4]
MSD							
4	60.6	101.18	80	1.26	2882	47.6	+ 8.0
8	77.0	125.11	80	1.56	3568	46.3	+ 9.0
13	62.0	120.28	80	1.50	3431	55.3	- 1.0
19	69.4	127.42	78	1.63	3728	53.7	+ 10.0
24	57.7	104.50	79	1.32	3119	54.1	+ 3.0
29	66.2	144.42	80	1.81	4139	62.7	+ 1.0
32	57.3	111.41	79	1.41	3225	56.3	+ 3.0
42	77.9	125.48	79	1.59	3636	46.7	- 1.0
55	75.8	101.73	80	1.27	2904	38.3	- 1.0
56	72.4	122.88	80	1.55	3545	49.0	+ 7.0
mean	(67.6)			(1.49)	(3418)	(51.0)	(+ 3.7)
STURDY							
2	81.8	113.06	79	1.43	2236	29.3	- 1.0
10	66.5	119.25	79	1.51	2362	35.5	- 10.5
15	69.6	127.84	79	1.62	2533	36.4	- 1.0
18	73.5	133.31	80	1.66	2596	35.3	0
22	65.7	146.05	79	1.85	2893	44.0	+ 4.0
46	56.2	79.71	72	1.11	1736	30.1	- 2.0
47	71.0	116.06	79	1.47	2299	32.4	0
58	62.5	93.18	79	1.18	1846	29.5	- 4.0
mean	(68.4)			(1.48)	(2312)	(33.8)	(- 1.6)
GAINES							
7	53.5	90.04	79	1.17	1872	35.0	- 4.5
14	62.5	121.19	79	1.57	2512	40.2	- 5.5
21	71.2	161.93	79	2.05	3280	46.1	- 2.0
27	56.6	137.37	79	1.74	2784	49.2	+ 1.0
35	57.1	140.09	78	1.80	2880	50.4	- 1.0
37	58.7	139.04	78	1.78	2848	48.5	0
45	56.2	119.39	78	1.53	2448	43.6	- 3.0
57	63.9	159.08	79	2.01	3216	50.3	0
mean	(59.9)			(1.73)	(2730)	(45.4)	(- 2.[illegible]9)

[1] mean of weekly weights throughout study

[2] calculated from mean digestibility coefficient for Kcal (Table 10) and mean caloric content of ration (Table 1)

[3] mean body weight

[4] difference between initial and final weight

TABLE 7A

Weekly Body Wgt. (lbs) Individual Dogs - MSD

Week	0	1	2	3	4	5	6	7	8	9	10	11	12	^
Dog Number														
4	55		58	63	64	61	58	58.5	60.5	62	63	61	63	60.6
8	74	74	74	76	77	77	76.5	78.5	79	78	79	75	83	77
13	62	60	61	61	63	62	61	63	59	62	64.5	62.5	61.5	[illegible]
19	63	65	68	74	71	71	70	70	73	65.5	68	70.5	73	69.4
24	57	57	58	56	57	57	56	60.5	58	56	59	59	60	57.7
29	70	65	64.5	63	62	62.5	65	70	66.5	66.5	66.5	67.5	70.5	66.2
32	58	55	55.5	54	54	57.5	55	58.5	59	58	60.5	58.5	61	57.3
42	79	75	78	78	77	79	77.5	80	78	77	78.5	77	78	77.9
55	79	77	79.5	76	74	73	72	73	74.5	74.5	77.5	77.5	77.5	75.8
56	69	70	67.5	73.5	73	70	69	73.5	73	75	74	75.5	75.5	72.4
$\bar{x}$	66.6												70.2	67.0

TABLE 7B

Weekly Body Wgt. (lbs) Individual Dogs - STURDY

Week / Dog Number	0	1	2	3	4	5	6	7	8	9	10	11	12	$\bar{x}$
2	83	82	83	83	82	76.5	72	84	83.5	83	85	83.5	84	81.0
10	77	69	65	66	67	66	64	66.5	66.5	65	60	65	66.5	66.5
15	75	71	67	69	69	68.5	67	70.5	67.5	69	69	69	74	69.5
18	73	77	74	73	72	72.5	69.5	76	72.5	73	74	75	73	73.5
22	65	65	64	66	65	65.5	65	65.5	66	65	65.5	67.5	69	65.7
46	59	60	55	58	55	56.5	55	56.5	54.5	54.5	55.5	53.5	57	56.2
47	71	74	67.5	69	73	69.5	77.5	71.5	71	68	70.5	70.5	70.5	71.0
58	66	61	62	69	63	63	60	62.5	61.5	59.5	62	60.5	62	62.5
$\bar{x}$	71.1												69.5	68.4

TABLE 7C

Weekly Body Wgt. (lbs) Individual Dogs - GAINES

Week	0	1	2	3	4	5	6	7	8	9	10	11	12	$\bar{x}$
Dog Number														
7	58	57	55	54.5	53	51	49	54	52.5	51	53.5	53	53.5	53.5
14	69	66	64	65	63	62.5	60.5	63.5	60	57.5	60	57.5	63.5	62.3
21	72	73	71	74	70	69	67.5	73	67.5	70.5	76.5	71.5	70	71.[illegible]
27	57	57	55	57	56	54.5	55	58	55	57.5	58	57.5	58	56.6
35	60	57	56	59	55	56	56	59.5	56	58	57.5	53	59	57.1
37	61	60	58	59	58	57	58	61.5	56	55	60	58	59	58.[illegible]
45	61	58	55	56	55	56.5	54	57	54	55.5	56	54	58	56.2
57	66	65	63	64	62	63	62	64	63	63	64	66	65.5	63.9
$\bar{x}$	64.0												61.1	59.9

TABLE 8

Indidivual Quantities of Food Consumed & Feces Produced
Balance Study 24-28 Sept 68

Ration; Dog No.	Food Eaten, Gm	Feces, Gm
MSD		
4	3137.1	894.9
8	2456.1	835.9
24	2569.6	908.0
29	4540.0	2457.3
mean	3175.7	1273.7
± 1 s.d.	± 957.0	± 789.6
STURDY		
2	1838.7	2111.7
18	2846.6	2765.5
46	2070.2	1916.4
58	2728.5	2524.2
mean	2371.0	2329.5
± 1 s.d.	± 492.5	± 385.6
GAINES		
14	3632.0	3091.7
21	4322.1	4767.0
27	3450.4	2965.2
57	4540.0	4367.5
mean	3986.1	3797.9
± 1 s.d.	± 526.6	± 904.7

TABLE 8A

Individual Quantities of Food Consumed & Feces Produced
Balance Study 14-18 Aug 68

Ration; Dog No.		Food Eaten, Gm	Feces, Gm
MSD			
	23M9	2812.2	939.8
	8M26	4408.3	1847.8
mean		3610.3	1393.8
STURDY			
	05M3	3205.2	2783.0
	6M22	4540.0	5316.3
mean		3872.6	4049.6
GAINES			
	M424	4426.5	4326.6
	7M19	4408.3	4512.7
mean		4417.9	4419.6

TABLE 9

Feces Analysis (Gm/100 Gm) Individual Dogs
Balance Study 24-28 Sept 68

Ration Group; Dog Number	Energy (Kcal/100 Gm)	Protein	Fat	Carbo-hydrate	Ash	Dry Matter	Moisture
MSD							
4	113.1	11.2	2.88	10.95	6.03	31.06	68.9[illegible]
8	75.3	8.1	1.56	7.35	3.99	22.41	77.59
29	100.8	8.8	1.44	11.91	5.40	27.55	72.4[illegible]
29	75.0	8.6	1.62	5.76	2.82	18.80	81.2[illegible]
mean	91.0	9.2	1.88	8.84	4.56	24.95	75.[illegible]
STURDY							
2	90.6	7.2	1.26	12.00	4.81	25.17	74.83
18	89.4	7.3	1.44	10.24	4.26	23.27	[illegible]
46	85.5	5.7	1.65	11.37	4.95	23.59	76.43
58	95.1	6.8	1.50	10.53	4.35	23.17	76.83
mean	90.1	6.8	1.46	11.04	4.58	23.79	76.21
GAINES							
14	72.6	5.2	1.59	11.88	3.72	22.39	77.6[illegible]
21	77.7	5.0	1.62	10.23	3.37	20.16	7[illegible].84
27	104.1	6.6	1.86	13.65	4.20	26.31	7[illegible]
57	89.4	5.4	1.35	12.60	3.81	23.20	76.84
mean	85.9	5.6	1.61	12.09	3.77	23.00	77.0[illegible]

TABLE 9A

Feces Analysis (Gm/100 Gm) Individual Dogs
Balance Study 14-18 Aug 68

Ration Group; Dog Number	Energy (Kcal/100Gm)	Protein	Fat	Carbo-hydrate	Ash	Dry Matter	Moisture
MSD							
23M9	110.1	9.0	2.19	12.87	6.45	37.51	69.49
8M26	112.5	7.8	3.99	10.05	4.98	26.32	73.18
mean	111.3	8.4	3.09	11.46	5.72	28.66	71.34
STURDY							
05M3	94.5	8.2	1.83	9.72	4.26	23.97	76.03
6M22	73.5	7.8	1.59	7.92	3.86	19.32	8[illegible]
mean	84.0	7.6	1.71	8.51	3.81	21.64	78.36
GAINES							
M424	87.0	5.7	2.22	10.86	3.81	22.54	77.44
7M19	86.1	6.3	1.68	11.70	4.26	23.94	76.06
mean	86.5	6.0	1.95	11.28	4.04	23.25	76.75

TABLE 10

Digestibility Coefficients (%) Individual Dogs
Balance Study 24-28 Sept 68

Ration Group; Dog Number	Kcal	Protein	Fat	Carbo-hydrate	Ash	Dry Matter
MSD						
4	94.01	88.42	96.63	90.61	66.67	90.29
8	95.24	90.01	97.82	92.48	73.68	91.56
24	93.38	88.73	97.92	87.34	63.02	87.24
29	92.46	83.12	96.41	90.62	70.42	85.06
mean	93.77	87.77	97.20	90.26	68.44	89.02
± 1 s.d.	± 1.17	± 3.05	± 0.79	± 2.13	± 1.30	± 2.80
STURDY						
2	75.86	70.63	81.40	71.62	28.26	68.59
18	79.85	75.81	82.02	79.51	45.11	75.43
46	81.64	91.26	80.37	78.33	39.23	76.27
58	79.59	77.65	82.16	79.94	46.26	76.09
mean	79.24	78.84	81.49	77.35	39.72	74.10
± 1 s.d.	± 2.43	± 8.80	± 0.81	± 3.88	± 8.23	± 3.69
GAINES						
14	85.45	83.00	82.19	80.24	50.83	79.23
21	79.82	78.81	79.49	77.95	42.97	75.77
27	78.95	78.21	78.97	77.07	43.95	75.36
57	79.75	80.05	82.91	76.31	43.09	75.72
mean	80.99	80.02	80.89	77.89	45.21	76.52
± 1 s.d.	± 3.00	± 2.13	± 1.96	± 1.70	± 3.77	± 1.82

TABLE 10A

Digestibility Coefficients (%), Individual Dogs
Balance Study 14-18 Aug 68

Ration Group; Dog Number	Kcal	Protein	Fat	Carbo-hydrate	Ash	Dry Matter
MSD						
23M9	93.07	89.56	96.92	86.41	57.23	88.5[illegible]
8M26	91.12	88.65	92.94	86.69	58.58	87.4[illegible]
mean	92.10	89.11	94.93	86.55	57.91	87.9[illegible]
± 1 s.d.	± 1.38	± 0.64	± 2.81	± 0.20	± 0.95	± 0.83
STURDY						
05M3	80.85	74.74	79.44	81.97	51.71	76[illegible]
6M22	79.91	70.50	75.91	81.76	48.63	73.[illegible]
mean	80.38	72.62	77.68	81.86	50.17	75.93
± 1 s.d.	± 0.44	± 2.30	± 2.50	± 1.56	± 2.18	± 1.42
GAINES						
M424	80.62	79.25	73.11	78.93	50.21	76.[illegible]
7M19	79.92	75.97	75.26	77.08	41.69	73.[illegible]
mean	80.27	77.61	74.19	78.00	45.95	74.9[illegible]
	± 0.50	± 2.3	± 1.52	± 1.30	± 6.02	± 1.8[illegible]

TABLE 11

Serum Sodium Level (mg/100 ml)

Ration Group; Dog Number	Week 0	2	4	6	8	10	12
MSD							
4	153	140	139	142	145	146	145
8	158	144	152	141	151	150	149
13	154	144	155	151	149	148	145
19	154	152	153	147	146	149	156
24	152	140	145	144	144	140	145
29	149	145	146	142	145	145	142
32	153	142	147	132	149	148	145
42	148	162	145	146	-	145	144
55	149	160	149	150	140	140	144
56	147	146	164	144	140	141	145
mean	151	147	149	143	145	145	146
STURDY							
2	159	138	152	127	150	154	145
10	153	140	176	140	145	151	145
15	152	153	140	142	148	145	144
18	153	151	147	143	145	148	149
22	153	160	152	141	145	146	145
46	149	149	143	142	145	150	145
47	151	165	145	144	145	148	145
58	148	144	164	139	144	141	145
mean	152	150	152	139	145	147	145
GAINES							
7	152	139	149	139	145	146	144
14	153	157	160	143	150	149	144
21	150	152	143	139	142	144	142
27	152	151	142	144	144	141	141
35	152	152	148	154	149	151	146
37	147	157	150	140	145	146	142
45	148	143	156	141	145	149	145
57	150	145	152	137	140	140	149
mean	150	149	150	142	145	145	144

Grand mean $\pm$ 1 s.d. = 147 $\pm$ 6.1

TABLE 12

Serum Potassium Level (mg/100 ml)

Ration Group; Dog Number	Week 0	2	4	6	8	10	12
MSD							
4	5.1	4.9	5.8	5.1	5.1	5.1	4.1
8	4.9	4.7	4.6	5.1	4.1	5.0	4.6
13	5.5	4.6	5.1	5.2	4.6	5.1	4.9
19	5.1	5.1	5.1	5.5	5.1	5.1	4.5
24	4.9	5.3	5.0	5.2	4.9	5.0	4.8
29	5.0	5.0	4.8	4.8	5.1	5.1	4.5
32	5.3	5.2	5.2	4.9	4.6	5.4	5.0
42	5.2	6.2	5.6		5.1	5.4	4.6
55	5.2	5.9	5.5	5.6	5.5	5.2	5.0
56	5.4	5.1	4.9	5.2	4.5	5.2	5.2
mean	5.2	4.7	4.7	5.2	4.8	5.2	4.7
STURDY							
2	5.0	5.5	5.8	5.4	5.2	5.2	4.4
10	5.2	4.4	5.2	5.3	5.1	4.6	4.6
15	5.0	5.4	5.0	5.3	5.1	5.0	4.9
18	5.1	5.1	6.7	5.4	5.4	5.0	5.0
22	5.3	5.7	5.9	5.4	5.1	5.2	4.8
46	4.9	5.0	5.5	5.0	5.0	5.0	4.5
47	4.7	5.6	5.3	5.3	4.8	5.1	4.8
58	4.8	5.1	4.8	5.1	4.9	4.4	4.6
mean	5.0	5.2	5.5	5.3	5.1	4.9	4.7
GAINES							
7	4.9	4.7	5.2	4.8	4.4	5.0	4.5
14	5.7	5.7	5.9	5.3	5.4	5.4	5.0
21	4.5	5.0	5.5	5.6	5.1	4.0	5.5
27	5.1	5.1	5.3	5.4	5.0	5.2	4.5
35	5.0	5.3	5.0	5.4	5.1	5.1	4.4
37	5.2	5.9	4.6	5.1	4.6	4.8	4.6
45	5.3	5.1	5.4	5.3	4.9	5.2	4.9
57	5.4	5.0	4.9	5.1	5.5	4.8	4.5
mean	5.1	5.2	5.2	5.2	5.0	4.9	4.7

Grand mean $\pm$ 1 s.d. = 5.0 $\pm$ 0.54

TABLE 13

Serum Chloride Level (mg/100 ml)

Ration Group; Dog Number	Week 0	2	4	6	8	10	12
MSD							
4	137	134	125	117	119	117	117
8	107	120	119	118	118	119	120
13	112	129	129	135	120	120	121
19	121	125	126	118	118	123	134
24	121	114		118	119	120	118
29	125	119	119	120	124	125	116
32		121	123	121	121	122	
42	108	128	120		123	121	117
55	118	128	116	123	116	119	115
56	120	116	129	118	122	119	115
mean	118	123	122	120	120	120	119
STURDY							
2	115	124	126	119	117	115	118
10	122	127	121	118	118	119	119
15	126	129	124	121	118	114	
18	126	118	120	117	122	115	120
22	115	115	133	126	120	118	118
46		135	128	118	122	114	116
47		120	125	118	118	119	118
58	110	123	130	119	123	116	114
mean	119	123	126	119	119	116	117
GAINES							
7	129	122	123	116	113	110	116
14	109	119	123	121	121	114	120
21	138	129	124	127	119	119	122
27	118	124		118	118	112	117
35	114	122	130	120	120	116	119
37	116	127	128	114	122	118	118
45	116	123	128	121	124	123	122
57	116	126	135	122	126	116	125
mean	119	124	127	119	120	116	119

Grand mean $\pm$ 1 s.d. = 121.7 $\pm$ 5.5

TABLE 14

Serum Calcium Level (mg/100 ml)

Ration Group; Dog Number	Week 0	2	4	6	8	10	12
MSD							
4	10.5	10.7	11.3	10.0	10.8	11.5	10.5
8	10.6	11.4	10.7	10.2	10.6	10.4	10.4
13	10.3	11.2	11.8	10.7	13.0	10.5	9.9
19	10.1	10.8	10.7	10.6	10.0	10.5	11.1
24	10.3	11.1	10.4	9.5	10.2	10.0	10.1
29	9.7	10.8	10.6	8.9	10.2	10.0	9.9
32	10.5	11.6	10.2	9.1	10.6	10.5	10.5
42	10.3	11.4	10.3		11.4	11.1	10.0
55	10.2	12.0	10.5	11.3	10.4	11.0	10.5
56	9.5	10.5	11.4	10.9	10.6	10.6	11.0
mean	10.2	11.2	10.8	10.1	10.8	10.6	10.4
STURDY							
2	11.1	7.8	11.1	9.6	11.4	12.5	10.2
10	10.4	10.5	10.1	10.0	10.2	10.6	9.4
15	10.5	12.1	10.2	9.9	10.6	10.2	10.1
18	10.1	10.4	10.4	10.0	10.5	10.2	10.5
22	10.4	10.6	11.3	9.2	9.6	10.2	10.1
46	10.1	11.8	10.0	10.3	10.8	10.5	10.2
47	10.2	12.3	10.3	10.5	10.5	11.0	10.1
58	9.5	9.7	10.7	11.3	10.6	10.4	10.0
mean	10.3	10.6	10.5	10.1	10.5	10.7	10.1
GAINES							
7	10.6	11.3	11.1	9.8	10.0	10.0	10.1
14	11.0	12.3	11.9	10.7	11.1	10.8	10.0
21	9.9	10.9	10.1	9.2	9.0	9.6	10.1
27	10.6	12.8	10.4	10.0	10.5	10.9	10.4
35	10.3	10.6	10.2	8.3	9.8	10.2	9.6
37	9.5	10.9	10.3	10.5	9.2	9.9	9.4
45	10.1	11.2	10.8	10.4	10.1	10.5	10.6
57	8.9	9.7	10.2	10.1	9.4	9.6	10.1
mean	10.1	11.2	10.6	9.9	9.9	10.2	10.0

Grand mean $\pm$ 1 s.d. = 10.4 $\pm$ 0.73

TABLE 15

Serum Phosphorus Level (mg/100 ml)

Ration Group; Dog Number	Week 0	2	4	6	8	10	12
MSD							
4	3.6	5.4	5.9	5.0	5.4	4.6	4.6
8	3.8	5.8	3.6	4.3	3.1	4.5	4.4
13	4.3	6.0	4.4	5.4	4.9	5.4	5.0
19	3.8	4.4	6.0	5.2	5.0	5.4	5.1
24	4.0	6.0	4.6	3.0	4.1	4.6	4.1
29	3.1	5.4	4.1	3.0	5.0	4.9	3.4
32	4.2	6.3	4.9	4.2	4.0	5.1	4.9
42	4.4	7.0	4.0		5.9	4.1	3.9
55	3.9	8.0	3.1	5.9	5.1	4.6	4.1
56	3.1	4.9	4.2	3.8	4.1	4.1	5.0
mean	3.8	5.9	4.5	4.4	4.7	4.7	4.5
STURDY							
2	4.2	5.4*	5.3	4.8	5.6	4.8	3.4
10	4.6	3.5	3.7	5.4	4.5	5.1	4.6
15	3.2	6.0	2.7	4.4	3.6	4.1	4.1
18	4.0	5.8	4.8	4.4	4.9	5.0	3.8
22	4.4	6.2	6.1	4.6	4.5	5.1	4.1
46	3.2	7.0	4.6	3.5	6.1	3.9	3.0
47	2.8	7.4	4.9	4.6	5.5	4.1	4.1
58	3.0	6.8	4.2	4.5	5.1	3.4	2.9
mean	3.7	6.0	4.5	4.5	5.0	4.4	3.8
GAINES							
7	3.4	5.0	4.1	4.0	3.5	4.1	4.1
14	3.6	5.7	4.5	3.5	5.0	3.6	4.6
21	3.2	5.5	5.2	4.4	3.5	4.6	5.2
27	4.2	6.3	5.2	5.2	6.0	5.0	4.4
35	4.1	5.8	4.3	3.8	4.9	4.6	4.1
37	4.1	4.7	3.5	6.6	3.2	3.9	4.4
45	3.7	5.8	3.8	4.6	3.4	3.6	3.4
57	3.7	6.6	4.1	5.6	5.1	4.0	4.5
mean	3.8	5.8	4.3	4.7	4.3	4.2	4.3

$$* \; 5.4 = \frac{\Sigma(\text{data for dog 2}) + \Sigma(\text{data for day 2})}{13}$$

Grand mean $\pm$ 1 s.d. = 4.6 $\pm$ 0.97

TABLE 16

Serum Total Protein (Gm/100 ml)

Ration Group; Dog Number	Week 0	2	4	6	8	10	12
MSD							
4	6.4	7.0	6.9	6.2	6.4	6.1	6.1
8	5.7	6.2	6.0	6.6	5.8	6.0	5.8
13	6.7	7.2	7 6	6.9	6.7	6.4	6.2
19	6.0	6.4	6.8	6.4	5.9	6.1	6.9
24	6.0	6.6	6.0	6.2	5.7	5.8	6.2
29	6.1	6.5	6.6	6.2	6.6	6.7	6.2
32	6.2	5.9	5.8	6.1	5.8	6.0	6.3
42	7.3	7.3	6.5		6.6	6.2	6.6
55	7.0	7.5	6.8	8.2	6.6	6.1	6.3
56	6.5	6.4	7.2	6.4	6.0	6.0	6.3
mean	6.4	6.7	6.6	6.6	6.2	6.1	6.3
STURDY							
2	6.6	6.2	6.8	6.2	6.8	6.4	6.0
10	5.9	6.0	8.2	6.6	6.0	6.2	5.6
15	6.6	6.8	7.0	6.6	6.6	6.4	6.2
18	5.6	6.2	6.5	6.2	6.3	6.2	6.2
22	6.6	6.5	7.6	6.4	6.0	6.6	6.2
46	7.4	6.6	5.8	5.4	5.6	5.8	5.7
47	6.5	6.8	6.7	5.8	5.5	5.4	6.2
58	8.2	6.1	7.3	6.4	6.1	6.4	6.0
mean	6.8	6.4	7.0	6.2	6.1	6.2	6.0
GAINES							
7	7.4	7.2	8.0	7.4	7.7	7.6	7.2
14	6.8	6.0	7.5	6.2	6.7	6.2	6.0
21	5.9	5.6	6.4	6.1	5.4	6.4	6.1
27	6.9	7.8	6.8	6.5	6.7	6.8	6.2
35	6.0	5.9	6.8	5.8	5.8	6.3	5.9
37	7.3	6.2	7.0	7.6	5.8	6.3	6.3
45	6.5	6.2	6.2	6.4	6.0	5.8	6.4
57	7.0	5.8	6.8	6.2	6.0	5.8	6.2
mean	6.7	6.3	6.9	6.5	6.3	6.4	6.3

Grand mean $\pm$ 1 s.d. = 6.4 $\pm$ 0.57

TABLE 17

Blood Urea Nitrogen (mg/100 ml)

Ration Group; Dog Number	Week 0 AM	Week 0 PM	Week 2 AM	Week 2 PM	Week 4 AM	Week 4 PM	Week 6 AM	Week 6 PM	Week 8 AM	Week 8 PM	Week 10 AM	Week 10 PM	Week 12 AM	Week 12 PM
MSD														
4	10	--	29	22	28	18	17	12	22	18	12	11	13	--
8	13	--	18	19	21	16	17	17	17	16	15	21	15	--
13	18	--	30	26	19	16	20	15	17	15	17	18	13	--
19	17	--	38	33	37	30	29	27	25	20	21	30	31	--
24	15	--	20	20	26	25	21	18	17	15	19	22	16	--
29	24	--	26	22	22	18	19	16	25	18	20	18	12	--
32	17	--	18	15	22	24	22	17	17	15	20	23	14	--
42	29	--	23	21	38	33	--	--	23	19	14	19	13	--
55	22	--	25	18	10	80	25	13	23	18	15	16	15	--
56	23	--	30	22	22	15	14	13	20	18	15	33	17	--
mean	18.8		25.7	21.8	24.5	27.5	20.4	16.4	20.6	17.2	16.8	22.1	15.9	
STURDY														
2	11	--	25	18	30	18	20	18	25	22	14	17	11	--
10	13	--	18	18	14	14	20	15	17	17	21	30	14	--
15	20	--	20	18	18	18	20	20	20	20	22	28	17	--
18	16	--	28	22	18	14	17	16	19	17	20	26	16	--
22	10	--	20	14	26	21	18	14	14	14	16	27	16	--
46	16	--	28	22	40	28	15	15	22	16	17	21	14	--
47	16	--	22	18	36	25	17	14	24	14	15	15	16	--
58	19	--	20	15	24	15	16	14	26	17	16	16	11	--
mean	15.1		22.6	18.1	26.0	19.1	17.9	15.8	20.9	17.1	17.6	22.5	14.4	

TABLE 17 - Blood Urea Nitrogen (mg/100 ml) (Continued)

Ration Group; Dog Number	Week 0 AM	0 PM	2 AM	2 PM	4 AM	4 PM	6 AM	6 PM	8 AM	8 PM	10 AM	10 PM	12 AM	12 PM
GAINES														
7	13	--	12	14	14	15	15	13	15	17	16	23	14	--
14	25	--	--	20	24	21	15	16	36	23	20	22	20	--
21	20	--	27	24	30	27	28	21	19	21	20	30	27	--
27	14	--	20	18	28	--	16	17	27	17	22	27	16	--
35	10	--	20	18	43	33	18	19	26	16	20	17	11	--
37	19	--	18	16	--	30	27	16	17	19	20	27	17	--
45	27	--	18	20	26	22	17	16	18	15	21	20	15	--
57	29	--	20	16	26	12	17	14	20	16	19	27	18	--
mean	19.6		19.3	18.2	27.3	22.9	19.1	16.5	22.3	18.0	19.8	21.6	17.2	

Grand mean $\pm$ 1 s.d. = 19.9 $\pm$ 6.67

TABLE 18

Serum Glucose Level (mg/100 ml)

Ration Group; Dog Number	Week 0 AM	0 PM	2 AM	2 PM	4 AM	4 PM	6 AM	6 PM	8 AM	8 PM	10 AM	10 PM	12 AM	12 PM
MSD														
4	109	--	98	95	91	100	87	88	91	101	95	93	100	--
8	109	--	100	95	87	86	82	87	86	88	85	106	97	--
13	74	--	96	81	91	85	99	83	85	88	71	99	87	--
19	102	--	103	81	83	89	91	84	93	82	85	65	98	--
24	95	--	89	85	90	98	88	88	92	88	97	77	84	--
29	79	--	95	97	77	77	91	88	89	80	88	95	77	--
32	73	--	79	74	67	101	91	78	84	95	89	96	72	--
42	89	--	84	84	114	122	--	--	86	98	84	101	82	--
55	78	--	84	76	78	75	78	81	79	85	74	84	74	--
56	82	--	90	66	84	90	75	77	87	96	83	107	90	--
mean	89.0		91.8	83.4	86.2	92.3	86.9	83.8	87.2	90.1	85.1	92.3	86.1	
STURDY														
2	102	--	92	69	94	85	87	79	76	95	60	100	88	--
10	59	--	98	84	--	73	82	69	76	74	92	91	87	--
15	88	--	91	77	76	82	76	71	81	67	81	92	83	--
18	89	--	88	77	114	91	75	91	84	71	76	89	91	--
22	112	--	102	110	100	103	92	86	89	79	82	94	84	--
46	61	--	96	86	123	102	99	88	92	97	93	99	82	--
47	87	--	77	70	115	111	98	88	93	87	98	89	84	--
58	75	--	92	86	95	81	84	82	89	89	86	93	77	--
mean	84.1		92.0	82.4	102.4	91.0	86.6	81.8	85.0	82.4	83.5	93.4	84.5	

TABLE 18 - Serum Glucose Level (mg/100 ml) (Continued)

Ration Group; Dog Number	Week 0 AM	0 PM	2 AM	2 PM	4 AM	4 PM	6 AM	6 PM	8 AM	8 PM	10 AM	10 PM	12 AM	12 PM
GAINES														
7	95	--	85	82	69	75	80	68	86	91	72	88	86	--
14	75	--	--	105	100	92	86	90	90	84	71	86	86	--
21	101	--	96	89	85	80	101	100	84	75	80	74	100	--
27	72	--	96	59	95	--	79	75	80	88	77	79	78	--
35	89	--	96	71	115	129	82	79	83	90	77	95	74	--
37	71	--	81	65	--	97	79	77	77	78	78	96	75	--
45	87	--	70	68	103	105	70	68	85	99	77	82	75	--
57	90	--	83	71	99	96	94	75	86	78	70	97	80	--
mean	85.0		86.7	76.2	94.7	96.3	83.9	79.0	83.9	85.4	75.2	87.1	81.8	

Grand mean $\pm$ 1 s.d. = 86.6 $\pm$ 11.2

TABLE 19

Serum Cholesterol Level (mg/100 ml)

Ration Group; Dog Number	Week 0 AM	0 PM	2 AM	2 PM	4 AM	4 PM	6 AM	6 PM	8 AM	8 PM	10 AM	10 PM	12 AM	12 PM
MSD														
4	150	--	200	--	246	218	186	--	224	--	210	205	202	--
8	164	--	189	202	198	226	207	207	225	213	210	171	222	--
13	--	--	224	199	--	--	252	213	207	214	236	242	228	--
19	--	--	214	154	--	293	207	210	217	211	200	194	--	--
24	241	--	318	312	--	--	282	--	287	254	287	280	280	--
29	--	--	199	214	190	196	201	225	223	236	234	220	220	--
32	--	--	167	180	168	148	195	198	265	265	247	233	--	--
42	143	--	202	171	--	--	171	177	181	182	163	153	196	--
55	155	--	230	198	265	278	245	232	206	--	249	268	250	--
56	199	--	260	--	297	191	304	306	254	277	280	282	270	--
mean	175.3		220.3	203.8	227.3	221.4	225.0	221.0	228.9	231.5	231.6	224.8	234.8	
STURDY														
2	175	--	--	149	154	176	171	176	234	213	237	245	170	--
10	--	--	133	--	--	164	192	153	156	159	170	163	168	--
15	172	--	175	151	--	--	--	210	--	217	181	194	--	--
18	134	--	111	123	--	--	171	165	132	120	132	142	144	--
22	179	--	199	324	--	--	210	203	183	173	203	180	136	--
46	204	--	178	180	157	175	163	154	192	177	195	193	180	--
47	--	--	234	186	--	272	240	211	218	186	194	181	198	--
58	157	--	128	210	181	164	160	160	173	160	165	172	136	--
mean	170.2		165.4	189.0	164.0	190.2	186.7	179.0	184.0	175.6	184.6	183.8	161.7	

TABLE 20

Serum Total Lipid (mg/100 ml)

Ration Group; Dog Number	Week 0 AM	0 PM	2 AM	2 PM	4 AM	4 PM	6 AM	6 PM	8 AM	8 PM	10 AM	10 PM	12 AM	12 PM
MSD														
4	--	--	--	--	747	619	727	701	609	701	645	738	--	--
8	--	--	--	--	682	710	645	664	821	774	645	682	--	--
13	--	--	--	--	802	821	876	756	738	839	756	756	--	--
19	811	--	--	--	765	618	701	793	664	664	599	636	--	--
24	1033	--	--	--	867	867	774	959	738	774	--	--	--	--
29	627	--	--	--	627	839	719	701	765	690	673	830	--	--
32	--	--	--	--	738	--	664	701	867	830	811	756	--	--
42	470	--	--	--	--	--	664	728	738	719	627	636	--	--
55	618	--	--	--	--	--	1070	811	793	885	738	747	--	--
56	682	--	--	--	--	--	811	774	913	738	848	904	--	--
mean	605.8				746.8	745.7	765.1	758.8	764.6	761.4	704.7	742.8		
STURDY														
2	--	--	--	--	572	627	--	--	719	618	618	590	--	--
10	940	--	--	--	--	599	535	424	562	526	553	627	--	--
15	793	--	--	--	--	645	677	645	756	756	701	599	--	--
18	507	--	--	--	--	553	479	470	535	609	544	738	--	--
22	774	--	--	--	728	811	618	627	618	710	645	618	--	--
46	793	--	--	--	--	--	618	618	738	647	673	719	--	--
47	811	--	--	--	--	--	599	738	710	627	636	738	--	--
58	599	--	--	--	--	--	618	774	627	627	627	765	--	--
mean	745.3				650.0	647.0	592.0	613.7	658.1	640.0	624.6	674.2		

TABLE 20 - Serum Total Lipid (mg/100 ml)(Continued)

	Week 0		2		4		6		8		10		12	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Ration Group; Dog Number														
GAINES														
7	719	--	--	--	572	544	535	498	572	645	516	498	--	--
14	--	--	--	--	609	655	756	765	645	645	645	645	--	--
21	793	--	--	--	572	618	609	562	433	489	544	406	--	--
27	--	--	--	--	--	--	645	572	498	553	738	507	--	--
35	--	--	--	--	--	--	562	596	673	645	738	673	--	--
37	710	--	--	--	--	--	682	535	618	609	618	618	--	--
45	609	--	--	--	--	--	655	581	673	609	673	747	--	--
57	765	--	--	--	--	--	609	599	618	553	627	692	--	--
mean	719.2				584.3	605.7	631.6	588.5	591.2	593.5	637.4	598.2		

Grand mean ± 1 s.d. = 677.2 ± 110.2

TABLE 21

Packed Cell Volume (%)

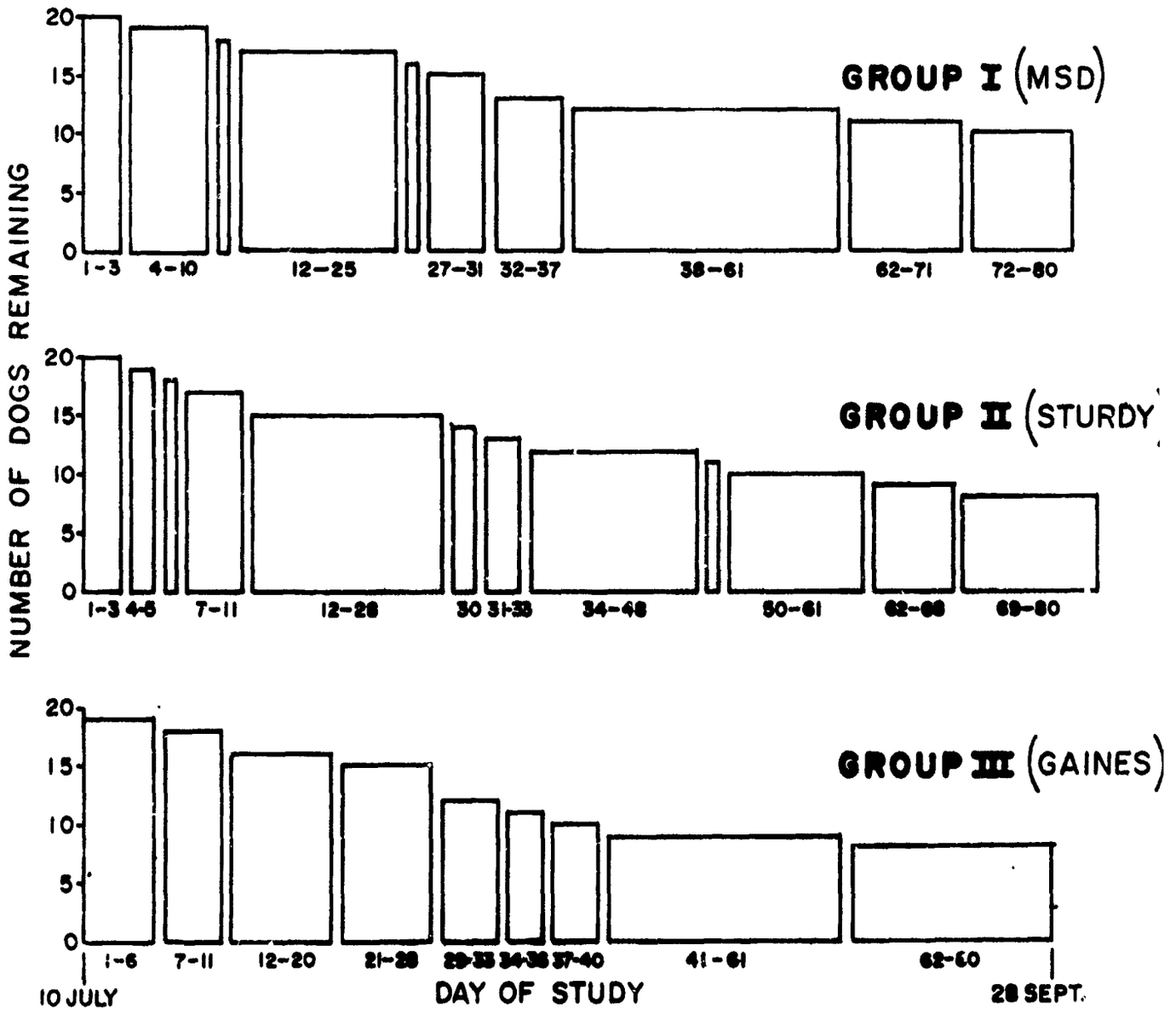
Ration Group; Dog Number	Week 0 AM	0 PM	2 AM	2 PM	4 AM	4 PM	6 AM	6 PM	8 AM	8 PM	10 AM	10 PM	12 AM	12 PM
MSD														
4	46	--	43	46	48	46	48	47	40	45	48	47	45	--
8	47	--	44	42	46	46	48	45	47	45	49	46	44	--
13	45	--	44	39	46	44	45	46	47	48	48	42	42	--
19	50	--	46	44	44	44	46	45	45	42	50	50	46	--
24	47	--	47	42	47	44	46	42	44	44	49	--	49	--
29	43	--	44	42	41	41	40	41	42	43	45	42	41	--
32	49	--	46	42	50	44	44	42	45	43	47	49	45	--
42	50	--	46	43	45	45	47	44	49	45	50	47	47	--
55	52	--	49	45	52	46	52	52	47	51	51	51	48	--
56	52	--	50	45	49	44	49	47	44	45	44	46	45	--
mean	48.1		46.4	43.0	46.8	44.4	46.5	45.1	45.0	44.9	48.1	46.7	45.2	
STURDY														
2	52	--	47	45	44	44	45	40	45	40	48	45	45	--
10	50	--	48	40	53	44	51	47	53	46	53	50	47	--
15	51	--	44	39	44	41	46	43	45	44	45	43	35	--
18	51	--	50	48	48	44	48	50	49	45	48	47	44	--
22	55	--	49	48	45	44	46	43	45	41	49	47	49	--
46	52	--	54	52	44	41	42	39	41	40	46	44	40	--
47	47	--	48	46	47	46	47	45	46	45	45	44	47	--
58	52	--	44	47	46	44	49	41	49	44	49	46	45	--
mean	51.2		48.0	45.6	46.4	43.5	46.8	43.5	46.6	43.1	47.9	45.8	44.0	

TABLE 21 - Packed Cell Volume (5) (Continued)

	Week 0		2		4		6		8		10		12	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
GAINES														
7	46	--	45	43	45	45	48	48	45	47	44	42	44	--
14	55	--	51	52	51	48	51	48	52	50	51	45	48	--
21	47	--	40	36	42	39	42	34	36	37	41	41	38	--
27	46	--	48	49	42	39	49	44	45	43	50	42	43	--
35	56	--	53	55	50	46	48	44	49	47	54	50	45	--
37	52	--	48	44	46	45	48	46	44	45	48	43	43	--
45	54	--	50	47	51	46	51	50	50	46	50	49	51	--
57	50	--	46	45	43	43	42	45	45	41	45	44	45	--
mean	50.8		47.6	46.4	46.2	43.9	47.4	44.9	45.8	44.5	47.9	44.5	44.6	

Grand mean $\pm$ 1 s.d = 46.1 $\pm$ 3.7

FIG. I ATTRITION OF DOGS FROM INITIAL GROUP



AMBIENT TEMPERATURE & RELATIVE HUMIDITY, FT. BENNING, 6 JULY-6 SEPT 1968

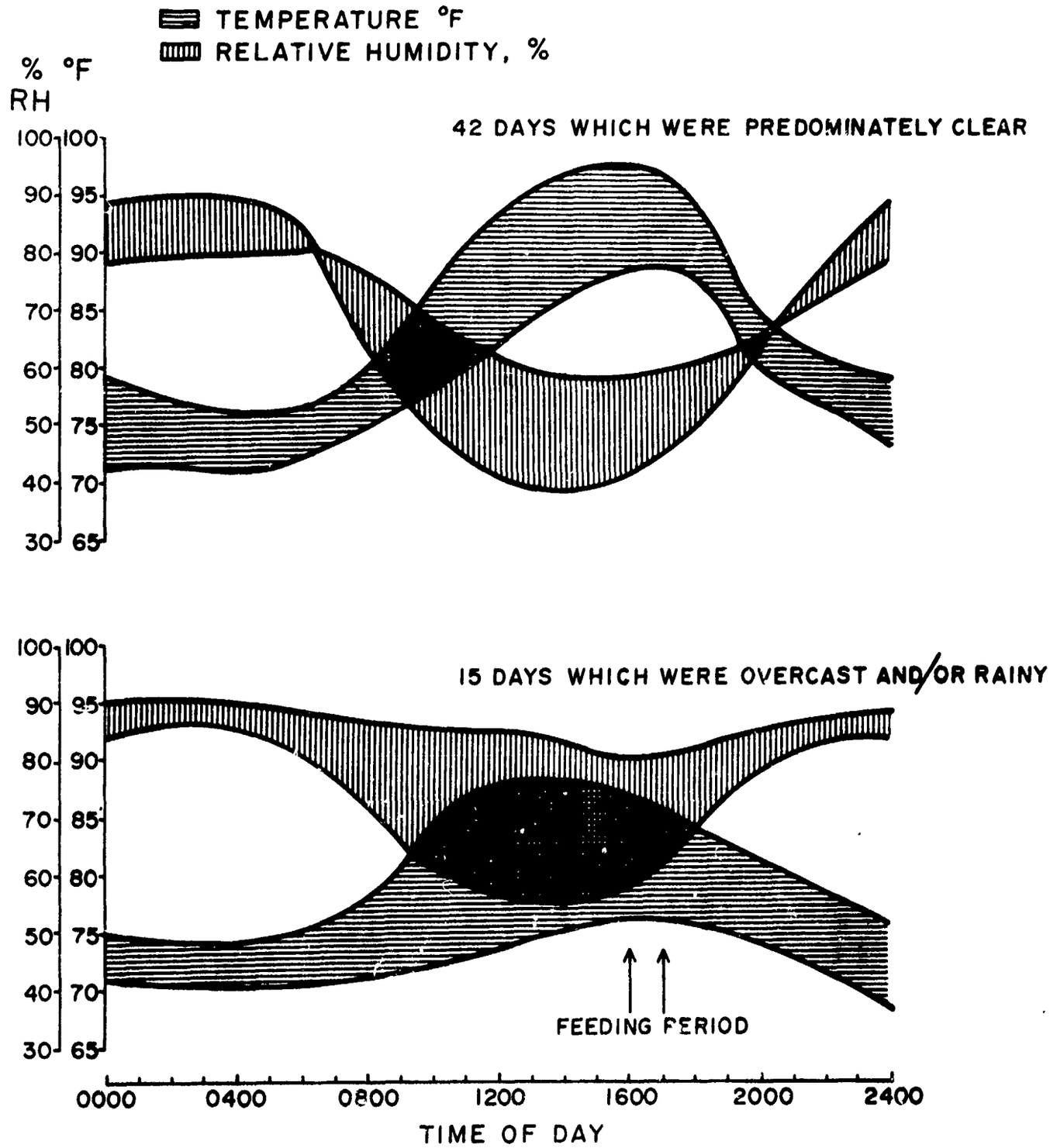


FIG. 2

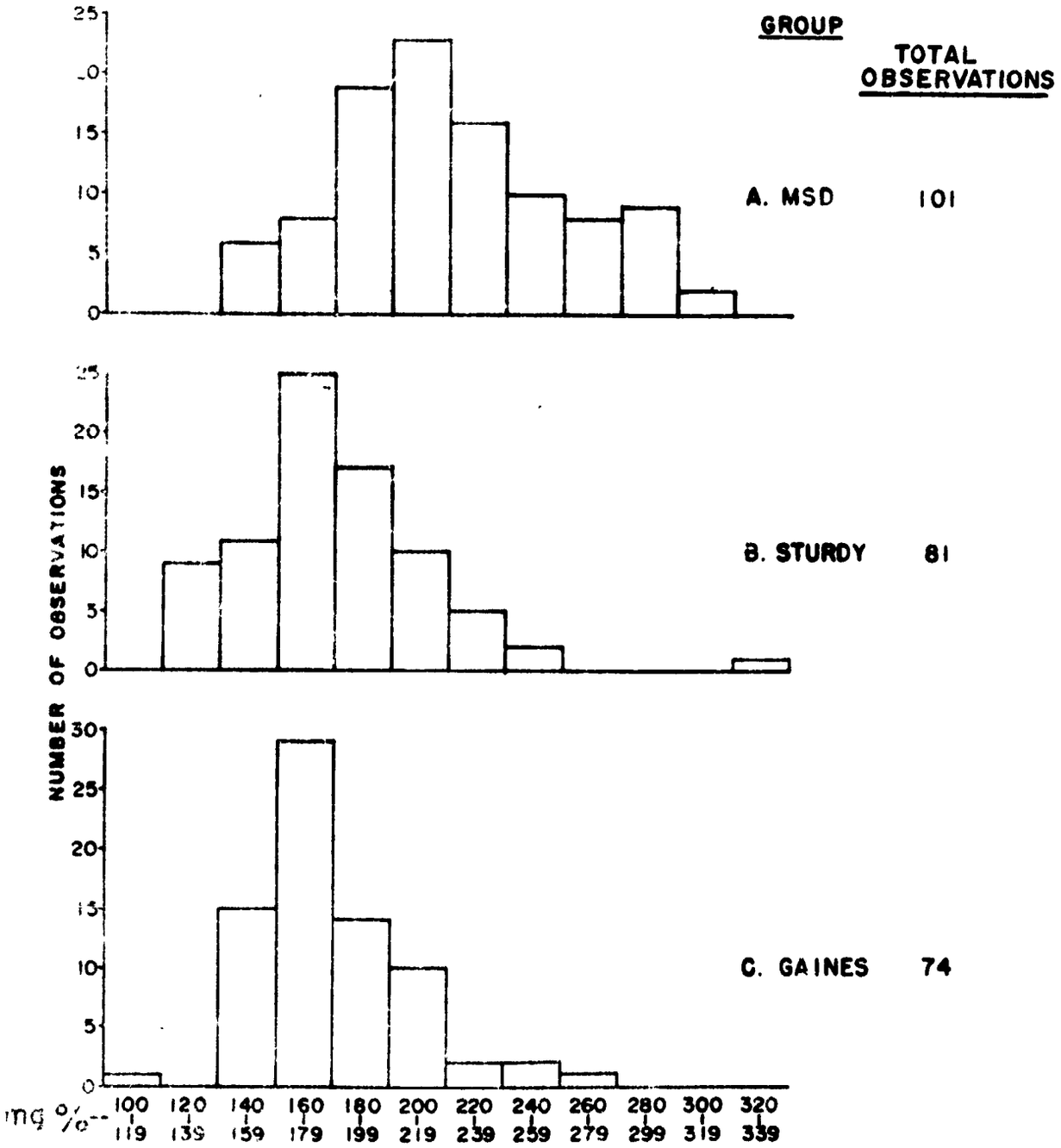
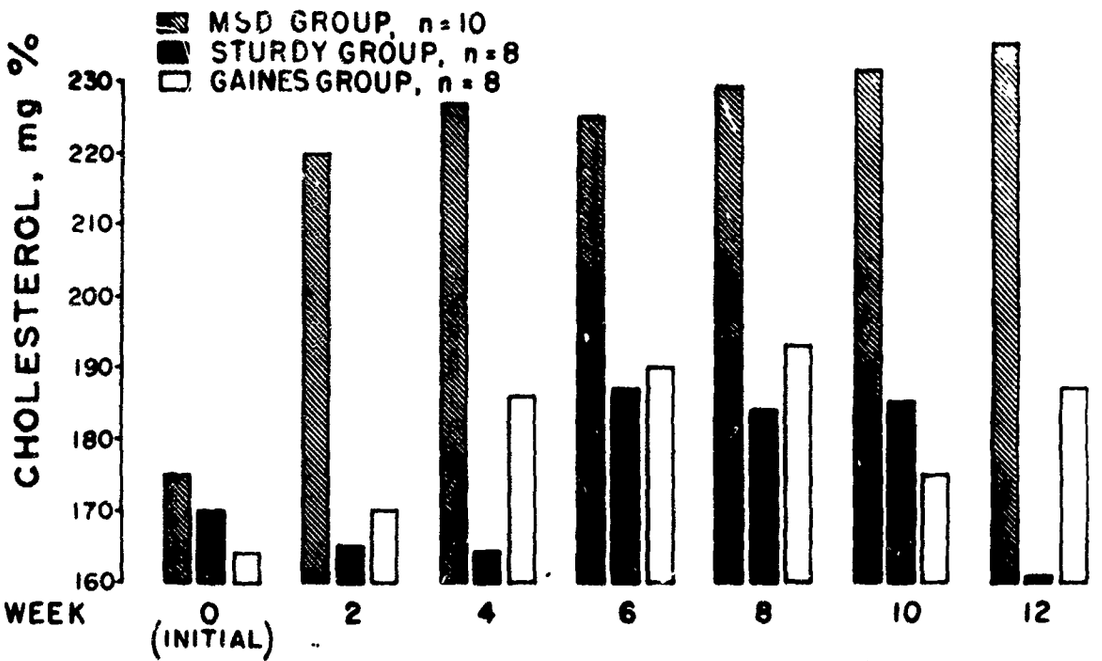
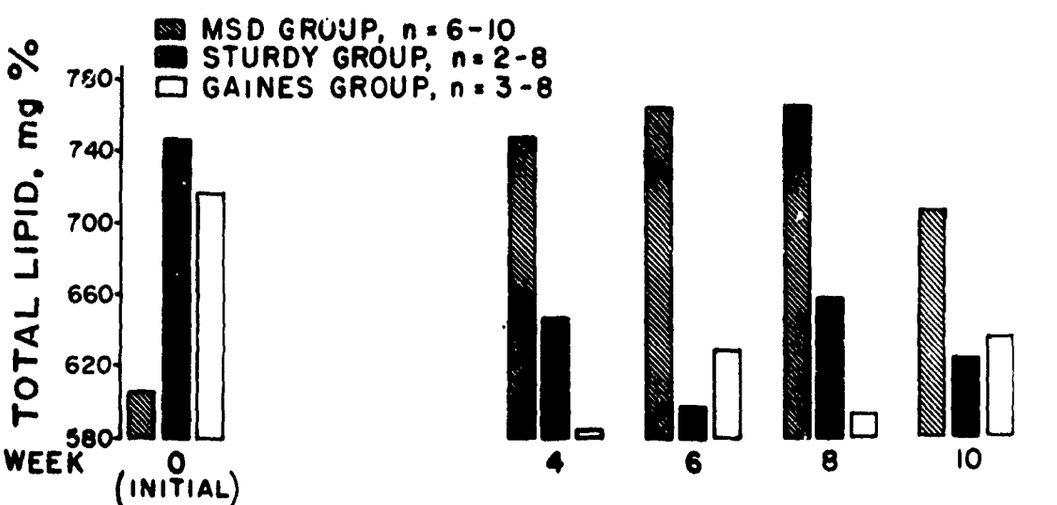


FIGURE 3 FREQUENCY DISTRIBUTION SERUM CHOLESTEROL LEVEL



A. GROUP MEAN SERUM CHOLESTEROL LEVELS (AM VALUES ONLY)



B. GROUP MEAN SERUM TOTAL LIPID LEVELS (AM VALUES ONLY)

FIG. 4 MEAN LEVELS OF SERUM CHOLESTEROL AND SERUM LIPID AT BIWEEKLY INTERVALS