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*Industrial* **BIO-TEST** *Laboratories, Inc.*
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NORTHBROOK, ILLINOIS 60062

REPORT TO

U. S. ARMY MEDICAL RESEARCH AND DEVELOPMENT COMMAND

# TERATOGENIC STUDIES WITH FROZEN, THERMALLY PROCESSED, COBALT IRRADIATED, AND ELECTRON IRRADIATED BEEF IN ALBINO MICE, ALBINO RATS, GOLDEN SYRIAN HAMSTERS, AND ALBINO RABBITS

CONTRACT NO. DADA 17-71-C-1030

SEPTEMBER 11, 1975

IBT NOS. 651-01785 AND 622-01786

#43

*Industrial* **BIO-TEST** *Laboratories, Inc.*
1810 FRONTAGE ROAD
NORTHBROOK, ILLINOIS 60062

September 11, 1975

Col. Roger W. Baker
U. S. Army Medical Research
and Development Command
Forrestall Building
Washington, D. C. 20314

Dear Col. Baker:

Re: IBT Nos. 651-01785 and 622-01786 - Teratogenic Studies with Frozen, Thermally Processed, Cobalt Irradiated, and Electron Irradiated Beef in Albino Mice, Albino Rats, Golden Syrian Hamsters, and Albino Rabbits - Contract No. DADA 17-71-C-1030

We are submitting herewith our laboratory report prepared in connection with the above study.

Very truly yours,

J. C. Calandra

J. C. Calandra
President

JCC:bp

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REPORT TO

U. S. ARMY MEDICAL RESEARCH AND DEVELOPMENT COMMAND

# TERATOGENIC STUDIES WITH FROZEN, THERMALLY PROCESSED, COBALT IRRADIATED, AND ELECTRON IRRADIATED BEEF IN ALBINO MICE, ALBINO RATS, GOLDEN SYRIAN HAMSTERS, AND ALBINO RABBITS

CONTRACT NO. DADA 17-71-C-1030

SEPTEMBER 11, 1975

IBT NOS. 651-01785 AND 622-01786

## I. Introduction

An investigation was initiated, at the request of the U. S. Army Medical Research and Development Command, to determine the teratogenic potential of frozen, thermally processed, cobalt irradiated, and electron irradiated beef in albino mice, albino rats, golden Syrian hamsters, and albino rabbits. This report presents the results of the investigation.

## II. Abstract

An investigation was conducted to determine the teratogenic potential of frozen, thermally processed, cobalt irradiated, and electron irradiated beef. Diets containing beef were fed to groups of pregnant albino mice, albino rats, golden Syrian hamsters, and albino rabbits during the period of fetal organogenesis. Each type of beef was fed at dietary concentrations of either 35 or 70 percent beef on a dry matter basis. Each beef diet was fed to 2 separate groups of pregnant animals. The experimental design included 2 control groups fed the appropriate standard stock ration. The experimental design for the experiments with albino mice, albino rats, and golden Syrian hamsters included 2 additional control groups fed the semi-purified diet which comprised the remaining portion of each of the beef diets in these 3 experiments. The parameters recorded included maternal body weights, food consumption, reproductive effects, and fetal body weight, external development, skeletal development, and internal development. The 24-hour survival of the young was also observed in the experiment with albino rabbits.

The groups of albino mice, albino rats, and golden Syrian hamsters fed diets containing frozen, thermally processed, cobalt irradiated, or electron irradiated beef exhibited no effects in maternal body weights or reproductive findings. The groups of these animals fed beef diets consumed more food than that consumed by the appropriate control groups fed the standard stock ration. The groups of albino rabbits fed diets containing beef exhibited either body weight losses or reductions of body weight gains during Gestation

Days 6 through 18 when the animals were fed the test diets. The albino rabbits fed beef diets exhibited normal overall body weight gains during Gestation Days 0 through 29. The albino rabbits fed beef diets consumed less food than that consumed by the control groups fed the standard stock ration. The food consumption reductions observed in the groups of albino rabbits fed diets containing beef were expected, as beef does not comprise part of the normal diet of these animals. Reproductive parameters measured in the beef fed rabbits were not significantly different than those of the controls.

An increase in fetal malformations was not observed in any species fed either of the 4 beef diets. No effects were noted in the body weights, external development, skeletal development, or internal development of the fetuses obtained from the albino mice, albino rats, golden Syrian hamsters, and albino rabbits which could be attributed to prenatal exposure to diets containing frozen, thermally processed, cobalt irradiated, or electron irradiated beef. The 24-hour survival of the young obtained from the albino rabbits fed diets containing beef was comparable to that of the young obtained from the control groups fed the standard stock ration.

Feeding diets containing frozen, thermally processed, cobalt irradiated, or electron irradiated beef to groups of pregnant albino mice, albino rats,

golden Syrian hamsters and albino rabbits during the period of fetal organogenesis did not induce teratogenic responses in these test systems.

Respectfully submitted,

INDUSTRIAL BIO-TEST LABORATORIES, INC.

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III. Diet Preparation

The proportions of dietary constituents for the diets fed to the albino mice, albino rats, and golden Syrian hamsters are listed in Table I. The proportions of the dietary constituents for the diets fed to the albino rabbits are listed in Table II. The formulation of the complete semipurified diet is presented in Tables III-A, III-B, and III-C. The frozen beef was removed from the freezer 3 days prior to anticipated use and was placed in a refrigerator to thaw. The frozen, thermally processed, and cobalt irradiated beef cans were all checked with a vacuum gauge prior to being opened to ensure that a vacuum of at least 1 inch existed. The electron irradiated beef packets were all inspected for structural integrity and proper sealing before being used.

The entire contents of the containers were placed in covered stainless steel pans and were heated in a preheated convection oven at 400°F for 15 minutes immediately after the containers were opened and the contents were weighed. The covers were removed from the pans during the last 3 minutes of cooking. Immediately after cooking, the appropriate amount of beef and either semipurified diet or standard stock ration (in the experiment with albino rabbits only) for each diet was placed in a high speed blender and mixed into a thick paste. Following mixing, each diet was immediately fed or was stored up to 48 hours before use.

TABLE I

TEST MATERIAL: Irradiated Beef

Teratogenic Studies: Albino Mice, Albino Rats, and Golden Syrian Hamsters

Proportions of Dietary Constituents

| Group | Diet | Dietary Constituents Beef* (percent) | Complete Semipurified Diet (percent) | Standard Stock Ration (percent) |
|---|---|---|---|---|
| Control I | Purina Chow | 0 | 0 | 100 |
| Control II | Purina Chow | 0 | 0 | 100 |
| CGN I | Complete Semipurified Diet | 0 | 100 | 0 |
| CGN II | Complete Semipurified Diet | 0 | 100 | 0 |
| CGF I | Frozen Beef | 35 | 65 | 0 |
| CGF II | Frozen Beef | 35 | 65 | 0 |
| CGF I | Frozen Beef | 70 | 30 | 0 |
| CGF II | Frozen Beef | 70 | 30 | 0 |
| CGT I | Thermally Processed Beef | 35 | 65 | 0 |
| CGT II | Thermally Processed Beef | 35 | 65 | 0 |
| CGT I | Thermally Processed Beef | 70 | 30 | 0 |
| CGT II | Thermally Processed Beef | 70 | 30 | 0 |
| TGCO I | Cobalt Irradiated Beef | 35 | 65 | 0 |
| TGCO II | Cobalt Irradiated Beef | 35 | 65 | 0 |
| TGCO I | Cobalt Irradiated Beef | 70 | 30 | 0 |
| TGCO II | Cobalt Irradiated Beef | 70 | 30 | 0 |
| TGEL I | Electron Irradiated Beef | 35 | 65 | 0 |
| TGEL II | Electron Irradiated Beef | 35 | 65 | 0 |
| TGEL I | Electron Irradiated Beef | 70 | 30 | 0 |
| TGEL II | Electron Irradiated Beef | 70 | 30 | 0 |

* Beef levels are expressed on a dry matter basis.

TABLE II

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rabbits

Proportions of Dietary Constituents

| Group | Diet | Dietary Constituents: Beef* (percent) | Dietary Constituents: Standard Stock Ration (percent) |
|---|---|---|---|
| Control I | Purina Chow | 0 | 100 |
| Control II | Purina Chow | 0 | 100 |
| CGF I | Frozen Beef | 35 | 65 |
| CGF II | Frozen Beef | 35 | 65 |
| CGF I | Frozen Beef | 70 | 30 |
| CGF II | Frozen Beef | 70 | 30 |
| CGT I | Thermally Processed Beef | 35 | 65 |
| CGT II | Thermally Processed Beef | 35 | 65 |
| CGT I | Thermally Processed Beef | 70 | 30 |
| CGT II | Thermally Processed Beef | 70 | 30 |
| TGCO I | Cobalt Irradiated Beef | 35 | 65 |
| TGCO II | Cobalt Irradiated Beef | 35 | 65 |
| TGCO I | Cobalt Irradiated Beef | 70 | 30 |
| TGCO II | Cobalt Irradiated Beef | 70 | 30 |
| TGEL I | Electron Irradiated Beef | 35 | 65 |
| TGEL II | Electron Irradiated Beef | 35 | 65 |
| TGEL I | Electron Irradiated Beef | 70 | 30 |
| TGEL II | Electron Irradiated Beef | 70 | 30 |

* Beef levels are expressed on a dry matter basis.

TABLE III-A

TEST MATERIAL: Irradiated Beef

Teratogenic Studies - Albino Mice, Albino Rats and Golden Syrian Hamsters

Formulation of the Complete Semipurified Diet

| Diet Constituent | % | Lb | Kg |
|---|---|---|---|
| Corn Starch | 26.0 | 100.0 | 45.4 |
| Glucose | 26.0 | 100.0 | 45.4 |
| Casein | 22.8 | 87.7 | 39.9 |
| Fat, Hydrogenated | 10.0 | 38.5 | 17.5 |
| Corn Oil | 5.0 | 19.2 | 8.8 |
| Cellulose | 4.0 | 15.4 | 7.0 |
| Bernhart Tommerilli Salt Mixture* | 4.0 | 15.4 | 7.0 |
| Vitamin Diet Fortification Mixture** | 2.0 | 7.7 | 3.5 |
| L-Cystine | 0.2 | 0.8 | 0.35 |
| Total | 100.0 | 384.7 | 174.9 |

* The constituents of the salt mixture are presented in Table III-A.
** The constituents of the vitamin mixture are presented in Table III-B.

TABLE III-B

TEST MATERIAL: Irradiated Beef

Teratogenic Studies - Albino Mice, Albino Rats and Golden Syrian Hamsters

Formulation of the Complete Semipurified Diet

Bernhart Tommerilli Salt Mixture

| Salt Mixture Constituents | Percent |
|---|---|
| Calcium Carbonate | 2.100 |
| Calcium Phosphate | 73.500 |
| Cupric Citrate | 0.046 |
| Ferric Citrate | 0.558 |
| Magnesium Oxide | 2.500 |
| Manganese Citrate | 0.835 |
| Potassium Iodide | 0.0007 |
| Potassium Sulfate | 6.800 |
| Potassium Phosphate Dibasic | 8.100 |
| Sodium Chloride | 3.060 |
| Sodium Phosphate | 2.140 |
| Zinc Citrate | 0.133 |
| Citric Acid | 0.117 |

TABLE III-C

TEST MATERIAL: Irradiated Beef

Teratogenic Studies - Albino Mice, Albino Rats and Golden Syrian Hamsters

Formulation of the Complete Semipurified Diet

Vitamin Diet Fortification Mixture

| Vitamin Mixture Constituents | mg of Constituent per 100 g of Semipurified Diet |
|---|---|
| Vitamin A | 0.390 |
| Vitamin $D_3$ | 0.003 |
| Vitamin E | 11.0 |
| Vitamin K | 0.1 |
| Thiamine - HCl | 1.0 |
| Riboflavin | 1.0 |
| Pyridoxine - HCl | 1.0 |
| Niacin | 6.0 |
| Calcium-D-pantothenate | 4.0 |
| Folic Acid | 0.5 |
| Biotin | 0.1 |
| Vitamin $B_{12}$ | 0.005 |
| Choline bitartrate | 180.0 |
| Ascorbic Acid | 7.5 |
| Starch to 2 g | |

## IV. Statistical Evaluations

### A. Maternal Body Weights

Statistical analyses were conducted upon maternal body weights. First a One-Way Analysis of Variance was conducted upon the body weights, and significant effects disclosed by that treatment were further studied by the Student's "t"-Test.

### B. Reproductive Data

Statistical analyses were conducted upon the data related to reproduction (number of resorption sites, number of animals showing resorption sites, and number of viable fetuses). A Chi-square analysis in a 2 x 2 contingency table with a correction factor for continuity was conducted upon the data related to reproduction.

## V. Experiment I - Albino Mice

### A. Summary

Diets containing frozen, thermally processed, cobalt irradiated, or electron irradiated beef were fed to groups of pregnant albino mice during the period of fetal organogenesis. Each type of beef was fed at dietary concentrations of either 35 or 70 percent beef (on a dry matter basis). Each beef diet was fed to 2 groups of pregnant animals. The experimental design included 2 control groups fed a standard stock ration and 2 groups fed the semipurified diet which comprised the remaining portion of each of the beef diets.

Maternal body weight, reproductive effects (including early and late resorption sites, the number of viable fetuses, and the number of females with 1 or more resorption sites), fetal body weight, and fetal development (external, skeletal, and internal) findings are summarized in Table IV. The only group with consistent findings differing from those normally observed for pregnant albino mice of this strain in this laboratory was 1 group fed the diet containing 35 percent electron irradiated beef [TGEL (35%) I]. This group exhibited a reduction in maternal body weight and weight gain, an increase in early resorption sites, a decrease in the number of viable fetuses, an increase in the number of females with 1 or more resorption sites, and an increase in the number of fetuses with incidental skeletal findings. The increase in early resorption sites in this group was due to 1 female with 5 early resorptions. The increase in the number of fetuses with incidental skeletal findings in this group was due to an increase in the incidence of

incompletely ossified and/or non-ossified sternum sections which are indicative of the extent of skeletal calcification at the time of sacrifice. The findings in the TGEL (35%) I group were not confirmed by the results obtained either with the other group fed a diet containing 35 percent electron irradiated beef or with the groups fed a diet containing 70 percent electron irradiated beef. Other findings noted in Table IV as being other than that normally expected were not confirmed as being significant either by the results obtained with the other group fed the same diet or by the results obtained with groups fed the same beef at a higher concentration.

The ingestion of diets containing frozen, thermally processed, cobalt irradiated, or electron irradiated beef resulted in no maternal body weight changes which could be attributed to exposure to the test diets. The groups fed beef diets consumed 7 to 46 percent more food than that consumed by the control groups. There were no changes noted in the data related to reproduction which could be attributed to the ingestion of diets containing beef. No deaths or abnormal behavioral reactions were noted among any of the animals in this phase of the investigation. No effects on fetal body weights were observed that could be attributed to prenatal exposure to diets containing beef. Fetal external, skeletal, and internal development was comparable in all groups fed either beef diets or control diets. Feeding diets containing frozen, thermally processed, cobalt irradiated, or electron irradiated beef to pregnant albino mice during the period of fetal organogenesis did not induce a teratogenic response in this test system.

TABLE IV

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Mice

Summary of Findings

| Group | (Beef Content) | | Reproductive Effects: Maternal Body Weight | Resorption Sites: Early | Resorption Sites: Late | Number of Viable Fetuses | Number of Females with 1 or More Resorption Sites | Fetal Body Weight | Fetal Development: External | Fetal Development: Skeletal | Fetal Development: Internal |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Control | (None) | I | - | - | - | - | - | - | - | - | - |
| | | II | - | - | - | - | - | - | - | - | - |
| CGN | (None) | I | - | - | - | - | - | - | - | - | - |
| | | II | - | +(I) | - | - | - | - | - | - | - |
| CGF | (35%) | I | - | - | - | - | - | - | - | - | - |
| | | II | - | - | - | - | - | - | - | - | - |
| CGF | (70%) | I | - | - | - | - | - | - | - | - | - |
| | | II | - | - | - | - | +(I) | - | - | - | - |
| CGT | (35%) | I | - | - | - | - | - | - | - | + | - |
| | | II | - | - | - | - | - | - | - | - | - |
| CGT | (70%) | I | - | - | - | - | - | - | - | - | - |
| | | II | - | - | - | - | - | - | - | - | - |
| TGCO | (35%) | I | - | - | - | - | - | - | - | - | - |
| | | II | - | +(I) | - | - | - | - | - | - | - |
| TGCO | (70%) | I | - | - | - | - | - | - | - | - | - |
| | | II | - | - | - | - | - | - | - | + | - |
| TGEL | (35%) | I | +(D) | +(I) | - | +(D) | +(I) | - | - | + | - |
| | | II | - | - | - | - | - | - | + | - | - |
| TGEL | (70%) | I | - | - | - | - | - | - | - | - | - |
| | | II | - | - | - | - | - | - | - | - | - |

- = Normal findings
+ = Finding other than normal
(I) = increase
(D) = decrease

B. Procedure

1. Experimental Animals

The animals employed were Charles River strain* Swiss Webster mice. The mice were bred at Charles River Breeding Laboratories and copulation was confirmed by sperm-positive results of vaginal examinations. Day zero is defined as the day of insemination. The animals were then shipped directly to this laboratory on Day 3 of gestation.

2. Organization of Groups

A structural outline of this portion of the investigation is given in Table V.

* Charles River Breeding Laboratories, Inc., Wilmington, Massachusetts.

TABLE V

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Mice

Outline of Experiment

| Group | Number of Pregnant Animals | Diet | % Beef* |
|---|---|---|---|
| Control I | 15 | Purina Chow | None |
| Control II | 12 | Purina Chow | None |
| CGN I | 13 | Complete Semipurified Diet | None |
| CGN II | 12 | Complete Semipurified Diet | None |
| CGF I | 16 | Frozen Beef | 35 |
| CGF II | 15 | Frozen Beef | 35 |
| CGF I | 10 | Frozen Beef | 70 |
| CGF II | 19 | Frozen Beef | 70 |
| CGT I | 16 | Thermally Processed Beef | 35 |
| CGT II | 13 | Thermally Processed Beef | 35 |
| CGT I | 13 | Thermally Processed Beef | 70 |
| CGT II | 18 | Thermally Processed Beef | 70 |
| TGCO I | 14 | Cobalt Irradiated Beef | 35 |
| TGCO II | 20 | Cobalt Irradiated Beef | 35 |
| TGCO I | 18 | Cobalt Irradiated Beef | 70 |
| TGCO II | 17 | Cobalt Irradiated Beef | 70 |
| TGEL I | 8 | Electron Irradiated Beef | 35 |
| TGEL II | 13 | Electron Irradiated Beef | 35 |
| TGEL I | 12 | Electron Irradiated Beef | 70 |
| TGEL II | 14 | Electron Irradiated Beef | 70 |

* Beef levels are expressed on a dry matter basis.

3. Exposure and Feeding

All diets were prepared in the manner outlined in section III of this report. Animals in control groups I and II were offered the standard stock ration* utilized at this laboratory, as were dams of the test groups prior to and following the treatment period. Dams of each group were offered their respective diets fresh daily from the 6th day of their gestation period to the 15th day inclusive (a total of 10 days of exposure). Daily records of food consumption were recorded. All animals were allowed food and water ad libitum.

4. Body Weight Data

Reported body weight data include the mean group body weights on Days 6 (initial exposure day), 9, 12, and 15 (final day of exposure) of gestation, and sacrifice (Gestation Day 17).

5. Mortality and Reactions

Daily records of mortality and untoward behavioral reactions were maintained throughout the investigation.

6. Reproductive Effects

All females were sacrificed by carbon dioxide asphyxiation on the 17th day of gestation. An incision was made in the abdominal wall and the full extent of both uterine horns was exposed immediately. Fetal swellings and implantation sites were counted, special attention being paid to resorption sites or any other uterine abnormalities.

The number of viable fetuses present in the uterus was determined, spontaneous movement and a more ruddy color distinguishing live from dead animals.

* Purina Rat Chow, Ralston Purina Company, St. Louis, Missouri.

7. Fetal Development

a. Body Weight

All fetuses were removed from the chorion after cutting the umbilical cord. Blotting paper was then used to remove excess amniotic fluid and the fetuses were sexed and weighed.

b. External Examination

An external examination of the fetuses was conducted with special attention paid to detection of the following abnormalities: hydrocephaly, exencephaly, meningoencephalocele, simple meningocele, anophthalmia, microphthalmia, cleft lip, oblique facial cleft, micrognathia, external ear abnormalities in size, shape or position, unusual size or position of the limbs, number and disposition of the digits, umbilical hernia, gastroschisis, myelomeningocele, spina bifida and scoliosis.

c. Fetal Skeletal and Internal Development

All of the fetuses which were obtained were examined for either skeletal or internal development. When possible, equal numbers of fetuses of each sex from each litter were examined by each method. Evaluation of skeletal development was conducted using Hurley's* method of Alizarin staining. Internal development was evaluated using the free-hand razor blade section technique of Wilson and Warkany**.

* Hurley, Lucille S., "Demonstration A-Alizarin Staining of Bone," (revised) Supplement to Teratology Workshop Manual, Berkeley, California, January 25-30, 1965, pp. 121-122.

** Wilson, James G. and Warkany, Josef, Teratology Principles and Techniques, University of Chicago Press, Chicago, Illinois, 1965, pp. 271-277.

C. Results

1. Body Weights

Mean body weight data are presented in Table VI. A slight reduction in body weight gains was observed in the TGEL (35%) I group. The TGEL (35%) II group and both the TGEL (70%) groups exhibited body weight gains comparable to those observed for other groups fed diets containing beef and for the CGN groups fed the semipurified diet. There were no changes in body weights or body weight gains which could be attributed to the ingestion of the test diets.

TABLE VI

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Mice

Body Weight Data

Summary of Results

| Group | (Beef Content) | | Mean Body Weight (g) Day of Gestation: 6 | 9 | 12 | 15 | 17 | Total Weight Gain (g) |
|---|---|---|---|---|---|---|---|---|
| Control | (None) | I | 32 | 33 | 35 | 41 | 49 | 17 |
| | | II | 30 | 32 | 35 | 40 | 48 | 18 |
| CGN | (None) | I | 33* | 34 | 39** | 44* | 47 | 14 |
| | | II | 30 | 33 | 36 | 41 | 45* | 15 |
| CGF | (35%) | I | 30 | 34* | 37* | 44* | 45* | 15 |
| | | II | 29 | 35** | 39** | 45** | 46 | 17 |
| CGF | (70%) | I | 30 | 35* | 38* | 45** | 45* | 15 |
| | | II | 29* | 35** | 39** | 44** | 44** | 14 |
| CGT | (35%) | I | 30 | 34 | 36 | 45** | 45* | 15 |
| | | II | 32 | 36** | 38** | 48** | 51 | 19 |
| CGT | (70%) | I | 32 | 36** | 38* | 48** | 49 | 17 |
| | | II | 30 | 34 | 37** | 45* | 46 | 16 |
| TGCO | (35%) | I | 31 | 36* | 40** | 47** | 49 | 18 |
| | | II | 31 | 34 | 39** | 46** | 48 | 17 |
| TGCO | (70%) | I | 31 | 36** | 39** | 45** | 49 | 18 |
| | | II | 30 | 34 | 39** | 44** | 47 | 17 |
| TGEL | (35%) | I | 31 | 32 | 38 | 44 | 42** | 11 |
| | | II | 30 | 32 | 36 | 43 | 43** | 13 |
| TGEL | (70%) | I | 31 | 33 | 37 | 44** | 45* | 14 |
| | | II | 30 | 33 | 37 | 44** | 45* | 14 |

* Statistically significant intergroup difference at the 95 percent confidence level.
** Statistically significant intergroup difference at the 99 percent confidence level.

2. Food Consumption

Results of the daily food consumption measurements are presented in Table VII. The groups fed diets containing beef consumed 7 to 46 percent more food than that consumed by the control groups fed the standard stock ration. The animals fed diets containing 70 percent beef consumed more food than that consumed by the animals fed diets containing 35 percent beef. The animals fed the semipurified diet (CGN) containing no beef consumed 12 percent more food than that consumed by the control groups.

TABLE VII

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Mice

Daily Food Consumption Data

Summary of Results

| Group | (Beef Content) | | Mean Daily Food Consumption (g/mouse) Day of Gestation: 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | Total Food Consumed Days 6-15 (g/mouse) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Control | (None) | I | 6.1 | 8.2 | 8.1 | 9.0 | 8.1 | 8.4 | 6.1 | 7.8 | 9.7 | 7.0 | 78.5 |
| | | II | 10.0 | 8.1 | 9.2 | 8.3 | 8.6 | 7.9 | 6.5 | 7.7 | 8.1 | 8.2 | 82.6 |
| CGN | (None) | I | 3.8 | 10.9 | 9.1 | 7.9 | 9.8 | 9.0 | 8.5 | 9.1 | 11.1 | 11.7 | 90.9 |
| | | II | 2.5 | 7.6 | 10.0 | 8.4 | 10.7 | 8.2 | 8.0 | 9.4 | 12.1 | 13.5 | 90.4 |
| CGF | (35%) | I | 7.4 | 7.8 | 6.1 | 8.6 | 10.2 | 10.2 | 10.1 | 12.3 | 10.3 | 12.0 | 95.0 |
| | | II | 4.9 | 9.2 | 6.5 | 9.3 | 10.7 | 10.5 | 11.6 | 9.7 | 9.8 | 12.3 | 94.5 |
| CGF | (70%) | I | 7.9 | 8.8 | 7.9 | 11.1 | 13.2 | 11.5 | 12.5 | 11.7 | 11.1 | 14.0 | 109.7 |
| | | II | 6.7 | 9.2 | 8.2 | 10.3 | 13.4 | 12.4 | 12.3 | 11.1 | 12.2 | 13.2 | 109.0 |
| CGT | (35%) | I | 4.2 | 6.7 | 10.0 | 11.1 | 9.7 | 11.4 | 11.6 | 9.5 | 12.4 | 11.4 | 98.0 |
| | | II | 5.0 | 8.4 | 7.3 | 10.6 | 9.6 | 9.5 | 10.9 | 9.0 | 10.2 | 10.5 | 91.0 |
| CGT | (70%) | I | 10.2 | 12.1 | 11.0 | 10.3 | 10.8 | 12.6 | 12.0 | 11.5 | 13.2 | 14.2 | 117.9 |
| | | II | 8.7 | 13.3 | 10.6 | 13.0 | 11.4 | 10.7 | 12.3 | 10.7 | 12.3 | 13.0 | 116.0 |
| TGCO | (35%) | I | 6.1 | 10.8 | 11.5 | 11.3 | 10.4 | 9.1 | 11.3 | 8.3 | 13.0 | 8.6 | 100.4 |
| | | II | 6.6 | 10.1 | 10.3 | 10.2 | 6.1 | 8.3 | 10.5 | 8.5 | 12.7 | 8.7 | 92.0 |
| TGCO | (70%) | I | 6.8 | 11.1 | 10.8 | 12.6 | 11.8 | 10.2 | 12.1 | 9.9 | 13.3 | 10.6 | 109.2 |
| | | II | 4.5 | 8.9 | 11.6 | 13.2 | 10.8 | 11.0 | 12.8 | 11.0 | 12.4 | 10.4 | 106.6 |
| TGEL | (35%) | I | 6.5 | 9.9 | 6.9 | 10.2 | 8.1 | 11.4 | 9.6 | 10.6 | 12.1 | 10.0 | 95.3 |
| | | II | 5.4 | 9.1 | 7.0 | 10.5 | 7.2 | 9.8 | 7.7 | 8.4 | 10.8 | 10.4 | 86.3 |
| TGEL | (70%) | I | 8.9 | 9.8 | 8.9 | 11.6 | 8.1 | 11.1 | 9.0 | 8.7 | 12.9 | 11.4 | 100.4 |
| | | II | 6.6 | 12.4 | 9.4 | 12.7 | 8.8 | 12.1 | 10.0 | 9.7 | 11.9 | 12.7 | 106.3 |

3. Mortality and Reactions

There were no deaths among test or control animals during the investigation. No untoward behavioral reactions were observed among test or control animals.

4. Reproductive Effects

The data related to reproduction which were collected at the time of sacrifice on Gestation Day 17 are summarized in Table VIII. These data include the mean numbers of corpora lutea, implantation sites, resorption sites, and viable fetuses per female. The CGN (None) II, TGCO (35%) II, and TGEL (35%) I groups exhibited increases in the mean number of early resorption sites per female. In each group, 1 female accounted for 5 or more early resorption sites. The CGN (None) I, TGCO (35%) I, and TGEL (35%) II groups, which were paired with the groups showing increases in resorption sites, did not exhibit similar effects. The CGF (70%) II and TGEL (35%) I groups exhibited increases in the percent of females with 1 or more resorption sites. The CGF (70%) I and TGEL (35%) II groups did not exhibit increases in the percent of females with 1 or more resorption sites. The above observations demonstrate the normal variability of results expected with albino mice. There were no reproductive effects noted which could be related to the ingestion of the test diets.

TABLE VIII

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Mice

Reproductive Effects

Summary of Results

| Group | (Beef Content) | | Number of Pregnant Females Examined | Autopsy Findings (Mean/Female) Corpora Lutea | Implantation Sites | Resorption Sites[a] (e) | (l) | Viable Fetuses | Females With 1 or More Resorption Sites Total | Percent |
|---|---|---|---|---|---|---|---|---|---|---|
| Control | (None) | I | 15 | 11.4 | 11.0 | 0.9 | 0.4 | 9.7 | 8 | 53.3 |
| | | II | 12 | 11.4 | 11.2 | 0.8 | 0.3 | 10.1 | 8 | 66.7 |
| CGN | (None) | I | 13 | 11.9 | 11.8 | 0.9 | 0.3 | 10.6 | 10 | 76.9 |
| | | II | 12 | 12.7 | 12.2 | 1.3[b] | 0.0 | 10.9 | 8 | 66.7 |
| CGF | (35%) | I | 16 | 12.0 | 11.6 | 0.4* | 0.1 | 11.1 | 6 | 37.5 |
| | | II | 15 | 12.2 | 11.9 | 0.5 | 0.3 | 11.0 | 7 | 46.7 |
| CGF | (70%) | I | 10 | 12.3 | 11.4 | 0.7 | 0.3 | 10.4 | 4 | 40.0 |
| | | II | 19 | 11.3 | 11.0 | 1.0 | 0.5 | 9.5 | 17 | 89.5 |
| CGT | (35%) | I | 16 | 11.8 | 11.4 | 0.8 | 0.0 | 10.6 | 10 | 62.5 |
| | | II | 13 | 12.7 | 12.3 | 0.5* | 0.0 | 11.8 | 4 | 30.8 |
| CGT | (70%) | I | 13 | 12.9 | 12.0 | 0.2** | 0.0 | 11.8 | 3 | 23.1 |
| | | II | 18 | 10.9 | 10.4 | 1.0 | 0.0 | 9.4 | 12 | 66.7 |
| TGCO | (35%) | I | 14 | 12.6 | 12.1 | 1.1 | 0.0 | 11.0 | 7 | 50.0 |
| | | II | 20 | 12.4 | 11.7 | 1.6[b] | 0.1 | 10.0 | 15 | 75.0 |
| TGCO | (70%) | I | 18 | 12.3 | 11.9 | 0.6 | 0.1 | 11.2 | 7 | 38.9 |
| | | II | 17 | 10.9 | 10.5 | 0.9 | 0.5 | 9.1 | 12 | 70.5 |
| TGEL | (35%) | I | 8 | 11.7 | 10.4 | 1.8**[b] | 0.7 | 7.9 | 8 | 100.0 |
| | | II | 13 | 12.3 | 11.9 | 0.5 | 0.1 | 11.3 | 7 | 53.8 |
| TGEL | (70%) | I | 12 | 11.8 | 11.6 | 0.7 | 0.1 | 10.8 | 7 | 58.3 |
| | | II | 14 | 11.7 | 11.6 | 0.4 | 0.2 | 11.0 | 8 | 57.1 |

* Statistically significant intergroup difference at the 95 percent confidence level.
** Statistically significant intergroup difference at the 99 percent confidence level.
[a] (e) = Early resorption site; (l) = late resorption site
[b] One female accounted for 5 or more early resorption sites.

5. Fetal Development

a. Body Weight

Fetal body weight data are presented in Table IX. The body weights of the fetuses obtained from some of the groups receiving diets containing beef were slightly reduced. The body weight reductions were minimal and were not dose-related. There were no significant differences in fetal body weight noted between groups fed diets containing irradiated beefs and those fed diets containing non-irradiated beefs. No effects on fetal body weights were observed that could be attributed to prenatal exposure to diets containing beef.

TABLE IX

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Mice

Fetal Body Weight Data

Summary of Results

| Group | (Beef Content) | | Number of Males | Mean Body Weight (g) | Number of Females | Mean Body Weight (g) | Number of Males per 100 Fetuses |
|---|---|---|---|---|---|---|---|
| Control | (None) | I | 79 | 1.0 | 66 | 1.1 | 54.5 |
| | | II | 70 | 0.9 | 51 | 0.9 | 57.8 |
| CGN | (None) | I | 67 | 1.0 | 71 | 0.9 | 48.6 |
| | | II | 70 | 1.0 | 61 | 0.9 | 53.4 |
| CGF | (35%) | I | 90 | 0.8 | 87 | 0.7 | 50.8 |
| | | II | 92 | 0.7 | 73 | 0.7 | 55.8 |
| CGF | (70%) | I | 51 | 0.7 | 53 | 0.7 | 49.0 |
| | | II | 90 | 0.8 | 90 | 0.7 | 50.0 |
| CGT | (35%) | I | 90 | 0.8 | 80 | 0.8 | 52.9 |
| | | II | 88 | 0.9 | 66 | 0.9 | 57.1 |
| CGT | (70%) | I | 86 | 0.9 | 68 | 0.9 | 55.8 |
| | | II | 91 | 0.9 | 78 | 0.8 | 53.8 |
| TGCO | (35%) | I | 80 | 0.7 | 75 | 0.7 | 56.0 |
| | | II | 112 | 0.7 | 88 | 0.7 | 56.0 |
| TGCO | (70%) | I | 108 | 0.8 | 94 | 0.7 | 53.5 |
| | | II | 87 | 0.7 | 67 | 0.7 | 56.5 |
| TGEL | (35%) | I | 28 | 0.8 | 35 | 0.8 | 44.4 |
| | | II | 74 | 0.8 | 73 | 0.8 | 50.3 |
| TGEL | (70%) | I | 70 | 0.8 | 60 | 0.8 | 53.8 |
| | | II | 73 | 0.8 | 80 | 0.8 | 47.7 |

b. External Development

The results of the examinations for fetal external development are presented in Table X. One (1) TGEL (35%) II female accounted for 11 of the 13 runt fetuses noted in this group. This observation was not attributed to the ingestion of the diet for this group. There were no external abnormalities noted in the TGEL (35%) I group which received the same diet. There were no changes in the type or incidence of external abnormalities which could be attributed to the ingestion of the test diets.

TABLE X

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Mice

External Fetal Development

Summary of Results

| Group | (Beef Content) | Number of Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| Control | (None) I | 145 | Hematoma | 3 | 2.1 |
| | | | Runt | 1 | 0.7 |
| | | | Total number of fetuses with findings | 3 | 2.1 |
| | | | Total number of normal fetuses | 142 | 97.9 |
| | II | 121 | Hematoma | 3 | 2.5 |
| | | | Runt | 2 | 1.7 |
| | | | Total number of fetuses with findings | 5 | 4.1 |
| | | | Total number of normal fetuses | 116 | 95.9 |
| CGN | (None) I | 132 | Runt | 2 | 1.5 |
| | | | Gastroschisis | 1 | 0.8 |
| | | | Total number of fetuses with findings | 2 | 1.5 |
| | | | Total number of normal fetuses | 130 | 98.5 |
| | II | 131 | Hematoma | 1 | 0.8 |
| | | | Total number of fetuses with findings | 1 | 0.8 |
| | | | Total number of normal fetuses | 130 | 99.2 |

TABLE X continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Mice

External Fetal Development

Summary of Results

| Group | (Beef Content) | Number of Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| CGF | (35%) I | 177 | Hematoma | 1 | 0.6 |
| | | | Runt | 1 | 0.6 |
| | | | Cranioschisis | 1 | 0.6 |
| | | | Total number of fetuses with findings | 2 | 1.1 |
| | | | Total number of normal fetuses | 175 | 98.9 |
| | II | 165 | No external malformations noted | - | - |
| CGF | (70%) I | 104 | Hematoma | 1 | 1.0 |
| | | | Total number of fetuses with findings | 1 | 1.0 |
| | | | Total number of normal fetuses | 103 | 99.0 |
| | II | 180 | Hematoma | 1 | 0.6 |
| | | | Total number of fetuses with findings | 1 | 0.6 |
| | | | Total number of normal fetuses | 179 | 99.4 |
| CGT | (35%) I | 170 | Hematoma | 1 | 0.6 |
| | | | Total number of fetuses with findings | 1 | 0.6 |
| | | | Total number of normal fetuses | 169 | 99.4 |
| | II | 154 | No external malformations noted | - | - |

TABLE X continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Mice

External Fetal Development

Summary of Results

| Group | (Beef Content) | Number of Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| CGT | (70%) I | 154 | No external malformations noted | - | - |
| | II | 169 | No external malformations noted | - | - |
| TGCO | (35%) I | 155 | Cranioschisis | 1 | 0.6 |
| | | | Total number of fetuses with findings | 1 | 0.6 |
| | | | Total number of normal fetuses | 154 | 99.4 |
| | II | 200 | No external malformations noted | - | - |
| TGCO | (70%) I | 202 | Hematoma | 1 | 0.5 |
| | | | Runt | 1 | 0.5 |
| | | | Total number of fetuses with findings | 2 | 1.0 |
| | | | Total number of normal fetuses | 200 | 99.0 |
| | II | 63 | No external malformations noted | - | - |

TABLE X continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Mice

External Fetal Development

Summary of Results

| Group | (Beef Content) | Number of Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| TGEL | (35%) I | 63 | No external malformations noted | - | - |
| | II | 147 | Runt | 13* | 8.8 |
| | | | Total number of fetuses with findings | 13 | 8.8 |
| | | | Total number of normal fetuses | 134 | 91.2 |
| TGEL | (70%) I | 130 | Shortened tail | 1 | 0.8 |
| | | | Total number of fetuses with findings | 1 | 0.8 |
| | | | Total number of normal fetuses | 129 | 99.2 |
| | II | 153 | No external malformations noted | - | - |

* Eleven (11) fetuses were obtained from 1 litter.

c. Skeletal Development

A summary and interpretation of skeletal findings is presented in Table XI. Observations of fetal skeletal development at caesarian section are presented in Table XII.

Those fetuses having sternum sections that were only partially stained with the calcium positive Alizarin dye were classified as incompletely ossified sections. Sternum sections that did not retain any of the dye were classified as non-ossified. These classifications are measures of the relative extent of fetal skeletal calcification at the time of sacrifice. Incompletely ossified sternum sections, non-ossified sternum sections, and supernumerary ribs are classified as incidental skeletal findings. These incidental skeletal findings are normally observed in fetuses obtained from untreated control does.

A few groups [CGT (35%) I, TGCO (70%) II, TGEL (35%) I] exhibited increases in the percentage of fetuses with incidental skeletal findings. The incidences of incidental skeletal findings in these groups exhibiting increases were within the ranges normally observed for fetuses obtained from albino mice used in similar teratogenic studies conducted in this laboratory. The incidences of incidental skeletal findings were considered normal in all groups. There were no changes in the occurrence of skeletal abnormalities which could be attributed to prenatal exposure to the test diets.

TABLE XI

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Mice

Fetal Skeletal Development

Summary and Interpretation of Findings

| Group | (Beef Content) | | Number of Fetuses | Number of Fetuses with Skeletal Findings (Abnormalities + Incidental Findings) | Number of Fetuses with Skeletal Abnormalities | Number of Fetuses with Incidental Findings Only | Number of Fetuses with no Findings | Total Fetuses Unaffected by Treatment |
|---|---|---|---|---|---|---|---|---|
| Control | (None) | I | 72 | 43 | 1 | 42 | 29 | 71 |
| | | | Percent: | 59.7 | 1.4 | 58.3 | 40.3 | 98.6 |
| | | II | 59 | 41 | 2 | 39 | 18 | 57 |
| | | | Percent: | 69.5 | 3.4 | 66.1 | 30.5 | 96.6 |
| CGN | (None) | I | 66 | 38 | 0 | 38 | 28 | 66 |
| | | | Percent: | 57.6 | 0.0 | 57.6 | 42.4 | 100.0 |
| | | II | 64 | 36 | 1 | 35 | 28 | 63 |
| | | | Percent: | 56.2 | 1.6 | 54.7 | 43.8 | 98.4 |
| CGF | (35%) | I | 89 | 68 | 1 | 67 | 21 | 88 |
| | | | Percent: | 76.4 | 1.1 | 75.3 | 23.6 | 98.9 |
| | | II | 82 | 58 | 1 | 57 | 24 | 81 |
| | | | Percent: | 70.7 | 1.2 | 69.5 | 29.3 | 98.8 |
| CGF | (70%) | I | 57 | 38 | 1 | 37 | 19 | 56 |
| | | | Percent: | 66.7 | 1.8 | 64.9 | 33.3 | 98.2 |
| | | II | 92 | 54 | 3 | 51 | 38 | 89 |
| | | | Percent: | 58.7 | 3.3 | 55.4 | 41.3 | 96.7 |
| CGT | (35%) | I | 87 | 72 | 0 | 72 | 15 | 87 |
| | | | Percent: | 82.8 | 0.0 | 82.8 | 17.2 | 100.0 |
| | | II | 80 | 46 | 0 | 46 | 34 | 80 |
| | | | Percent: | 57.5 | 0.0 | 57.5 | 42.5 | 100.0 |
| CGT | (70%) | I | 80 | 52 | 0 | 52 | 28 | 80 |
| | | | Percent: | 65.0 | 0.0 | 65.0 | 35.0 | 100.0 |
| | | II | 88 | 69 | 0 | 69 | 19 | 88 |
| | | | Percent: | 78.4 | 0.0 | 78.4 | 21.6 | 100.0 |
| TGCO | (35%) | I | 76 | 55 | 0 | 55 | 21 | 76 |
| | | | Percent: | 72.4 | 0.0 | 72.4 | 27.6 | 100.0 |
| | | II | 100 | 65 | 0 | 65 | 35 | 100 |
| | | | Percent: | 65.0 | 0.0 | 65.0 | 35.0 | 100.0 |
| TGCO | (70%) | I | 99 | 72 | 0 | 72 | 27 | 99 |
| | | | Percent: | 72.7 | 0.0 | 72.7 | 27.3 | 100.0 |
| | | II | 77 | 63 | 0 | 63 | 14 | 77 |
| | | | Percent: | 81.8 | 0.0 | 81.8 | 18.1 | 100.0 |
| TGEL | (35%) | I | 31 | 28 | 0 | 28 | 3 | 31 |
| | | | Percent: | 90.3 | 0.0 | 90.3 | 9.7 | 100.0 |
| | | II | 72 | 54 | 1 | 53 | 18 | 71 |
| | | | Percent: | 75.0 | 1.4 | 73.6 | 25.0 | 98.6 |
| TGEL | (70%) | I | 65 | 33 | 0 | 33 | 32 | 65 |
| | | | Percent: | 50.8 | 0.0 | 50.8 | 49.2 | 100.0 |
| | | II | 77 | 59 | 2 | 57 | 18 | 75 |
| | | | Percent: | 76.6 | 2.6 | 74.0 | 23.4 | 97.4 |

TABLE XII

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Mice

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | Number of Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| Control | (None) I | 72 | Incompletely ossified sternum section(s) | 29 | 40.3 |
| | | | Non-ossified sternum section(s) | 21 | 29.2 |
| | | | Sternocostal asymmetry | 1 | 1.4 |
| | | | Supernumerary ribs | 5 | 6.9 |
| | | | Total number of fetuses with findings | 43 | 59.7 |
| | | | Total number of normal fetuses | 29 | 40.3 |
| | II | 59 | Incompletely ossified sternum section(s) | 16 | 27.1 |
| | | | Non-ossified sternum section(s) | 30 | 50.8 |
| | | | Dual ossification of sternum sections | 1 | 1.7 |
| | | | Supernumerary ribs | 9 | 15.2 |
| | | | Angulated ribs | 1 | 1.7 |
| | | | Total number of fetuses with findings | 41 | 69.5 |
| | | | Total number of normal fetuses | 18 | 30.5 |

TABLE XII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Mice

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | Number of Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| CGN | (None) I | 66 | Incompletely ossified sternum section(s) | 15 | 22.7 |
| | | | Non-ossified sternum section(s) | 27 | 40.7 |
| | | | Total number of fetuses with findings | 38 | 57.6 |
| | | | Total number of normal fetuses | 28 | 42.4 |
| | II | 64 | Incompletely ossified sternum section(s) | 13 | 20.3 |
| | | | Non-ossified sternum section(s) | 23 | 35.9 |
| | | | Sternocostal asymmetry | 1 | 1.6 |
| | | | Supernumerary ribs | 4 | 6.2 |
| | | | Total number of fetuses with findings | 36 | 56.2 |
| | | | Total number of normal fetuses | 28 | 43.8 |
| CGF | (35%) I | 89 | Incompletely ossified sternum section(s) | 34 | 38.2 |
| | | | Non-ossified sternum section(s) | 34 | 38.2 |
| | | | Sternocostal asymmetry | 1 | 1.1 |
| | | | Supernumerary ribs | 17 | 19.1 |
| | | | Total number of fetuses with findings | 68 | 76.4 |
| | | | Total number of normal fetuses | 21 | 23.6 |

TABLE XII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Mice

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | Number of Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| CGF | (35%) II | 82 | Incompletely ossified sternum section(s) | 36 | 43.9 |
| | | | Non-ossified sternum section(s) | 28 | 34.1 |
| | | | Sternocostal asymmetry | 1 | 1.2 |
| | | | Supernumerary ribs | 12 | 14.6 |
| | | | Total number of fetuses with findings | 58 | 70.7 |
| | | | Total number of normal fetuses | 24 | 29.3 |
| CGF | (70%) I | 57 | Incompletely ossified sternum section(s) | 29 | 50.9 |
| | | | Non-ossified sternum section(s) | 21 | 36.8 |
| | | | Extra sternum section | 1 | 1.8 |
| | | | Supernumerary ribs | 6 | 10.5 |
| | | | Total number of fetuses with findings | 38 | 66.7 |
| | | | Total number of normal fetuses | 19 | 33.3 |
| | II | 92 | Incompletely ossified sternum section(s) | 24 | 26.1 |
| | | | Non-ossified sternum section(s) | 30 | 32.6 |
| | | | Sternocostal asymmetry | 2 | 2.2 |
| | | | Extra sternum section | 1 | 1.1 |
| | | | Supernumerary ribs | 11 | 12.0 |
| | | | Total number of fetuses with findings | 54 | 58.7 |
| | | | Total number of normal fetuses | 38 | 41.3 |

TABLE XII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Mice

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | Number of Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| CGT | (35%) I | 87 | Incompletely ossified sternum section(s) | 37 | 42.5 |
| | | | Non-ossified sternum section(s) | 43 | 49.4 |
| | | | Supernumerary ribs | 11 | 12.6 |
| | | | Total number of fetuses with findings | 72 | 82.8 |
| | | | Total number of normal fetuses | 15 | 17.2 |
| | II | 80 | Incompletely ossified sternum section(s) | 20 | 25.0 |
| | | | Non-ossified sternum section(s) | 16 | 20.0 |
| | | | Supernumerary ribs | 15 | 18.8 |
| | | | Total number of fetuses with findings | 46 | 57.5 |
| | | | Total number of normal fetuses | 34 | 42.5 |
| CGT | (70%) I | 80 | Incompletely ossified sternum section(s) | 30 | 37.5 |
| | | | Non-ossified sternum section(s) | 36 | 45.0 |
| | | | Supernumerary ribs | 11 | 13.8 |
| | | | Total number of fetuses with findings | 52 | 65.0 |
| | | | Total number of normal fetuses | 28 | 35.0 |
| | II | 88 | Incompletely ossified sternum section(s) | 30 | 34.1 |
| | | | Non-ossified sternum section (s) | 46 | 52.3 |
| | | | Supernumerary ribs | 11 | 12.5 |
| | | | Total number of fetuses with findings | 69 | 78.4 |
| | | | Total number of normal fetuses | 19 | 21.6 |

TABLE XII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Mice

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | Number of Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| TGCO | (35%) I | 76 | Incompletely ossified sternum section(s) | 33 | 43.4 |
| | | | Non-ossified sternum section(s) | 31 | 40.8 |
| | | | Supernumerary ribs | 10 | 13.2 |
| | | | Total number of fetuses with findings | 55 | 72.4 |
| | | | Total number of normal fetuses | 21 | 27.6 |
| | II | 100 | Incompletely ossified sternum section(s) | 25 | 25.0 |
| | | | Non-ossified sternum section(s) | 45 | 45.0 |
| | | | Supernumerary ribs | 4 | 4.0 |
| | | | Total number of fetuses with findings | 65 | 65.0 |
| | | | Total number of normal fetuses | 35 | 35.0 |
| TGCO | (70%) I | 99 | Incompletely ossified sternum section(s) | 43 | 43.4 |
| | | | Non-ossified sternum section(s) | 37 | 37.4 |
| | | | Supernumerary ribs | 15 | 15.2 |
| | | | Total number of fetuses with findings | 72 | 72.7 |
| | | | Total number of normal fetuses | 27 | 27.3 |
| | II | 77 | Incompletely ossified sternum section(s) | 40 | 51.9 |
| | | | Non-ossified sternum section(s) | 41 | 53.2 |
| | | | Supernumerary ribs | 5 | 6.5 |
| | | | Total number of fetuses with findings | 63 | 81.8 |
| | | | Total number of normal fetuses | 14 | 18.1 |

TABLE XII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Mice

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | Number of Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| TGEL | (35%) I | 31 | Incompletely ossified sternum section(s) | 19 | 61.3 |
| | | | Non-ossified sternum section(s) | 18 | 58.1 |
| | | | Supernumerary ribs | 4 | 12.9 |
| | | | Total number of fetuses with findings | 28 | 90.3 |
| | | | Total number of normal fetuses | 3 | 9.7 |
| | II | 72 | Incompletely ossified sternum section(s) | 27 | 37.5 |
| | | | Non-ossified sternum section(s) | 37 | 51.4 |
| | | | Supernumerary ribs | 9 | 12.5 |
| | | | Dome-shaped frontal and parietal bones | 1 | 1.4 |
| | | | Total number of fetuses with findings | 54 | 75.0 |
| | | | Total number of normal fetuses | 18 | 25.0 |

TABLE XII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Mice

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | Number of Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| TGEL | (70%) I | 65 | Incompletely ossified sternum section(s) | 20 | 30.8 |
| | | | Non-ossified sternum section(s) | 16 | 24.6 |
| | | | Supernumerary ribs | 5 | 7.7 |
| | | | Total number of fetuses with findings | 33 | 50.8 |
| | | | Total number of normal fetuses | 32 | 49.2 |
| | II | 77 | Incompletely ossified sternum section(s) | 34 | 44.1 |
| | | | Non-ossified sternum section(s) | 40 | 51.9 |
| | | | Supernumerary ribs | 10 | 13.0 |
| | | | Malformed (curved) femur and tibula-fibula | 1 | 1.3 |
| | | | Extra digit | 1 | 1.3 |
| | | | Total number of fetuses with findings | 59 | 76.6 |
| | | | Total number of normal fetuses | 18 | 23.4 |

d. Internal Development

The results of the evaluation of fetal internal development are presented in Table XIII. Large and small atria noted in this table are considered to be incidental findings. Slight variations in the size of the atrium are considered to occur as a result of fixation and the extent of fetal viability prior to sacrifice. There were no changes in the types or incidences of internal findings in any of the groups which could be a attributed to prenatal exposure to the test diets.

TABLE XIII

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Mice

Fetal Internal Development

Summary of Results

| Group | (Beef Content) | Number of Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| Control | (None) I | 73 | Small atria | 5 | 6.8 |
| | | | Large atria | 3 | 4.1 |
| | | | Total number of fetuses with findings | 8 | 11.0 |
| | | | Total number of normal fetuses | 65 | 89.0 |
| | II | 62 | Large atria | 1 | 1.6 |
| | | | Cleft palate | 1 | 1.6 |
| | | | Total number of fetuses with findings | 2 | 3.2 |
| | | | Total number of normal fetuses | 60 | 96.8 |

TABLE XIII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Mice

Fetal Internal Development

Summary of Results

| Group | (Beef Content) | Number of Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| CGN | (None) I | 72 | Large atria | 2 | 2.8 |
| | | | Cleft palate | 1 | 1.4 |
| | | | Gastroschisis | 1 | 1.4 |
| | | | Total number of fetuses with findings | 4 | 5.6 |
| | | | Total number of normal fetuses | 68 | 94.4 |
| | II | 67 | Large atria | 1 | 1.5 |
| | | | Total number of fetuses with findings | 1 | 1.5 |
| | | | Total number of normal fetuses | 66 | 98.5 |

TABLE XIII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Mice

Fetal Internal Development

Summary of Results

| Group | (Beef Content) | Number of Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| CGF | (35%) I | 88 | Large atria | 9 | 10.2 |
| | | | Total number of fetuses with findings | 9 | 10.2 |
| | | | Total number of normal fetuses | 79 | 89.8 |
| | II | 83 | Small atria | 1 | 1.2 |
| | | | Large atria | 15 | 18.1 |
| | | | Total number of fetuses with findings | 16 | 19.3 |
| | | | Total number of normal fetuses | 67 | 80.7 |
| CGF | (70%) I | 47 | Large atria | 7 | 14.9 |
| | | | Total number of fetuses with findings | 7 | 14.9 |
| | | | Total number of normal fetuses | 40 | 85.1 |
| | II | 88 | Large atria | 10 | 11.4 |
| | | | Total number of fetuses with findings | 10 | 11.4 |
| | | | Total number of normal fetuses | 78 | 88.6 |

TABLE XIII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Mice

Fetal Internal Development

Summary of Results

| Group | (Beef Content) | Number of Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| CGT | (35%) I | 83 | Small atria | 1 | 1.2 |
| | | | Large atria | 2 | 2.4 |
| | | | Total number of fetuses with findings | 3 | 3.6 |
| | | | Total number of normal fetuses | 80 | 96.4 |
| | II | 74 | Large atria | 11 | 14.9 |
| | | | Total number of fetuses with findings | 11 | 14.9 |
| | | | Total number of normal fetuses | 63 | 85.1 |
| CGT | (70%) I | 74 | Large atria | 5 | 6.8 |
| | | | Cleft palate | 1 | 1.4 |
| | | | Total number of fetuses with findings | 6 | 8.1 |
| | | | Total number of normal fetuses | 68 | 91.9 |
| | II | 81 | Small atria | 1 | 1.2 |
| | | | Large atria | 3 | 3.7 |
| | | | Total number of fetuses with findings | 4 | 4.9 |
| | | | Total number of normal fetuses | 77 | 95.1 |

TABLE XIII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Mice

Fetal Internal Development

Summary of Results

| Group | (Beef Content) | Number of Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| TGCO | (35%) I | 79 | Large atria | 5 | 6.3 |
| | | | Cleft palate | 3 | 3.8 |
| | | | Total number of fetuses with findings | 8 | 10.1 |
| | | | Total number of normal fetuses | 71 | 89.9 |
| | II | 100 | Large atria | 3 | 3.0 |
| | | | Total number of fetuses with findings | 3 | 3.0 |
| | | | Total number of normal fetuses | 97 | 97.0 |
| TGCO | (70%) I | 103 | Large atria | 8 | 7.8 |
| | | | Total number of fetuses with findings | 8 | 7.8 |
| | | | Total number of normal fetuses | 95 | 92.2 |
| | II | 77 | Large atria | 4 | 5.2 |
| | | | Total number of fetuses with findings | 4 | 5.2 |
| | | | Total number of normal fetuses | 73 | 94.8 |

TABLE XIII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Mice

Fetal Internal Development

Summary of Results

| Group | (Beef Content) | Number of Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| TGEL | (35%) I | 32 | Large atria | 5 | 15.6 |
| | | | Total number of fetuses with findings | 5 | 15.6 |
| | | | Total number of normal fetuses | 27 | 84.4 |
| | II | 75 | Large atria | 5 | 6.7 |
| | | | Cleft palate | 1 | 1.3 |
| | | | Total number of fetuses with findings | 6 | 8.0 |
| | | | Total number of normal fetuses | 69 | 92.0 |
| TGEL | (70%) I | 65 | Large atria | 6 | 9.2 |
| | | | Cleft palate | 1 | 1.5 |
| | | | Total number of fetuses with findings | 7 | 10.8 |
| | | | Total number of normal fetuses | 58 | 89.2 |
| | II | 76 | Large atria | 6 | 7.9 |
| | | | Cleft palate | 1 | 1.3 |
| | | | Total number of fetuses with findings | 7 | 9.2 |
| | | | Total number of normal fetuses | 69 | 90.8 |

## VI. Experiment II - Albino Rats

### A. Summary

Diets containing frozen, thermally processed, cobalt irradiated, or electron irradiated beef were fed to groups of pregnant albino rats during the period of fetal organogenesis. Each type of beef was fed at dietary concentrations of either 35 or 70 percent beef (on a dry matter basis). Each beef diet was fed to 2 groups of pregnant animals. The experimental design included 2 control groups fed a standard stock ration and 2 groups fed the semipurified diet which comprised the remaining portion of each of the beef diets.

Maternal body weight, reproductive effects (including early and late resorption sites, the number of viable fetuses, and the number of females with 1 or more resorption sites), fetal body weight, and fetal development (external, skeletal, and internal) findings are summarized in Table XIV. None of the groups had consistent findings differing from those normally observed for pregnant albino rats of this strain in this laboratory. The findings noted in Table XIV as being other than that normally expected were not confirmed as being significant by either the results obtained with the other group fed the same diet or by the results obtained with groups fed the same beef at a higher concentration.

The ingestion of diets containing frozen, thermally processed, cobalt irradiated, or electron irradiated beef resulted in no maternal body weight changes which could be attributed to the test diets. The groups fed beef

diets generally consumed more food than that consumed by the control groups. There were no changes noted in the data related to reproduction which could be attributed to the ingestion of diets containing beef. No deaths or abnormal behavioral reactions were noted among any of the animals in this phase of the investigation. The body weights of fetuses obtained from females fed diets containing beef were comparable to those of fetuses obtained from females fed control diets (standard stock ration or semipurified diet). Examinations for external, skeletal, and internal development revealed no findings which could be attributed to prenatal exposure to the test diets. Feeding diets containing frozen, thermally processed, cobalt irradiated, or electron irradiated beef to pregnant albino rats during the period of fetal organogenesis did not induce a teratogenic response in this test system.

TABLE XIV

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rats

Summary of Findings

| Group | (Beef Content) | | Reproductive Effects: Maternal Body Weight | Resorption Sites: Early | Resorption Sites: Late | Number of Viable Fetuses | Number of Females with 1 or More Resorption Sites | Fetal Body Weight | Fetal Development: External | Fetal Development: Skeletal | Fetal Development: Internal |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Control | (None) | I | - | - | - | - | - | - | - | - | - |
| | | II | - | - | - | - | - | - | - | - | - |
| CGN | (None) | I | - | - | - | - | - | - | - | - | - |
| | | II | - | - | - | - | - | - | - | - | - |
| CGF | (35%) | I | - | +(I) | - | - | - | - | - | - | - |
| | | II | - | - | - | - | - | - | - | - | - |
| CGF | (70%) | I | - | - | - | - | - | - | - | - | - |
| | | II | - | - | - | - | - | - | - | - | - |
| CGT | (35%) | I | - | +(I) | - | - | - | - | - | - | + |
| | | II | - | - | - | - | - | - | - | - | + |
| CGT | (70%) | I | - | - | - | - | - | - | - | + | - |
| | | II | - | - | - | - | - | - | - | - | - |
| TGCO | (35%) | I | - | - | - | - | - | - | - | - | - |
| | | II | - | - | - | - | - | - | - | - | - |
| TGCO | (70%) | I | - | - | - | - | - | - | - | - | - |
| | | II | - | - | - | - | - | - | - | - | - |
| TGEL | (35%) | I | - | - | - | - | - | - | - | - | - |
| | | II | - | - | - | - | - | - | - | - | - |
| TGEL | (70%) | I | - | - | - | - | - | - | - | - | - |
| | | II | - | - | - | - | - | - | - | - | - |

- = Normal findings
+ = Finding other than normal
(I) = Increase

B. Procedure

1. Experimental Animals

The animals employed were Charles River strain* albino rats. The rats were bred at Charles River Breeding Laboratories and copulation was confirmed by sperm-positive results of vaginal examinations. Day zero is defined as the day of insemination. The animals were then shipped directly to this laboratory on Day 1 of gestation.

2. Organization of Groups

A structural outline of this portion of the investigation is given in Table XV.

* Charles River Breeding Laboratories, Inc., Wilmington, Massachusetts.

TABLE XV

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rats

Outline of Experiment

| Group | Number of Pregnant Animals | Diet | % Beef* |
|---|---|---|---|
| Control I | 19 | Purina Chow | None |
| Control II | 21 | Purina Chow | None |
| CGN I | 19 | Complete Semipurified Diet | None |
| CGN II | 18 | Complete Semipurified Diet | None |
| CGF I | 18 | Frozen Beef | 35 |
| CGF II | 16 | Frozen Beef | 35 |
| CGF I | 17 | Frozen Beef | 70 |
| CGF II | 17 | Frozen Beef | 70 |
| CGT I | 16 | Thermally Processed Beef | 35 |
| CGT II | 19 | Thermally Processed Beef | 35 |
| CGT I | 16 | Thermally Processed Beef | 70 |
| CGT II | 14 | Thermally Processed Beef | 70 |
| TGCO I | 19 | Cobalt Irradiated Beef | 35 |
| TGCO II | 20 | Cobalt Irradiated Beef | 35 |
| TGCO I | 18 | Cobalt Irradiated Beef | 70 |
| TGCO II | 19 | Cobalt Irradiated Beef | 70 |
| TGEL I | 14 | Electron Irradiated Beef | 35 |
| TGEL II | 20 | Electron Irradiated Beef | 35 |
| TGEL I | 15 | Electron Irradiated Beef | 70 |
| TGEL II | 20 | Electron Irradiated Beef | 70 |

* Beef levels are expressed on a dry matter basis.

3. Exposure and Feeding

All diets were prepared in the manner outlined in section III of this report. Animals in control groups I and II were offered the standard stock ration* utilized at this laboratory, as were dams of the test groups prior to and following the treatment period. Dams of each group were offered their respective test diets fresh daily from the 6th day of their gestation period to the 15th day inclusive (a total of 10 days of exposure). Daily records of food consumption were recorded. All animals were allowed food and water ad libitum.

4. Body Weight Data

Body weight data reported include the mean group body weights on Days 6 (initial exposure day), 9, 12, and 15 (final day of exposure) of gestation, and sacrifice (Gestation Day 20).

5. Mortality and Reactions

Daily records of mortality and untoward behavioral reactions were maintained throughout the investigation.

6. Reproductive Effects

All females were sacrificed by carbon dioxide asphyxiation on the 20th day of gestation. An incision was made in the abdominal wall and the full extent of both uterine horns was exposed immediately. Fetal swellings and implantation sites were counted, special attention being paid to resorption sites or any other uterine abnormalities.

The number of viable fetuses present in the uterus was determined, spontaneous movement and a more ruddy color distinguishing live from dead animals.

* Purina Rat Chow, Ralston Purina Company, St. Louis, Missouri.

7. Fetal Development

a. Body Weight

All fetuses were removed from the chorion after cutting the umbilical cord. Blotting paper was then used to remove excess amniotic fluid and the fetuses were sexed and weighed.

b. External Examination

An external examination of the fetuses was conducted with special attention paid to detection of the following abnormalities: hydrocephaly, exencephaly, meningoencephalocele, simple meningocele, anophthalmia, microphthalmia, cleft lip, oblique facial cleft, micrognathia, external ear abnormalities in size, shape or position, unusual size or position of the limbs, number and disposition of the digits, umbilical hernia, gastroschisis, myelomeningocele, spina bifida and scoliosis.

c. Fetal Skeletal and Internal Development

All of the fetuses which were obtained were examined for either skeletal or internal development. When possible, equal numbers of fetuses of each sex from each litter were examined by each method. Evaluation of skeletal development was conducted using Hurley's* method of Alizarin staining. Internal development was evaluated using the free-hand razor blade section technique of Wilson and Warkany**.

* Hurley, Lucille S., "Demonstration A-Alizarin Staining of Bone," (revised) Supplement to Teratology Workshop Manual, Berkeley, California, January 25-30, 1965, pp. 121-122.

** Wilson, James G. and Warkany, Josef, Teratology Principles and Techniques, University of Chicago Press, Chicago, Illinois, 1965, pp. 271-277.

C. Results

1. Body Weight Data

Mean body weight data are presented in Table XVI. The groups fed diets containing 35 percent frozen beef, and either 35 or 70 percent thermally processed and electron irradiated beef exhibited body weight gains which were slightly lower than those of either the control groups or the groups fed the semipurified diet. The other groups fed beef diets exhibited weight gains that were comparable to those of the control groups and to the groups fed the semipurified diet. There were no changes in body weights or body weight gains which could be attributed to the ingestion of the test diets.

TABLE XVI

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rats

Body Weight Data

Summary of Results

| Group | (Beef Content) | | Mean Body Weight (g) Day of Gestation: 6 | 9 | 12 | 15 | 20 | Total Weight Gain (g) |
|---|---|---|---|---|---|---|---|---|
| Control | (None) | I | 206 | 223 | 249 | 269 | 333 | 127 |
| | | II | 204 | 224 | 252 | 274 | 340 | 136 |
| CGN | (None) | I | 196* | 214* | 239* | 264 | 317* | 121 |
| | | II | 203 | 228 | 255 | 282 | 343 | 140 |
| CGF | (35%) | I | 194** | 215 | 238* | 260* | 309** | 115 |
| | | II | 192** | 211* | 233** | 259 | 311** | 119 |
| CGF | (70%) | I | 199 | 221 | 246 | 272 | 335 | 136 |
| | | II | 190** | 216 | 240 | 264 | 310** | 120 |
| CGT | (35%) | I | 178** | 200** | 220** | 248** | 290** | 112 |
| | | II | 172** | 189** | 214** | 240** | 283** | 111 |
| CGT | (70%) | I | 175** | 205** | 222** | 246** | 282** | 107 |
| | | II | 171** | 191** | 218** | 245** | 280** | 109 |
| TGCO | (35%) | I | 199 | 220 | 247 | 273 | 328 | 129 |
| | | II | 192** | 210** | 237** | 264 | 315* | 123 |
| TGCO | (70%) | I | 191** | 211* | 236* | 263 | 327 | 136 |
| | | II | 190** | 210** | 235** | 260 | 310** | 120 |
| TGEL | (35%) | I | 206 | 213 | 236* | 260 | 321 | 115 |
| | | II | 207 | 216 | 244 | 270 | 324 | 117 |
| TGEL | (70%) | I | 204 | 217 | 241 | 268 | 321 | 117 |
| | | II | 203 | 212* | 241 | 273 | 318* | 115 |

* Statistically significant intergroup difference at the 95 percent confidence level.
** Statistically significant intergroup difference at the 99 percent confidence level.

2. Food Consumption

Results of the daily food consumption measurements are presented in Table XVII. The groups fed diets containing 35 percent thermally processed beef consumed slightly less food than that consumed by either the control groups or by the groups fed the semipurified diet. The groups fed diets containing 35 percent frozen beef consumed amounts of food comparable to that consumed by the control groups. All other groups fed diets containing beef consumed 4 to 47 percent more food than that consumed by the control groups fed the standard stock ration. The animals fed diets containing 70 percent beef consumed more food than that consumed by the animals fed diets containing 35 percent beef. The animals fed the semipurified diet (CGN) containing no beef consumed 3 percent more food than that consumed by the control groups.

TABLE XVII

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rats

Daily Food Consumption Data

Summary of Results

| Group | (Beef Content) | | Mean Daily Food Consumption (g/rat) Day of Gestation: 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | Total Food Consumed Days 6-15 (g/rat) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Control | (None) | I | 22.3 | 20.8 | 18.0 | 23.3 | 28.3 | 31.2 | 29.4 | 27.6 | 27.8 | 28.2 | 256.9 |
| | | II | 22.6 | 21.8 | 25.3 | 26.0 | 34.7 | 31.1 | 30.5 | 24.5 | 28.4 | 29.1 | 274.0 |
| CGN | (None) | I | 19.7 | 22.8 | 26.0 | 23.9 | 32.6 | 34.5 | 29.4 | 27.0 | 26.9 | 27.3 | 270.1 |
| | | II | 20.9 | 23.3 | 21.5 | 26.5 | 31.3 | 34.8 | 29.4 | 31.0 | 28.9 | 29.1 | 276.7 |
| CGF | (35%) | I | 13.6 | 14.2 | 28.6 | 25.2 | 26.0 | 29.9 | 37.1 | 19.6 | 26.9 | 37.9 | 259.0 |
| | | II | 13.2 | 13.0 | 24.1 | 26.9 | 27.7 | 27.7 | 47.7 | 20.9 | 33.6 | 36.8 | 271.6 |
| CGF | (70%) | I | 23.6 | 29.3 | 33.3 | 33.4 | 36.3 | 43.0 | 43.9 | 48.6 | 48.4 | 50.7 | 390.5 |
| | | II | 29.8 | 31.4 | 32.2 | 26.5 | 33.5 | 42.3 | 44.8 | 45.6 | 49.1 | 46.6 | 381.8 |
| CGT | (35%) | I | 5.7 | 11.3 | 20.4 | 25.8 | 30.6 | 30.4 | 33.7 | 33.1 | 33.4 | 29.9 | 254.3 |
| | | II | 4.8 | 8.9 | 21.5 | 22.6 | 30.0 | 17.2 | 33.6 | 34.1 | 34.6 | 31.3 | 238.6 |
| CGT | (70%) | I | 9.5 | 20.9 | 26.7 | 32.4 | 33.1 | 33.9 | 35.8 | 36.8 | 40.6 | 33.6 | 303.3 |
| | | II | 4.4 | 10.0 | 20.1 | 25.3 | 33.4 | 35.6 | 37.7 | 36.3 | 39.2 | 34.1 | 276.1 |
| TGCO | (35%) | I | 24.5 | 28.9 | 31.2 | 30.1 | 31.7 | 35.7 | 35.9 | 37.1 | 36.9 | 36.4 | 328.4 |
| | | II | 22.0 | 27.2 | 33.0 | 28.8 | 30.6 | 31.0 | 35.4 | 36.0 | 36.9 | 35.2 | 316.1 |
| TGCO | (70%) | I | 23.1 | 28.0 | 30.0 | 27.3 | 31.5 | 33.7 | 35.2 | 35.7 | 37.2 | 32.9 | 314.6 |
| | | II | 23.4 | 31.3 | 31.5 | 27.9 | 35.1 | 37.0 | 36.9 | 37.7 | 37.7 | 36.5 | 335.0 |
| TGEL | (35%) | I | 30.5 | 26.8 | 32.1 | 31.3 | 33.1 | 35.2 | 32.8 | 33.1 | 34.3 | 38.3 | 327.5 |
| | | II | 59.1 | 30.2 | 32.5 | 33.5 | 35.6 | 36.2 | 32.1 | 35.0 | 34.7 | 39.9 | 368.8 |
| TGEL | (70%) | I | 32.0 | 33.1 | 36.4 | 35.3 | 37.5 | 40.5 | 33.6 | 36.3 | 37.6 | 38.5 | 360.8 |
| | | II | 32.3 | 35.0 | 34.5 | 36.4 | 38.8 | 42.2 | 36.6 | 37.5 | 39.6 | 39.0 | 371.9 |

3. Mortality and Reactions

There were no deaths among test or control animals during the investigation. No untoward behavioral reactions were observed among test or control animals.

4. Reproductive Effects

The data related to reproduction which were collected at the time of sacrifice on Gestation Day 20 are summarized in Table XVIII. These data include the mean numbers of corpora lutea, implantation sites, resorption sites, and viable fetuses per female. The CGF (35%) I, and CGT (70%) I groups exhibited increases in the mean number of early resorption sites per female. In each group, 2 females each accounted for 4 or more early resorption sites. The CGF (35%) II and CGT (70%) II groups, which were paired with the groups showing increases in resorption sites, did not exhibit similar affects. The groups fed diets containing beef exhibited a slightly lower mean number of viable fetuses per female. This was due to a slightly lower number of corpora lutea and thus a slightly lower number of implantation sites in these animals. The above observations demonstrate the normal variability of results expected with albino rats. There were no reproductive effects noted which could be related to the ingestion of the test diets.

TABLE XVIII

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rats

Reproductive Effects

Summary of Results

| Group | (Beef Content) | | Number of Pregnant Females Examined | Autopsy Findings (Mean/Female) Corpora Lutea | Implantation Sites | Resorption Sites[a] (e) | (l) | Viable Fetuses | Females with 1 or More Resorption Sites Total | Percent |
|---|---|---|---|---|---|---|---|---|---|---|
| Control | (None) | I | 19 | 12.0 | 10.3 | 0.3 | 0.0 | 10.0 | 5 | 26.3 |
| | | II | 21 | 13.0 | 10.5 | 0.2 | 0.0 | 10.3 | 4 | 19.0 |
| CGN | (None) | I | 19 | 10.8 | 9.1 | 0.6* | 0.0 | 8.5 | 7 | 36.8 |
| | | II | 18 | 13.4 | 9.9 | 0.4 | 0.0 | 9.5 | 6 | 33.3 |
| CGF | (35%) | I | 18 | 11.4 | 9.9 | 1.1**[b] | 0.0 | 8.8 | 9 | 50.0 |
| | | II | 16 | 10.6 | 8.2 | 0.3 | 0.0 | 7.9 | 3 | 18.8 |
| CGF | (70%) | I | 17 | 12.1 | 10.4 | 0.4 | 0.0 | 10.0 | 6 | 35.3 |
| | | II | 17 | 12.0 | 9.5 | 0.4 | 0.0 | 9.1 | 3 | 17.6 |
| CGT | (35%) | I | 16 | 11.1 | 9.8 | 0.7* | 0.0 | 9.1 | 8 | 50.0 |
| | | II | 19 | 11.2 | 10.1 | 0.7* | 0.0 | 9.4 | 8 | 42.1 |
| CGT | (70%) | I | 16 | 12.1 | 10.0 | 1.2**[c] | 0.0 | 8.8 | 7 | 43.8 |
| | | II | 14 | 10.8 | 9.8 | 0.5 | 0.0 | 9.3 | 4 | 28.6 |
| TGCO | (35%) | I | 19 | 11.4 | 9.3 | 0.6* | 0.0 | 8.7 | 8 | 42.1 |
| | | II | 20 | 11.3 | 9.7 | 0.6* | 0.0 | 9.1 | 9 | 47.4 |
| TGCO | (70%) | I | 18 | 10.8 | 9.8 | 0.4 | 0.0 | 9.4 | 6 | 31.6 |
| | | II | 19 | 10.9 | 9.2 | 0.5 | 0.0 | 8.7 | 7 | 36.8 |
| TGEL | (35%) | I | 14 | 11.6 | 10.1 | 0.2 | 0.0 | 9.9 | 3 | 21.4 |
| | | II | 20 | 11.1 | 9.6 | 0.6 | 0.0 | 9.0 | 9 | 45.0 |
| TGEL | (70%) | I | 15 | 11.6 | 9.5 | 0.4 | 0.1 | 9.0 | 4 | 26.7 |
| | | II | 20 | 11.0 | 9.6 | 0.4 | 0.0 | 9.2 | 6 | 30.0 |

[a] (e) = early resorption site; (l) = late resorption site.

[b] Two females each accounted for 4 or more early resorption sites.

[c] Two females each accounted for 5 resorption sites.

* Statistically significant intergroup difference at the 95 percent confidence level.

** Statistically significant intergroup difference at the 99 percent confidence level.

5. Fetal Development

a. Body Weight

Fetal body weight data are presented in Table XIX. The body weights of the fetuses obtained from some of the groups receiving diets containing beef were slightly reduced. The body weight reductions were minimal and were not dose-related. There were no significant differences in fetal body weight noted between groups fed diets containing irradiated beefs and those fed diets containing non-irradiated beefs. The body weights of fetuses obtained from females fed diets containing beef were comparable to those of fetuses obtained from females fed control diets (standard stock ration or semipurified diet).

TABLE XIX

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rats

Fetal Body Weight Data

Summary of Results

| Group | (Beef Content) | | Number of Males | Mean Body Weight (g) | Number of Females | Mean Body Weight (g) | Number of Males per 100 Fetuses |
|---|---|---|---|---|---|---|---|
| Control | (None) | I | 90 | 4.4 | 100 | 4.1 | 47.4 |
| | | II | 112 | 4.5 | 104 | 4.4 | 51.8 |
| CGN | (None) | I | 79 | 4.5 | 82 | 4.2 | 49.1 |
| | | II | 88 | 5.0 | 83 | 5.1 | 51.5 |
| CGF | (35%) | I | 77 | 4.1 | 73 | 3.9 | 51.3 |
| | | II | 57 | 4.1 | 70 | 4.0 | 44.9 |
| CGF | (70%) | I | 71 | 4.3 | 98 | 4.0 | 42.0 |
| | | II | 68 | 4.4 | 87 | 4.1 | 43.9 |
| CGT | (35%) | I | 61 | 3.7 | 85 | 3.5 | 41.8 |
| | | II | 89 | 3.6 | 89 | 3.5 | 50.0 |
| CGT | (70%) | I | 77 | 3.7 | 64 | 3.7 | 54.6 |
| | | II | 71 | 4.1 | 59 | 3.8 | 54.1 |
| TGCO | (35%) | I | 86 | 4.3 | 80 | 4.0 | 51.8 |
| | | II | 82 | 4.1 | 99 | 3.8 | 45.3 |
| TGCO | (70%) | I | 85 | 4.1 | 85 | 4.0 | 50.0 |
| | | II | 86 | 4.9 | 79 | 4.5 | 52.1 |
| TGEL | (35%) | I | 70 | 3.8 | 69 | 3.6 | 50.4 |
| | | II | 80 | 4.0 | 100 | 3.9 | 43.8 |
| TGEL | (70%) | I | 58 | 4.4 | 77 | 4.2 | 43.0 |
| | | II | 101 | 4.4 | 83 | 4.1 | 54.9 |

b. External Development

The examinations for fetal external development revealed 2 fetuses with hematomas. One fetus with a hematoma was obtained from a Control (None) I group dam and the other was obtained from a TGCO (70%) I group dam. All other fetuses obtained during this phase of the investigation were judged to be free of gross external abnormalities.

c. Skeletal Development

A summary and interpretation of skeletal findings is presented in Table XX. Observations of fetal skeletal development at caesarian section are presented in Table XXI.

Those fetuses having sternum sections that were only partially stained with the calcium positive Alizarin dye were classified as incompletely ossified sections. Sternum sections that did not retain any of the dye were classified as non-ossified. These classifications are measures of the relative extent of fetal skeletal calcification at the time of sacrifice. Incompletely ossified sternum sections, non-ossified sternum sections, and supernumerary ribs are classified as incidental skeletal findings. These incidental skeletal findings are normally observed in fetuses obtained from untreated control does.

The CGT (70%) I group exhibited an increase in the percentage of fetuses with incidental skeletal findings. The incidences of incidental skeletal findings in the CGT (70%) I group were within the ranges normally observed for fetuses obtained from albino mice used in similar teratogenic studies conducted in this laboratory. The incidences of incidental skeletal findings were considered normal in all groups. There were no changes in the occurrence of skeletal abnormalities which could be attributed to prenatal exposure to the test diets. Observations of fetal skeletal development disclosed no effects which could be attributed to prenatal exposure to the test diets.

TABLE XX

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rats

Fetal Skeletal Development

Summary and Interpretation of Findings

| Group | (Beef Content) | | Number of Fetuses | Number of Fetuses with Skeletal Findings (Abnormalities + Incidental Findings) | Number of Fetuses with Skeletal Abnormalities | Number of Fetuses with Incidental Findings Only | Number of Fetuses with no Findings | Total Fetuses Unaffected by Treatment |
|---|---|---|---|---|---|---|---|---|
| Control | (None) | I | 93 | 30 | 0 | 30 | 63 | 93 |
| | | | Percent: | 32.2 | 0.0 | 32.2 | 67.8 | 100.0 |
| | | II | 104 | 31 | 0 | 31 | 73 | 104 |
| | | | Percent: | 29.8 | 0.0 | 29.8 | 70.2 | 100.0 |
| CGN | (None) | I | 77 | 26 | 0 | 26 | 51 | 77 |
| | | | Percent: | 33.8 | 0.0 | 33.8 | 66.2 | 100.0 |
| | | II | 84 | 13 | 0 | 13 | 71 | 84 |
| | | | Percent: | 15.5 | 0.0 | 15.5 | 84.5 | 100.0 |
| CGF | (35%) | I | 75 | 18 | 0 | 18 | 57 | 75 |
| | | | Percent: | 24.0 | 0.0 | 24.0 | 76.0 | 100.0 |
| | | II | 63 | 20 | 0 | 20 | 43 | 63 |
| | | | Percent: | 31.7 | 0.0 | 31.7 | 68.3 | 100.0 |
| CGF | (70%) | I | 84 | 25 | 0 | 25 | 59 | 84 |
| | | | Percent: | 29.8 | 0.0 | 29.8 | 70.2 | 100.0 |
| | | II | 73 | 22 | 1 | 21 | 51 | 72 |
| | | | Percent: | 30.1 | 1.4 | 28.8 | 69.9 | 98.6 |
| CGT | (35%) | I | 71 | 23 | 0 | 23 | 48 | 71 |
| | | | Percent: | 32.4 | 0.0 | 32.4 | 67.6 | 100.0 |
| | | II | 88 | 25 | 0 | 25 | 63 | 88 |
| | | | Percent: | 28.4 | 0.0 | 28.4 | 71.6 | 100.0 |
| CGT | (70%) | I | 70 | 38 | 0 | 38 | 32 | 70 |
| | | | Percent: | 54.3 | 0.0 | 54.3 | 45.7 | 100.0 |
| | | II | 65 | 21 | 0 | 21 | 44 | 65 |
| | | | Percent: | 32.3 | 0.0 | 32.3 | 67.7 | 100.0 |
| TGCO | (35%) | I | 77 | 21 | 0 | 21 | 56 | 77 |
| | | | Percent: | 27.3 | 0.0 | 27.3 | 72.7 | 100.0 |
| | | II | 85 | 23 | 0 | 23 | 62 | 85 |
| | | | Percent: | 27.1 | 0.0 | 27.1 | 72.9 | 100.0 |
| TGCO | (70%) | I | 81 | 14 | 0 | 14 | 67 | 81 |
| | | | Percent: | 17.3 | 0.0 | 17.3 | 82.7 | 100.0 |
| | | II | 76 | 10 | 0 | 10 | 66 | 76 |
| | | | Percent: | 13.2 | 0.0 | 13.2 | 86.8 | 100.0 |
| TGEL | (35%) | I | 69 | 15 | 0 | 15 | 54 | 69 |
| | | | Percent: | 21.7 | 0.0 | 21.7 | 78.3 | 100.0 |
| | | II | 84 | 16 | 0 | 16 | 68 | 84 |
| | | | Percent: | 19.0 | 0.0 | 19.0 | 81.0 | 100.0 |
| TGEL | (70%) | I | 62 | 9 | 0 | 9 | 53 | 62 |
| | | | Percent: | 14.5 | 0.0 | 14.5 | 85.5 | 100.0 |
| | | II | 87 | 6 | 0 | 6 | 81 | 87 |
| | | | Percent: | 6.9 | 0.0 | 6.9 | 93.1 | 100.0 |

TABLE XXI

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rats

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| Control | (None) I | 93 | Incompletely ossified sternum section(s) | 21 | 22.6 |
| | | | Non-ossified sternum section(s) | 12 | 12.9 |
| | | | Total number of fetuses with findings | 30 | 32.2 |
| | | | Total number of normal fetuses | 63 | 67.8 |
| | II | 104 | Incompletely ossified sternum section(s) | 25 | 24.0 |
| | | | Non-ossified sternum section(s) | 4 | 3.8 |
| | | | Supernumerary ribs | 4 | 3.8 |
| | | | Total number of fetuses with findings | 31 | 29.8 |
| | | | Total number of normal fetuses | 73 | 70.2 |

TABLE XXI continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rats

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| CGN | (None) | I | 77 | Incompletely ossified sternum section(s) | 18 | 23.4 |
| | | | | Non-ossified sternum section(s) | 4 | 5.2 |
| | | | | Supernumerary ribs | 7 | 9.1 |
| | | | | Total number of fetuses with findings | 26 | 33.8 |
| | | | | Total number of normal fetuses | 51 | 66.2 |
| | | II | 84 | Incompletely ossified sternum section(s) | 5 | 6.0 |
| | | | | Non-ossified sternum section(s) | 2 | 2.4 |
| | | | | Supernumerary ribs | 6 | 7.1 |
| | | | | Total number of fetuses with findings | 13 | 15.5 |
| | | | | Total number of normal fetuses | 71 | 84.5 |

TABLE XXI continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rats

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| CGF | (35%) | I | 75 | Incompletely ossified sternum section(s) | 16 | 21.3 |
| | | | | Non-ossified sternum section(s) | 3 | 4.0 |
| | | | | Supernumerary ribs | 2 | 2.7 |
| | | | | Total number of fetuses with findings | 18 | 24.0 |
| | | | | Total number of normal fetuses | 57 | 76.0 |
| | | II | 63 | Incompletely ossified sternum section(s) | 11 | 17.5 |
| | | | | Non-ossified sternum sections | 8 | 12.7 |
| | | | | Supernumerary ribs | 2 | 3.2 |
| | | | | Total number of fetuses with findings | 20 | 31.7 |
| | | | | Total number of normal fetuses | 43 | 68.3 |

TABLE XXI continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rats

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| CGF | (70%) | I | 84 | Incompletely ossified sternum section(s) | 13 | 15.5 |
| | | | | Non-ossified sternum section(s) | 5 | 6.0 |
| | | | | Supernumerary ribs | 8 | 9.5 |
| | | | | Total number of fetuses with findings | 25 | 29.8 |
| | | | | Total number of normal fetuses | 59 | 70.2 |
| | | II | 73 | Incompletely ossified sternum section(s) | 12 | 16.4 |
| | | | | Non-ossified sternum section(s) | 10 | 13.7 |
| | | | | Supernumerary ribs | 4 | 5.5 |
| | | | | Spiraled cauda | 1 | 1.4 |
| | | | | Total number of fetuses with findings | 22 | 30.1 |
| | | | | Total number of normal fetuses | 51 | 69.9 |

TABLE XXI continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rats

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| CGT | (70%) | I | 70 | Incompletely ossified sternum section(s) | 27 | 38.6 |
| | | | | Non-ossified sternum section(s) | 15 | 21.4 |
| | | | | Supernumerary ribs | 2 | 2.9 |
| | | | | Total number of fetuses with findings | 38 | 54.3 |
| | | | | Total number of normal fetuses | 32 | 45.7 |
| | | II | 65 | Incompletely ossified sternum section(s) | 15 | 23.1 |
| | | | | Non-ossified sternum section(s) | 4 | 6.2 |
| | | | | Supernumerary ribs | 3 | 4.6 |
| | | | | Total number of fetuses with findings | 21 | 32.3 |
| | | | | Total number of normal fetuses | 44 | 67.7 |

TABLE XXI continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rats

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| TGCO | (35%) | I | 77 | Incompletely ossified sternum section(s) | 15 | 19.5 |
| | | | | Non-ossified sternum section(s) | 1 | 1.3 |
| | | | | Supernumerary ribs | 6 | 7.8 |
| | | | | Total number of fetuses with findings | 21 | 27.3 |
| | | | | Total number of normal fetuses | 56 | 72.7 |
| | | II | 85 | Incompletely ossified sternum section(s) | 14 | 16.5 |
| | | | | Non-ossified sternum section(s) | 5 | 5.9 |
| | | | | Supernumerary ribs | 7 | 8.2 |
| | | | | Total number of fetuses with findings | 23 | 27.1 |
| | | | | Total number of normal fetuses | 62 | 72.9 |

TABLE XXI continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rats

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| TGCO | (70%) | I | 81 | Incompletely ossified sternum section(s) | 7 | 8.6 |
| | | | | Non-ossified sternum section(s) | 2 | 2.5 |
| | | | | Supernumerary ribs | 7 | 8.6 |
| | | | | Total number of fetuses with findings | 14 | 17.3 |
| | | | | Total number of normal fetuses | 67 | 82.7 |
| | | II | 76 | Incompletely ossified sternum section(s) | 9 | 11.8 |
| | | | | Supernumerary ribs | 1 | 1.3 |
| | | | | Total number of fetuses with findings | 10 | 13.2 |
| | | | | Total number of normal fetuses | 66 | 86.8 |

TABLE XXI continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rats

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| TGEL | (35%) | I | 69 | Incompletely ossified sternum section(s) | 8 | 11.6 |
| | | | | Non-ossified sternum section(s) | 2 | 2.9 |
| | | | | Supernumerary ribs | 6 | 8.7 |
| | | | | Total number of fetuses with findings | 15 | 21.7 |
| | | | | Total number of normal fetuses | 54 | 78.3 |
| | | II | 84 | Incompletely ossified sternum section(s) | 11 | 13.1 |
| | | | | Non-ossified sternum section(s) | 3 | 3.6 |
| | | | | Supernumerary ribs | 2 | 2.4 |
| | | | | Total number of fetuses with findings | 16 | 19.0 |
| | | | | Total number of normal fetuses | 68 | 81.0 |

TABLE XXI continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rats

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| TGEL | (70%) | I | 62 | Incompletely ossified sternum section(s) | 6 | 9.7 |
| | | | | Non-ossified sternum section(s) | 2 | 3.2 |
| | | | | Supernumerary ribs | 1 | 1.6 |
| | | | | Total number of fetuses with findings | 9 | 14.5 |
| | | | | Total number of normal fetuses | 53 | 85.5 |
| | | II | 87 | Incompletely ossified sternum section(s) | 4 | 4.6 |
| | | | | Non-ossified sternum section(s) | 1 | 1.1 |
| | | | | Supernumerary ribs | | |
| | | | | Total number of fetuses with findings | 6 | 6.9 |
| | | | | Total number of normal fetuses | 81 | 93.1 |

d. Internal Development

The results of the evaluation of fetal internal development are presented in Table XXII. Large and small atria noted in this table are considered to be incidental findings. Slight variations in the size of the atrium are considered to occur as a result of fixation and the extent of fetal viability prior to sacrifice. Three fetuses, 2 from the CGT (35%) I group and 1 from the CGT (35%) II group were observed with small right kidneys. This finding was not observed among any of the fetuses from the CGT (70%) I and II groups. There were no changes in the types or incidences of internal findings in any of the groups which could be attributed to prenatal exposure to the test diets.

TABLE XXII

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rats

Fetal Internal Development

Summary of Results

| Group | (Beef Content) | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| Control | (None) I | 97 | Small atria | 4 | 4.1 |
| | | | Large atria | 33 | 34.0 |
| | | | Edema | 1 | 1.0 |
| | | | Total number of fetuses with findings | 38 | 39.2 |
| | | | Total number of normal fetuses | 59 | 60.8 |
| | II | 112 | Small atria | 5 | 4.5 |
| | | | Large atria | 22 | 19.6 |
| | | | Total number of fetuses with findings | 27 | 24.1 |
| | | | Total number of normal fetuses | 85 | 75.9 |

TABLE XXII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rats

Fetal Internal Development

Summary of Results

| Group | (Beef Content) | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| CGN | (None) I | 84 | Small atria | 6 | 7.1 |
| | | | Large atria | 23 | 27.4 |
| | | | Edema | 1 | 1.2 |
| | | | Total number of fetuses with findings | 29 | 34.5 |
| | | | Total number of normal fetuses | 55 | 65.5 |
| | II | 87 | Small atria | 11 | 12.6 |
| | | | Large atria | 7 | 8.0 |
| | | | Total number of fetuses with findings | 18 | 20.7 |
| | | | Total number of normal fetuses | 69 | 79.3 |

TABLE XXII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rats

Fetal Internal Development

Summary of Results

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| CGF | (35%) | I | 75 | Small atria | 18 | 24.0 |
| | | | | Large atria | 2 | 2.7 |
| | | | | Total number of fetuses with findings | 20 | 26.7 |
| | | | | Total number of normal fetuses | 55 | 73.3 |
| | | II | 64 | Small atria | 10 | 15.6 |
| | | | | Large atria | 3 | 4.7 |
| | | | | Total number of fetuses with findings | 13 | 20.3 |
| | | | | Total number of normal fetuses | 51 | 79.7 |

TABLE XXII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rats

Fetal Internal Development

Summary of Results

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| CGF | (70%) | I | 85 | Small atria | 12 | 14.1 |
| | | | | Large atria | 3 | 3.5 |
| | | | | Total number of fetuses with findings | 15 | 17.6 |
| | | | | Total number of normal fetuses | 70 | 82.4 |
| | | II | 82 | Small atria | 4 | 4.9 |
| | | | | Large atria | 3 | 3.7 |
| | | | | Total number of fetuses with findings | 7 | 8.5 |
| | | | | Total number of normal fetuses | 75 | 91.5 |

TABLE XXII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rats

Fetal Internal Development

Summary of Results

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| CGT | (35%) | I | 75 | Small atria | 11 | 14.7 |
| | | | | Large atria | 1 | 1.3 |
| | | | | Small kidney (right) | 2 | 2.7 |
| | | | | Total number of fetuses with findings | 14 | 18.7 |
| | | | | Total number of normal fetuses | 61 | 81.3 |
| | | II | 90 | Small atria | 19 | 21.1 |
| | | | | Large atria | 1 | 1.1 |
| | | | | Caudal renal ectopia | 2 | 2.2 |
| | | | | Small kidney (right) | 1 | 1.1 |
| | | | | Total number of fetuses with findings | 22 | 24.4 |
| | | | | Total number of normal fetuses | 68 | 75.6 |

TABLE XXII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rats

Fetal Internal Development

Summary of Results

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| CGT | (70%) | I | 71 | Small atria | 23 | 32.4 |
| | | | | Large atria | 2 | 2.8 |
| | | | | Total number of fetuses with findings | 25 | 35.2 |
| | | | | Total number of normal fetuses | 46 | 64.8 |
| | | II | 65 | Small atria | 7 | 10.8 |
| | | | | Large atria | 3 | 4.6 |
| | | | | Enlarged bladder | 2 | 3.1 |
| | | | | Total number of fetuses with findings | 11 | 16.9 |
| | | | | Total number of normal fetuses | 54 | 83.1 |

TABLE XXII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rats

Fetal Internal Development

Summary of Results

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| TGCO | (35%) | I | 89 | Small atria | 7 | 7.9 |
| | | | | Large atria | 3 | 3.4 |
| | | | | Total number of fetuses with findings | 10 | 11.2 |
| | | | | Total number of normal fetuses | 79 | 88.8 |
| | | II | 96 | Small atria | 4 | 4.2 |
| | | | | Large atria | 2 | 2.1 |
| | | | | Total number of fetuses with findings | 6 | 6.2 |
| | | | | Total number of normal fetuses | 90 | 93.8 |

TABLE XXII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rats

Fetal Internal Development

Summary of Results

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| TGCO | (70%) | I | 89 | Small atria | 8 | 9.0 |
| | | | | Large atria | 5 | 5.6 |
| | | | | Total number of fetuses with findings | 13 | 14.6 |
| | | | | Total number of normal fetuses | 76 | 85.4 |
| | | II | 89 | Small atria | 3 | 3.4 |
| | | | | Large atria | 7 | 7.9 |
| | | | | Total number of fetuses with findings | 10 | 11.2 |
| | | | | Total number of normal fetuses | 79 | 88.8 |

TABLE XXII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rats

Fetal Internal Development

Summary of Results

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| TGEL | (35%) | I | 70 | Small atria | 7 | 10.0 |
| | | | | Total number of fetuses with findings | 7 | 10.0 |
| | | | | Total number of normal fetuses | 63 | 90.0 |
| | | II | 96 | Small atria | 5 | 5.2 |
| | | | | Large atria | 3 | 3.1 |
| | | | | Total number of fetuses with findings | 8 | 8.3 |
| | | | | Total number of normal fetuses | 88 | 91.7 |

TABLE XXII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rats

Fetal Internal Development

Summary of Results

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| TGEL | (70%) | I | 73 | Small atria | 1 | 1.4 |
| | | | | Large atria | 6 | 8.2 |
| | | | | Total number of fetuses with findings | 7 | 9.6 |
| | | | | Total number of normal fetuses | 66 | 90.4 |
| | | II | 97 | Small atria | 2 | 2.1 |
| | | | | Large atria | 5 | 5.2 |
| | | | | Total number of fetuses with findings | 7 | 7.2 |
| | | | | Total number of normal fetuses | 90 | 92.8 |

## VII. Experiment III - Golden Syrian Hamsters

### A. Summary

Diets containing frozen, thermally processed, cobalt irradiated, or electron irradiated beef were fed to groups of pregnant golden Syrian hamsters during the period of fetal organogenesis. Each type of beef was fed at dietary concentrations of either 35 or 70 percent beef (on a dry matter basis). Each beef diet was fed to 2 groups of pregnant animals. The experimental design included 2 control groups fed a standard stock ration and 2 groups fed the semipurified diet which comprised the remaining portion of each of the beef diets.

Maternal body weight, reproductive effects (including early and late resorption sites, the number of viable fetuses, and the number of females with 1 or more resorption sites), fetal body weight, and fetal development (external, skeletal, and internal) findings are summarized in Table XXIII. The only groups with consistent findings differing from those normally observed for pregnant Syrian hamsters of this strain in this laboratory were the control groups fed the semipurified diet [CGN (None) I and II]. These groups exhibited reductions in maternal body weights and weight gains, reductions in the amounts of food consumed, increases in the number of runt fetuses (external development), and increases in the number of fetuses with incidental skeletal findings. Seventy-two (72) percent of the runt fetuses were from 4 females (2 females from each group). The increase in the number of fetuses with

incidental skeletal findings in these groups was due to an increase in the incidence of non-ossified sternum sections, which is indicative of the extent of skeletal calcification at the time of sacrifice. Other findings noted in Table XXIII as being other than that normally expected were not confirmed as being significant by the results obtained with groups fed the same beef at a higher concentration.

The ingestion of diets containing frozen, thermally processed, cobalt irradiated, or electron irradiated beef resulted in no body weight changes which could be attributed to the test diets. The groups fed beef diets consumed 33 to 267 percent more food than that consumed by the control groups. There were no changes noted in the data related to reproduction which could be attributed to the ingestion of diets containing beef. No deaths or abnormal behavioral reactions were noted among any of the animals in this phase of the investigation. The body weights of fetuses obtained from females fed diets containing beef were comparable to those of fetuses obtained from females fed control diets (standard stock ration or semipurified diet). Fetal external, skeletal, and internal development was comparable in all groups fed either beef diets or the control diet. Feeding diets containing frozen, thermally processed, cobalt irradiated, or electron irradiated beef to pregnant golden Syrian hamsters during the period of fetal organogenesis did not induce a teratogenic response in this test system.

TABLE XXIII

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Summary of Findings

| Group | (Beef Content) | | Reproductive Effects: Maternal Body Weight | Resorption Sites: Early | Resorption Sites: Late | Number of Viable Fetuses | Number of Females with 1 or More Resorption Sites | Fetal Body Weight | Fetal Development: External | Fetal Development: Skeletal | Fetal Development: Internal |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Control | (None) | I | - | - | - | - | - | - | - | - | - |
| | | II | - | - | - | - | - | - | - | - | - |
| CGN | (None) | I | +(D) | - | - | - | - | - | + | + | - |
| | | II | +(D) | - | - | - | - | - | + | + | - |
| CGF | (35%) | I | - | - | - | - | - | - | - | - | - |
| | | II | - | - | - | - | - | - | - | - | - |
| CGF | (70%) | I | - | - | - | - | - | - | - | - | - |
| | | II | - | - | - | - | - | - | - | - | - |
| CGT | (35%) | I | - | - | - | - | - | - | - | - | - |
| | | II | - | - | - | - | - | - | - | - | - |
| CGT | (70%) | I | - | - | - | - | - | - | - | - | - |
| | | II | - | - | - | - | - | - | - | - | - |
| TGCO | (35%) | I | - | - | - | - | - | - | - | - | - |
| | | II | - | - | - | - | - | - | - | - | - |
| TGCO | (70%) | I | - | - | - | - | - | - | - | - | - |
| | | II | - | - | - | - | - | - | - | - | - |
| TGEL | (35%) | I | - | - | - | - | - | - | - | + | - |
| | | II | - | - | - | - | - | - | - | + | - |
| TGEL | (70%) | I | - | - | - | - | - | - | - | - | - |
| | | II | - | - | - | - | - | - | - | - | - |

- = Normal finding (D) = Decrease

+ = Finding other than normal

B. Procedure

1. Experimental Animals

The animals employed were golden Syrian hamsters. The hamsters were bred at Lakeview Hamster Colony* and copulation was confirmed by sperm-positive results of vaginal examinations. Day zero is defined as the day of insemination. The animals were shipped directly to this laboratory on Day 3 of gestation.

2. Organization of Groups

A structural outline of this portion of the investigation is given in Table XXIV.

* Lakeview Hamster Colony, Newfield, New Jersey.

TABLE XXIV

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Outline of Experiment

| Group | Number of Pregnant Animals | Diet | % Beef* |
|---|---|---|---|
| Control I | 24 | Purina Chow | None |
| Control II | 25 | Purina Chow | None |
| CGN I | 23 | Complete Semipurified Diet | None |
| CGN II | 23 | Complete Semipurified Diet | None |
| CGF I | 21 | Frozen Beef | 35 |
| CGF II | 15 | Frozen Beef | 35 |
| CGF I | 22 | Frozen Beef | 70 |
| CGF II | 11 | Frozen Beef | 70 |
| CGT I | 23 | Thermally Processed Beef | 35 |
| CGT II | 22 | Thermally Processed Beef | 35 |
| CGT I | 20 | Thermally Processed Beef | 70 |
| CGT II | 21 | Thermally Processed Beef | 70 |
| TGCO I | 19 | Cobalt Irradiated Beef | 35 |
| TGCO II | 18 | Cobalt Irradiated Beef | 35 |
| TGCO I | 18 | Cobalt Irradiated Beef | 70 |
| TGCO II | 24 | Cobalt Irradiated Beef | 70 |
| TGEL I | 23 | Electron Irradiated Beef | 35 |
| TGEL II | 19 | Electron Irradiated Beef | 35 |
| TGEL I | 22 | Electron Irradiated Beef | 70 |
| TGEL II | 22 | Electron Irradiated Beef | 70 |

* Beef levels are expressed on a dry matter basis.

3. Exposure and Feeding

All diets were prepared in the manner outlined in section III of this report. Animals in control groups I and II were offered the standard stock ration* utilized at this laboratory, as were dams of the test groups prior to the treatment period. Dams of each group were offered their respective diets fresh daily from the 6th day of their gestation period to the 15th day inclusive (a total of 10 days of exposure). Daily records of food consumption were recorded from Day 6 through 14 inclusive. All animals were allowed food and water ad libitum.

4. Body Weight Data

Body weight data reported include the mean group body weights on Days 6 (initial exposure day), 9, 12, and 15 (final day of exposure and day of sacrifice).

5. Mortality and Reactions

Daily records of mortality and untoward behavioral reactions were maintained throughout the investigation.

6. Reproductive Effects

All females were sacrificed by carbon dioxide asphyxiation on the 15th day of gestation. An incision was made in the abdominal wall and the full extent of both uterine horns was exposed immediately. Fetal swellings and implantation sites were counted, special attention being paid to resorption sites or any other uterine abnormalities.

The number of viable fetuses present in the uterus was determined, spontaneous movement and a more ruddy color distinguishing live from dead animals.

* Purina Rat Chow, Ralston Purina Company, St. Louis, Missouri.

7. Fetal Development

a. Body Weight

All fetuses were removed from the chorion after cutting the umbilical cord. Blotting paper was then used to remove excess amniotic fluid and the fetuses were sexed and weighed.

b. External Examination

An external examination of the fetuses was conducted with special attention paid to detection of the following abnormalities: hydrocephaly, exencephaly, meningoencephalocele, simple meningocele, anophthalmia, microphthalmia, cleft lip, oblique facial cleft, micrognathia, external ear abnormalities in size, shape or position, unusual size or position of the limbs, number and disposition of the digits, umbilical hernia, gastroschisis, myelomeningocele, spina bifida and scoliosis.

c. Fetal Skeletal and Internal Development

All of the fetuses which were obtained were examined for either skeletal or internal development. When possible, equal numbers of fetuses of each sex from each litter were examined by each method. Evaluation of skeletal development was conducted using Hurley's* method of Alizarin staining. Internal development was evaluated using the free-hand razor blade section technique of Wilson and Warkany**.

* Hurley, Lucille S., "Demonstration A-Alizarin Staining of Bone," (revised) Supplement to Teratology Workshop Manual, Berkeley, California, January 25-30, 1965, pp. 121-122.

** Wilson, James G. and Warkany, Josef, Teratology Principles and Techniques, University of Chicago Press, Chicago, Illinois, 1965, pp. 271-277.

C. Results

1. Body Weight Data

Mean body weight data are presented in Table XXV. The animals fed the semipurified diet (CGN (None) I and II) exhibited a 56 percent reduction of body weight gain during the treatment period (Days 6-15). The animals fed test diets containing beef exhibited body weight gains comparable to those of the control animals. There were no changes in body weights or body weight gains which could be attributed to the ingestion of the test diets containing beef.

TABLE XXV

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Body Weight Data

Summary of Results

| Group | (Beef Content) | | Mean Body Weight (g) Day of Gestation: 6 | 9 | 12 | 15 | Total Weight Gain (g) |
|---|---|---|---|---|---|---|---|
| Control | (None) | I | 138 | 146 | 161 | 166 | 28 |
| | | II | 140 | 152 | 163 | 168 | 28 |
| CGN | (None) | I | 124** | 133** | 138** | 138** | 14 |
| | | II | 127** | 131** | 134** | 137** | 10 |
| CGF | (35%) | I | 127** | 134** | 145** | 153* | 26 |
| | | II | 124** | 130** | 145** | 153* | 29 |
| CGF | (70%) | I | 127** | 135** | 153* | 163 | 36 |
| | | II | 128** | 137* | 155 | 160 | 32 |
| CGT | (35%) | I | 134 | 142 | 154 | 160 | 26 |
| | | II | 138 | 144 | 160 | 168 | 30 |
| CGT | (70%) | I | 136 | 143 | 162 | 166 | 30 |
| | | II | 138 | 147 | 166 | 175 | 37 |
| TGCO | (35%) | I | 134 | 136** | 153 | 159 | 25 |
| | | II | 142 | 144 | 158 | 162 | 20 |
| TGCO | (70%) | I | 133 | 140* | 159 | 164 | 31 |
| | | II | 133 | 137** | 155 | 158 | 25 |
| TGEL | (35%) | I | 142 | 147 | 161 | 166 | 24 |
| | | II | 135 | 140* | 154 | 157 | 22 |
| TGEL | (70%) | I | 138 | 149 | 163 | 168 | 30 |
| | | II | 138 | 150 | 164 | 175 | 37 |

* Statistically significant intergroup difference at the 95 percent confidence level.
** Statistically significant intergroup difference at the 99 percent confidence level.

2. Food Consumption

Results of the daily food consumption measurements are presented in Table XXVI. The groups fed diets containing beef consumed 33 to 267 percent more food than that consumed by the control groups fed the standard stock ration. The animals fed diets containing 70 percent beef generally consumed more food than that consumed by the animals fed diets containing 35 percent beef. The animals fed the semipurified diet (CGN) containing no beef consumed 49 percent less food than that consumed by the control groups.

TABLE XXVI

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Daily Food Consumption Data

Summary of Results

| Group | (Beef Content) | | Mean Daily Food Consumption (g/hamster) Day of Gestation: 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | Total Food Consumed Days 6-14 (g/hamster) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Control | (None) | I | 5.6 | 9.8 | 12.8 | 11.7 | 10.5 | 14.1 | 12.0 | 12.4 | 12.7 | 101.6 |
| | | II | 4.4 | 11.3 | 12.4 | 12.5 | 10.0 | 13.9 | 12.3 | 13.4 | 13.3 | 103.5 |
| CGN | (None) | I | 4.7 | 5.8 | 4.4 | 4.8 | 4.9 | 6.3 | 4.6 | 7.1 | 8.6 | 51.2 |
| | | II | 5.0 | 5.7 | 4.6 | 4.3 | 5.3 | 7.6 | 5.9 | 7.2 | 8.3 | 53.9 |
| CGF | (35%) | I | 6.1 | 9.8 | 16.1 | 19.6 | 23.6 | 29.5 | 33.4 | 33.4 | 45.9 | 217.4 |
| | | II | 10.3 | 9.3 | 19.2 | 19.7 | 26.9 | 27.3 | 31.2 | 33.3 | 42.3 | 219.5 |
| CGF | (70%) | I | 10.2 | 24.1 | 23.4 | 23.8 | 34.5 | 32.4 | 35.1 | 40.4 | 50.1 | 274.0 |
| | | II | 7.6 | 18.4 | 16.0 | 17.9 | 24.7 | 23.9 | 24.9 | 36.2 | 33.2 | 202.8 |
| CGT | (35%) | I | 15.1 | 13.3 | 14.3 | 11.6 | 14.3 | 26.4 | 20.3 | 28.0 | 37.0 | 180.3 |
| | | II | 15.4 | 14.4 | 14.8 | 12.8 | 16.4 | 27.0 | 21.2 | 22.4 | 30.2 | 174.6 |
| CGT | (70%) | I | 13.8 | 18.3 | 17.4 | 13.2 | 18.7 | 27.0 | 23.0 | 23.0 | 31.2 | 185.6 |
| | | II | 14.8 | 18.4 | 16.1 | 15.0 | 19.4 | 28.9 | 22.7 | 26.8 | 31.0 | 193.1 |
| TGCO | (35%) | I | 10.9 | 13.5 | 15.7 | 17.3 | 14.5 | 20.6 | 22.6 | 29.8 | 32.1 | 177.0 |
| | | II | 12.4 | 16.5 | 19.3 | 23.9 | 23.8 | 29.4 | 30.4 | 32.4 | 39.5 | 227.6 |
| TGCO | (70%) | I | 9.7 | 16.4 | 15.8 | 17.8 | 17.8 | 21.4 | 26.2 | 33.4 | 35.7 | 194.2 |
| | | II | 11.2 | 16.3 | 18.7 | 23.0 | 21.9 | 23.7 | 25.6 | 29.3 | 26.0 | 195.7 |
| TGEL | (35%) | I | 11.7 | 14.2 | 17.8 | 13.4 | 12.2 | 20.0 | 18.6 | 20.7 | 26.5 | 155.1 |
| | | II | 11.4 | 12.1 | 17.4 | 10.9 | 11.8 | 14.8 | 17.6 | 21.1 | 19.5 | 136.6 |
| TGEL | (70%) | I | 12.5 | 17.2 | 19.1 | 15.4 | 12.2 | 17.3 | 22.3 | 20.9 | 20.6 | 157.5 |
| | | II | 11.2 | 17.9 | 19.9 | 14.6 | 12.5 | 19.9 | 19.4 | 20.4 | 21.0 | 156.8 |

3. Mortality and Reactions

There were no deaths among test or control animals during the investigation. No untoward behavioral reactions were observed among test or control animals.

4. Reproductive Effects

The data related to reproduction which were collected at the time of sacrifice on Gestation Day 17 are summarized in Table XXVII. These data include the mean numbers of corpora lutea, implantation sites, resorption sites, and viable fetuses per female. The mean numbers of corpora lutea, implantation sites, resorption sites and viable fetuses per female were comparable in all groups. There were no reproductive effects noted which could be related to the ingestion of the test diets.

TABLE XXVII

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Reproductive Effects

Summary of Results

| Group | (Beef Content) | | Number of Pregnant Females Examined | Autopsy Findings (Mean/Female) Corpora Lutea | Implantation Sites | Resorption Sites[a] (e) | (l) | Viable Fetuses | Number of Females with 1 or More Resorption Sites Total | Percent |
|---|---|---|---|---|---|---|---|---|---|---|
| Control | (None) | I | 24 | 14.1 | 13.2 | 0.3 | 0.2 | 12.7 | 9 | 37.5 |
| | | II | 25 | 13.5 | 12.5 | 1.0 | 0.2 | 11.3 | 15 | 60.0 |
| CGN | (None) | I | 23 | 13.4 | 12.7 | 1.2 | 0.1 | 11.4 | 11 | 45.8 |
| | | II | 23 | 13.7 | 12.6 | 1.8** | 0.8** | 10.0 | 16 | 72.7 |
| CGF | (35%) | I | 21 | 13.1 | 12.2 | 1.0 | 0.2 | 11.0 | 13. | 62.0 |
| | | II | 15 | 14.5 | 13.1 | 0.7 | 0.1 | 12.3 | 8 | 53.0 |
| CGT | (70%) | I | 22 | 13.9 | 12.8 | 0.6 | <0.1 | 12.2 | 7 | 31.8 |
| | | II | 11 | 13.2 | 12.3 | 0.9 | 0.0 | 11.4 | 3 | 27.2 |
| CGT | (35%) | I | 23 | 14.2 | 13.9 | 0.9 | <0.1 | 13.0 | 11 | 47.8 |
| | | II | 22 | 13.5 | 12.7 | 0.4 | 0.0 | 12.3 | 8 | 36.4 |
| CGT | (70%) | I | 20 | 14.0 | 13.4 | 0.6 | <0.1 | 12.8 | 6 | 30.0 |
| | | II | 21 | 14.1 | 13.5 | 0.4 | 0.0 | 13.1 | 6 | 28.6 |
| TGCO | (35%) | I | 19 | 13.8 | 12.9 | 0.9 | 0.0 | 12.0 | 7 | 36.8 |
| | | II | 18 | 14.1 | 13.0 | 0.6 | <0.1 | 12.4 | 7 | 38.9 |
| TGCO | (70%) | I | 18 | 14.8 | 13.3 | 0.9 | 0.0 | 12.4 | 11 | 61.1 |
| | | II | 24 | 14.4 | 13.3 | 1.7** | 0.2 | 11.4 | 20* | 83.3 |
| TGEL | (35%) | I | 23 | 14.2 | 13.2 | 0.9 | 0.1 | 12.2 | 12 | 52.1 |
| | | II | 19 | 12.3 | 13.1 | 1.3 | 0.0 | 11.8 | 12 | 63.2 |
| TGEL | (70%) | I | 22 | 13.8 | 12.6 | 0.5 | <0.1 | 12.1 | 7 | 31.8 |
| | | II | 22 | 15.0 | 13.7 | 0.7 | <0.1 | 13.0 | 10 | 45.2 |

[a] (e) = Early resorption site; (l) = Late resorption site.

* Statistically significant intergroup difference at the 95 percent confidence level.

** Statistically significant intergroup difference at the 99 percent confidence level.

5. Fetal Development

a. Body Weight

Fetal body weight data are presented in Table XXVIII. The body weights of the fetuses obtained from animals receiving diets containing beef were comparable to those of fetuses obtained from control animals.

TABLE XXVIII

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Fetal Body Weight Data

Summary of Results

| Group | (Beef Content) | | Number of Males | Mean Body Weight (g) | Number of Females | Mean Body Weight (g) | Number of Males per 100 Fetuses |
|---|---|---|---|---|---|---|---|
| Control | (None) | I | 144 | 1.8 | 161 | 1.7 | 47.2 |
| | | II | 151 | 1.8 | 135 | 1.8 | 52.8 |
| CGN | (None) | I | 127 | 1.5 | 138 | 1.5 | 47.9 |
| | | II | 106 | 1.6 | 125 | 1.5 | 45.9 |
| CGF | (35%) | I | 121 | 2.0 | 111 | 1.9 | 37.5 |
| | | II | 101 | 2.0 | 84 | 2.1 | 54.6 |
| CGF | (70%) | I | 128 | 2.1 | 140 | 2.0 | 47.8 |
| | | II | 51 | 2.0 | 74 | 2.0 | 41.8 |
| CGT | (35%) | I | 126 | 1.7 | 171 | 1.7 | 42.4 |
| | | II | 117 | 1.9 | 154 | 1.8 | 43.1 |
| CGT | (70%) | I | 107 | 1.8 | 149 | 1.8 | 41.8 |
| | | II | 115 | 1.9 | 162 | 1.9 | 41.5 |
| TGCO | (35%) | I | 110 | 1.6 | 119 | 1.5 | 48.0 |
| | | II | 97 | 1.6 | 126 | 1.5 | 43.5 |
| TGCO | (70%) | I | 107 | 1.7 | 117 | 1.4 | 47.8 |
| | | II | 111 | 1.7 | 163 | 1.7 | 40.5 |
| TGEL | (35%) | I | 158 | 1.7 | 122 | 1.6 | 56.4 |
| | | II | 130 | 1.7 | 94 | 1.7 | 58.0 |
| TGEL | (70%) | I | 124 | 1.9 | 141 | 1.9 | 46.8 |
| | | II | 141 | 1.9 | 145 | 1.9 | 49.3 |

b. External Development

The results of the examinations for fetal external development are presented in Table XXIX. Two CGN (None) I females accounted for 22 of the 32 runt fetuses observed in this group. Two CGN (None) II females accounted for 23 of the 30 runt fetuses observed in this group. There were no changes in the type or incidence of external abnormalities which could be attributed to ingestion of the test diets containing beef.

TABLE XXIX

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

External Fetal Development

Summary of Results

| Group | (Beef Content) | | Number of Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| Control | (None) | I | 305 | Runt | 1 | 0.3 |
| | | | | Total number of fetuses with findings | 1 | 0.3 |
| | | | | Total number of normal fetuses | 304 | 99.7 |
| | | II | 286 | Hematoma | 2 | 0.7 |
| | | | | Runt | 7 | 2.4 |
| | | | | Total number of fetuses with findings | 8 | 2.8 |
| | | | | Total number of normal fetuses | 278 | 97.2 |
| CGN | (None) | I | 265 | Hematoma | 4 | 1.5 |
| | | | | Runt | 32* | 12.1 |
| | | | | Extended lower jaw | 1 | 0.4 |
| | | | | Total number of fetuses with findings | 37 | 14.0 |
| | | | | Total number of normal fetuses | 228 | 86.0 |
| | | II | 231 | Hematoma | 2 | 0.9 |
| | | | | Runt | 30** | 13.0 |
| | | | | Protruding snout | 1 | 0.4 |
| | | | | Assymmetrical facial features | 1 | 0.4 |
| | | | | Total number of fetuses with findings | 34 | 14.7 |
| | | | | Total number of normal fetuses | 197 | 85.3 |
| CGF | (35%) | I | 232 | Runt | 5 | 2.2 |
| | | | | Anurous condition | 1 | 0.4 |
| | | | | Slightly edematous | 6 | 2.6 |
| | | | | Total number of fetuses with findings | 11 | 4.7 |
| | | | | Total number of normal fetuses | 221 | 95.3 |
| | | II | 185 | Hematoma | 1 | 0.5 |
| | | | | Runt | 4 | 2.2 |
| | | | | Total number of fetuses with findings | 4 | 2.2 |
| | | | | Total number of normal fetuses | 181 | 97.8 |
| CGF | (70%) | I | 268 | Runt | 1 | 0.4 |
| | | | | Total number of fetuses with findings | 1 | 0.4 |
| | | | | Total number of normal fetuses | 267 | 99.6 |
| | | II | 125 | Runt | 4 | 3.2 |
| | | | | Total number of fetuses with findings | 4 | 3.2 |
| | | | | Total number of normal fetuses | 121 | 96.8 |
| CGT | (35%) | I | 297 | Hematoma | 1 | 0.3 |
| | | | | Runt | 3 | 1.0 |
| | | | | Umbilical hernia | 1 | 0.3 |
| | | | | Unusual curvature of spinal column | 1 | 0.3 |
| | | | | Small area of spinal column (posterior) exposed | 1 | 0.3 |
| | | | | Total number of fetuses with findings | 7 | 2.4 |
| | | | | Total number of normal fetuses | 290 | 97.6 |
| | | II | 271 | Runt | 2 | 0.7 |
| | | | | Total number of fetuses with findings | 2 | 0.7 |
| | | | | Total number of normal fetuses | 269 | 99.3 |
| CGT | (70%) | I | 256 | Cranioschisis | 1 | 0.4 |
| | | | | Slightly edematous | 1 | 0.4 |
| | | | | Malformation of lower jaw | 1 | 0.4 |
| | | | | Cleft palate | 1 | 0.4 |
| | | | | Total number of fetuses with findings | 2 | 0.8 |
| | | | | Total number of normal fetuses | 254 | 99.2 |
| | | II | 277 | Hematoma | 1 | 0.4 |
| | | | | Runt | 3 | 1.1 |
| | | | | Gastroschisis | 1 | 0.4 |
| | | | | Cranioschisis | 1 | 0.4 |
| | | | | Total number of fetuses with findings | 3 | 1.1 |
| | | | | Total number of normal fetuses | 274 | 98.9 |

TABLE XXIX continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

External Fetal Development

Summary of Results

| Group | (Beef Content) | | Number of Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| TGCO | (35%) | I | 229 | Hematoma | 2 | 0.9 |
| | | | | Total number of fetuses with findings | 2 | 0.9 |
| | | | | Total number of normal fetuses | 227 | 99.1 |
| | | II | 223 | Gastroschisis | 1 | 0.4 |
| | | | | Total number of fetuses with findings | 1 | 0.4 |
| | | | | Total number of normal fetuses | 222 | 99.6 |
| TGCO | (70%) | I | 224 | Hematoma | 2 | 0.9 |
| | | | | Runt | 1 | 0.4 |
| | | | | Total number of fetuses with findings | 3 | 1.3 |
| | | | | Total number of normal fetuses | 221 | 98.7 |
| | | II | 274 | Hematoma | 1 | 0.4 |
| | | | | Runt | 2 | 0.7 |
| | | | | Hydrocephalus | 1 | 0.4 |
| | | | | Total number of fetuses with findings | 3 | 1.1 |
| | | | | Total number of normal fetuses | 271 | 98.9 |
| TGEL | (35%) | I | 280 | Hematoma | 1 | 0.4 |
| | | | | Runt | 1 | 0.4 |
| | | | | Total number of fetuses with findings | 2 | 0.7 |
| | | | | Total number of normal fetuses | 278 | 99.3 |
| | | II | 224 | No external malformations noted | | |
| TGEL | (70%) | I | 265 | Rear limbs malformed | 1 | 0.4 |
| | | | | Total number of fetuses with findings | 1 | 0.4 |
| | | | | Total number of normal fetuses | 264 | 99.6 |
| | | II | 286 | Hematoma | 1 | 0.4 |
| | | | | Runt | 1 | 0.4 |
| | | | | Total number of fetuses with findings | 1 | 0.4 |
| | | | | Total number of normal fetuses | 285 | 99.6 |

* Twenty-two (22) fetuses were obtained from 2 litters.
** Twenty-three (23) fetuses were obtained from 2 litters.

c. Skeletal Development

A summary and interpretation of skeletal findings is presented in Table XXX. Observations of fetal skeletal development at caesarian section are presented in Table XXXI.

Those fetuses having sternum sections that were only partially stained with the calcium positive Alizarin dye were classified as incompletely ossified sections. Sternum sections that did not retain any of the dye were classified as non-ossified. These classifications are measures of the relative extent of fetal skeletal calcification at the time of sacrifice. Incompletely ossified sternum sections, non-ossified sternum sections, and supernumerary ribs are classified as incidental skeletal findings. These incidental skeletal findings are normally observed in fetuses obtained from untreated control does.

The fetuses obtained from the groups fed the semipurified diet [CGN (None) I and II] exhibited an increase in the number of fetuses with incidental skeletal findings. This increase was due to an increase in the number of fetuses with non-ossified sternum sections. Two groups fed diets containing 35 percent electron irradiated beef [TGEL (35%) I and II] exhibited increases in the percentage of fetuses with findings. The TGEL (35%) I and II groups exhibited increases in incompletely ossified sternum sections that accounted for the increases in the percentage of fetuses with incidental skeletal findings in the groups fed diets containing 70 percent of the same beef [TGEL (70%) I and II]. The incidences of

incidental skeletal findings were considered normal in all groups fed diets containing beef. There were no changes in the occurrence of skeletal abnormalities which could be attributed to prenatal exposure either to the semipurified diet or to diets containing frozen, thermally processed, cobalt irradiated beef, or electron irradiated beef. Observations of fetal skeletal development disclosed no effects which could be attributed to prenatal exposure to diets containing beef.

TABLE XXX

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Fetal Skeletal Development

Summary and Interpretation of Findings

| Group | (Beef Content) | | Number of Fetuses | Number of Fetuses with Skeletal Findings (Abnormalities + Incidental Findings) | Number of Fetuses with Skeletal Abnormalities | Number of Fetuses with Incidental Findings Only | Number of Fetuses with no Findings | Total Fetuses Unaffected by Treatment |
|---|---|---|---|---|---|---|---|---|
| Control | (None) | I | 152 | 105 | 2 | 103 | 47 | 150 |
| | | | Percent: | 69.1 | 1.3 | 67.8 | 30.9 | 98.7 |
| | | II | 139 | 99 | 13 | 86 | 40 | 126 |
| | | | Percent: | 71.2 | 9.4 | 61.9 | 28.8 | 90.6 |
| CGN | (None) | I | 134 | 112 | 12 | 100 | 22 | 122 |
| | | | Percent: | 83.6 | 9.0 | 74.6 | 16.4 | 91.0 |
| | | II | 114 | 93 | 2 | 91 | 21 | 112 |
| | | | Percent: | 81.6 | 1.8 | 79.8 | 18.4 | 98.2 |
| CGF | (35%) | I | 111 | 76 | 1 | 75 | 35 | 110 |
| | | | Percent: | 68.5 | 0.9 | 67.6 | 31.5 | 99.1 |
| | | II | 93 | 46 | 4 | 42 | 47 | 89 |
| | | | Percent: | 49.5 | 4.3 | 45.2 | 50.5 | 95.7 |
| CGF | (70%) | I | 132 | 68 | 0 | 68 | 64 | 132 |
| | | | Percent: | 51.5 | 0.0 | 51.5 | 48.5 | 100.0 |
| | | II | 59 | 31 | 2 | 29 | 28 | 57 |
| | | | Percent: | 52.5 | 3.4 | 49.2 | 47.5 | 96.6 |
| CGT | (35%) | I | 144 | 107 | 2 | 105 | 37 | 142 |
| | | | Percent: | 74.3 | 1.4 | 72.9 | 25.7 | 98.6 |
| | | II | 136 | 76 | 2 | 74 | 60 | 134 |
| | | | Percent: | 55.9 | 1.5 | 54.4 | 44.1 | 98.5 |
| CGT | (70%) | I | 124 | 66 | 4 | 62 | 58 | 120 |
| | | | Percent: | 53.2 | 3.2 | 50.0 | 46.8 | 96.8 |
| | | II | 130 | 70 | 3 | 67 | 60 | 127 |
| | | | Percent: | 53.8 | 2.3 | 51.5 | 46.2 | 97.7 |
| TGCO | (35%) | I | 109 | 75 | 4 | 71 | 34 | 105 |
| | | | Percent: | 68.8 | 3.7 | 65.1 | 31.2 | 96.3 |
| | | II | 104 | 73 | 1 | 72 | 31 | 103 |
| | | | Percent: | 70.2 | 1.0 | 69.2 | 29.8 | 99.0 |
| TGCO | (70%) | I | 108 | 53 | 1 | 52 | 55 | 107 |
| | | | Percent: | 49.1 | 0.9 | 48.1 | 50.9 | 99.1 |
| | | II | 131 | 63 | 5 | 58 | 68 | 126 |
| | | | Percent: | 48.1 | 3.8 | 44.3 | 51.9 | 96.2 |
| TGEL | (35%) | I | 135 | 109 | 7 | 102 | 26 | 128 |
| | | | Percent: | 80.7 | 5.2 | 75.6 | 19.3 | 94.8 |
| | | II | 111 | 84 | 2 | 82 | 27 | 109 |
| | | | Percent: | 75.7 | 1.8 | 73.9 | 24.3 | 98.2 |
| TGEL | (70%) | I | 127 | 83 | 2 | 81 | 44 | 125 |
| | | | Percent: | 65.4 | 1.6 | 63.8 | 34.6 | 98.4 |
| | | II | 134 | 67 | 1 | 66 | 67 | 133 |
| | | | Percent: | 50.0 | 0.7 | 49.2 | 50.0 | 99.3 |

TABLE XXXI

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| Control | (None) | I | 152 | Incompletely ossified sternum section(s) | 82 | 53.9 |
| | | | | Non-ossified sternum section(s) | 39 | 25.7 |
| | | | | Asymmetry of sternum section(s) | 1 | 0.6 |
| | | | | Bifurcated sternum | 1 | 0.6 |
| | | | | Supernumerary ribs | 23 | 15.1 |
| | | | | Total number of fetuses with findings | 105 | 69.1 |
| | | | | Total number of normal fetuses | 47 | 30.9 |
| | | II | 139 | Incompletely ossified sternum section(s) | 59 | 42.4 |
| | | | | Non-ossified sternum section(s) | 41 | 29.5 |
| | | | | Asymmetry of sternum section(s) | 4 | 2.9 |
| | | | | Bifurcated sternum | 3 | 2.2 |
| | | | | Supernumerary ribs | 29 | 20.9 |
| | | | | Fused ribs | 3 | 2.2 |
| | | | | Forked ribs | 2 | 1.4 |
| | | | | Angulated ribs | 1 | 0.7 |
| | | | | Total number of fetuses with findings | 99 | 71.2 |
| | | | | Total number of normal fetuses | 40 | 28.8 |

TABLE XXXI continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| CGN | (None) I | 134 | Incompletely ossified sternum section(s) | 57 | 42.5 |
| | | | Non-ossified sternum section(s) | 92 | 68.6 |
| | | | Dual ossification of sternum section(s) | 1 | 0.7 |
| | | | Asymmetry of sternum section(s) | 1 | 0.7 |
| | | | Fused sternum section(s) | 1 | 0.7 |
| | | | Bifurcated sternum | 2 | 1.5 |
| | | | Supernumerary ribs | 12 | 9.0 |
| | | | Fused ribs | 3 | 2.2 |
| | | | Shortened rib(s) | 1 | 0.7 |
| | | | Spina bifida | 1 | 0.7 |
| | | | Mandible extended-nasal curves upward | 2 | 1.5 |
| | | | Total number of fetuses with findings | 112 | 83.6 |
| | | | Total number of normal fetuses | 22 | 16.4 |
| | II | 114 | Incompletely ossified sternum section(s) | 59 | 51.8 |
| | | | Non-ossified sternum section(s) | 59 | 51.8 |
| | | | Dual ossification of sternum section(s) | 2 | 1.8 |
| | | | Supernumerary ribs | 14 | 12.3 |
| | | | Total number of fetuses with findings | 93 | 81.6 |
| | | | Total number of normal fetuses | 21 | 18.4 |

TABLE XXXI continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| CGF | (35%) | I | 111 | Incompletely ossified sternum section(s) | 42 | 37.8 |
| | | | | Non-ossified sternum section(s) | 38 | 34.2 |
| | | | | Asymmetry of sternum section(s) | 1 | 0.9 |
| | | | | Supernumerary ribs | 11 | 9.9 |
| | | | | Total number of fetuses with findings | 76 | 68.5 |
| | | | | Total number of normal fetuses | 35 | 31.5 |
| | | II | 93 | Incompletely ossified sternum section(s) | 19 | 20.4 |
| | | | | Non-ossified sternum section(s) | 22 | 23.6 |
| | | | | Asymmetry of sternum sections | 4 | 4.3 |
| | | | | Supernumerary ribs | 10 | 10.8 |
| | | | | Total number of fetuses with findings | 46 | 49.5 |
| | | | | Total number of normal fetuses | 47 | 50.5 |

TABLE XXXI continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| CGF | (70%) | I | 132 | Incompletely ossified sternum section(s) | 52 | 39.4 |
| | | | | Non-ossified sternum section(s) | 21 | 15.9 |
| | | | | Supernumerary ribs | 19 | 14.4 |
| | | | | Total number of fetuses with findings | 68 | 51.5 |
| | | | | Total number of normal fetuses | 64 | 48.5 |
| | | II | 59 | Incompletely ossified sternum section(s) | 23 | 39.0 |
| | | | | Non-ossified sternum section(s) | 19 | 32.2 |
| | | | | Supernumerary ribs | 6 | 10.2 |
| | | | | Fused ribs | 2 | 3.4 |
| | | | | Total number of fetuses with findings | 31 | 52.5 |
| | | | | Total number of normal fetuses | 28 | 47.5 |

TABLE XXXI continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| CGT | (35%) | I | 144 | Incompletely ossified sternum section(s) | 76 | 52.8 |
| | | | | Non-ossified sternum section(s) | 45 | 31.2 |
| | | | | Dual ossification of sternum sections | 2 | 1.4 |
| | | | | Supernumerary ribs | 28 | 19.4 |
| | | | | Total number of fetuses with findings | 107 | 74.3 |
| | | | | Total number of normal fetuses | 37 | 25.7 |
| | | II | 136 | Incompletely ossified sternum section(s) | 59 | 43.4 |
| | | | | Non-ossified sternum section(s) | 24 | 17.6 |
| | | | | Supernumerary ribs | 14 | 10.3 |
| | | | | Fissure in mandible | 2 | 1.5 |
| | | | | Total number of fetuses with findings | 76 | 55.9 |
| | | | | Total number of normal fetuses | 60 | 44.1 |

TABLE XXXI continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| CGT | (70%) | I | 124 | Incompletely ossified sternum section(s) | 44 | 35.5 |
| | | | | Non-ossified sternum section(s) | 27 | 21.8 |
| | | | | Supernumerary ribs | 23 | 18.5 |
| | | | | Fused ribs | 2 | 1.6 |
| | | | | Angulated ribs | 1 | 0.8 |
| | | | | Mandible retarded | 1 | 0.8 |
| | | | | Total number of fetuses with findings | 66 | 53.2 |
| | | | | Total number of normal fetuses | 58 | 46.8 |
| | | II | 130 | Incompletely ossified sternum section(s) | 51 | 39.2 |
| | | | | Non-ossified sternum section(s) | 21 | 16.1 |
| | | | | Dual ossification of sternum sections | 2 | 1.5 |
| | | | | Supernumerary ribs | 13 | 10.0 |
| | | | | Fused ribs | 1 | 0.8 |
| | | | | Total number of fetuses with findings | 70 | 53.8 |
| | | | | Total number of normal fetuses | 60 | 46.2 |

TABLE XXXI continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| TGCO | (35%) | I | 109 | Incompletely ossified sternum section(s) | 63 | 57.8 |
| | | | | Non-ossified sternum section(s) | 30 | 27.5 |
| | | | | Asymmetry of sternum sections | 1 | 0.9 |
| | | | | Supernumerary ribs | 17 | 15.6 |
| | | | | Fused ribs | 3 | 2.8 |
| | | | | Total number of fetuses with findings | 75 | 68.8 |
| | | | | Total number of normal fetuses | 34 | 31.2 |
| | | II | 104 | Incompletely ossified sternum section(s) | 47 | 45.2 |
| | | | | Non-ossified sternum section(s) | 50 | 48.1 |
| | | | | Supernumerary ribs | 6 | 5.8 |
| | | | | Fused ribs | 1 | 1.0 |
| | | | | Total number of fetuses with findings | 73 | 70.2 |
| | | | | Total number of normal fetuses | 31 | 29.8 |

TABLE XXXI continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| TGCO | (70%) | I | 108 | Incompletely ossified sternum section(s) | 46 | 42.6 |
| | | | | Non-ossified sternum section(s) | 17 | 15.7 |
| | | | | Supernumerary ribs | 4 | 3.7 |
| | | | | Fused ribs | 1 | 0.9 |
| | | | | Total number of fetuses with findings | 53 | 49.1 |
| | | | | Total number of normal fetuses | 55 | 50.9 |
| | | II | 131 | Incompletely ossified sternum section(s) | 49 | 37.4 |
| | | | | Non-ossified sternum section(s) | 14 | 10.7 |
| | | | | Asymmetry of sternum sections | 1 | 0.8 |
| | | | | Supernumerary ribs | 10 | 7.6 |
| | | | | Fused ribs | 3 | 2.3 |
| | | | | Mandible extended | 1 | 0.8 |
| | | | | Total number of fetuses with findings | 63 | 48.1 |
| | | | | Total number of normal fetuses | 68 | 51.9 |

TABLE XXXI continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| TGEL | (35%) | I | 135 | Incompletely ossified sternum section(s) | 89 | 65.9 |
| | | | | Non-ossified sternum section(s) | 55 | 40.7 |
| | | | | Asymmetry of sternum sections | 2 | 1.5 |
| | | | | Bifurcated spinal column | 1 | 0.7 |
| | | | | Supernumerary ribs | 12 | 8.9 |
| | | | | Fused ribs | 1 | 0.7 |
| | | | | Angulated ribs | 1 | 0.7 |
| | | | | Humerus and radius shortened | 1 | 0.7 |
| | | | | Ulna missing | 1 | 0.7 |
| | | | | Total number of fetuses with findings | 109 | 80.7 |
| | | | | Total number of normal fetuses | 26 | 19.3 |
| | | II | 111 | Incompletely ossified sternum section(s) | 74 | 66.7 |
| | | | | Non-ossified sternum section(s) | 27 | 24.3 |
| | | | | Dual ossification of sternum sections | 1 | 0.9 |
| | | | | Asymmetry of sternum sections | 1 | 0.9 |
| | | | | Supernumerary ribs | 17 | 15.3 |
| | | | | Total number of fetuses with findings | 84 | 75.7 |
| | | | | Total number of normal fetuses | 27 | 24.3 |

TABLE XXXI continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| TGEL | (70%) | I | 127 | Incompletely ossified sternum section(s) | 72 | 57.5 |
| | | | | Non-ossified sternum section(s) | 26 | 20.5 |
| | | | | Dual ossification of sternum sections | 1 | 0.8 |
| | | | | Supernumerary ribs | 4 | 3.1 |
| | | | | Fused ribs | 1 | 0.8 |
| | | | | Total number of fetuses with findings | 83 | 65.4 |
| | | | | Total number of normal fetuses | 44 | 34.6 |
| | | II | 134 | Incompletely ossified sternum section(s) | 56 | 41.8 |
| | | | | Non-ossified sternum section(s) | 9 | 6.7 |
| | | | | Supernumerary ribs | 17 | 12.7 |
| | | | | Shortened rib(s) | 1 | 0.7 |
| | | | | Total number of fetuses with findings | 67 | 50.0 |
| | | | | Total number of normal fetuses | 67 | 50.0 |

d. Internal Development

The results of the evaluation of fetal internal development are presented in Table XXXII. Large and small atria noted in this table are considered to be incidental findings. Slight variations in the size of the atrium are considered to occur as a result of fixation and the extent of fetal viability prior to sacrifice. There were no changes in the types or incidences of internal findings in any of the groups which could be attributed to prenatal exposure to the test diets.

TABLE XXXII

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Fetal Internal Development

Summary of Results

| Group | (Beef Content) | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| Control | (None) I | 153 | Small atria | 11 | 7.2 |
| | | | Large atria | 11 | 7.2 |
| | | | Total number of fetuses with findings | 22 | 14.4 |
| | | | Total number of normal fetuses | 131 | 85.6 |
| | II | 147 | Small atria | 10 | 6.8 |
| | | | Large atria | 6 | 4.1 |
| | | | Total number of fetuses with findings | 16 | 10.9 |
| | | | Total number of normal fetuses | 131 | 89.1 |

TABLE XXXII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Fetal Internal Development

Summary of Results

| Group | (Beef Content) | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| CGN | (None) I | 131 | Small atria | 8 | 6.1 |
| | | | Large atria | 12 | 9.2 |
| | | | Total number of fetuses with findings | 20 | 15.3 |
| | | | Total number of normal fetuses | 111 | 84.7 |
| | II | 117 | Small atria | 8 | 6.8 |
| | | | Large atria | 4 | 3.4 |
| | | | Cleft palate | 1 | 0.8 |
| | | | Hole in heart | 1 | 0.8 |
| | | | Total number of fetuses with findings | 14 | 12.0 |
| | | | Total number of normal fetuses | 103 | 88.0 |

TABLE XXXII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Fetal Internal Development

Summary of Results

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| CGF | (35%) | I | 121 | Small atria | 4 | 3.3 |
| | | | | Large atria | 5 | 4.1 |
| | | | | Small kidneys | 1 | 1.0 |
| | | | | Undescended testes | 2 | 1.7 |
| | | | | Anurous condition | 1 | 1.0 |
| | | | | Total number of fetuses with findings | 12 | 9.9 |
| | | | | Total number of normal fetuses | 109 | 90.1 |
| | | II | 92 | Small atria | 3 | 3.3 |
| | | | | Large atria | 8 | 8.7 |
| | | | | Total number of fetuses with findings | 11 | 12.0 |
| | | | | Total number of normal fetuses | 81 | 88.0 |

TABLE XXXII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Fetal Internal Development

Summary of Results

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| CGF | (70%) | I | 136 | Small atria | 13 | 9.6 |
| | | | | Large atria | 2 | 1.5 |
| | | | | Total number of fetuses with findings | 15 | 11.0 |
| | | | | Total number of normal fetuses | 121 | 89.0 |
| | | II | 66 | Small atria | 6 | 9.1 |
| | | | | Total number of fetuses with findings | 6 | 9.1 |
| | | | | Total number of normal fetuses | 60 | 90.9 |

TABLE XXXII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Fetal Internal Development

Summary of Results

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| CGT | (35%) | I | 153 | Small atria | 4 | 2.6 |
| | | | | Large atria | 4 | 2.6 |
| | | | | Moderate internal hydrocephalus | 1 | 0.6 |
| | | | | Partially fibroid heart | 1 | 0.6 |
| | | | | Total number of fetuses with findings | 9 | 5.9 |
| | | | | Total number of normal fetuses | 144 | 94.1 |
| | | II | 135 | Small atria | 5 | 3.7 |
| | | | | Large atria | 7 | 5.2 |
| | | | | Cleft palate | 1 | 0.7 |
| | | | | Total number of fetuses with findings | 13 | 9.6 |
| | | | | Total number of normal fetuses | 122 | 90.4 |

TABLE XXXII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Fetal Internal Development

Summary of Results

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| CGT | (70%) | I | 132 | Small atria | 6 | 4.5 |
| | | | | Large atria | 2 | 1.5 |
| | | | | Total number of fetuses with findings | 8 | 6.1 |
| | | | | Total number of normal fetuses | 124 | 93.9 |
| | | II | 147 | Small atria | 4 | 2.7 |
| | | | | Large atria | 7 | 4.8 |
| | | | | Severe internal hydrocephalus | 1 | 0.7 |
| | | | | Total number of fetuses with findings | 12 | 8.2 |
| | | | | Total number of normal fetuses | 135 | 91.8 |

TABLE XXXII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Fetal Internal Development

Summary of Results

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| TGCO | (35%) | I | 120 | Small atria | 3 | 2.5 |
| | | | | Large atria | 2 | 1.7 |
| | | | | Total number of fetuses with findings | 5 | 4.2 |
| | | | | Total number of normal fetuses | 115 | 95.8 |
| | | II | 119 | Small atria | 6 | 5.0 |
| | | | | Large atria | 9 | 7.6 |
| | | | | Gastroschisis | 1 | 0.8 |
| | | | | Total number of fetuses with findings | 16 | 13.4 |
| | | | | Total number of normal fetuses | 113 | 86.6 |

TABLE XXXII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Fetal Internal Development

Summary of Results

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| TGCO | (70%) | I | 116 | Small atria | 8 | 6.9 |
| | | | | Large atria | 3 | 2.6 |
| | | | | Total number of fetuses with findings | 11 | 9.5 |
| | | | | Total number of normal fetuses | 105 | 90.5 |
| | | II | 143 | Small atria | 2 | 1.4 |
| | | | | Large atria | 5 | 3.5 |
| | | | | Cleft palate | 3 | 2.1 |
| | | | | Undescended testes | 2 | 1.4 |
| | | | | Total number of fetuses with findings | 12 | 8.4 |
| | | | | Total number of normal fetuses | 131 | 91.6 |

TABLE XXXII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Fetal Internal Development

Summary of Results

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| TGEL | (35%) | I | 145 | Small atria | 1 | 0.7 |
| | | | | Large atria | 10 | 6.9 |
| | | | | Small kidney (right) | 1 | 0.7 |
| | | | | Total number of fetuses with findings | 12 | 8.3 |
| | | | | Total number of normal fetuses | 133 | 91.7 |
| | | II | 113 | Small atria | 3 | 2.7 |
| | | | | Large atria | 9 | 8.0 |
| | | | | Undescended testes | 1 | 0.9 |
| | | | | Total number of fetuses with findings | 13 | 11.5 |
| | | | | Total number of normal fetuses | 100 | 88.5 |

TABLE XXXII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Golden Syrian Hamsters

Fetal Internal Development

Summary of Results

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| TGEL | (70%) | I | 138 | Small atria | 11 | 8.0 |
| | | | | Large atria | 7 | 5.1 |
| | | | | Total number of fetuses with findings | 18 | 13.0 |
| | | | | Total number of normal fetuses | 120 | 87.0 |
| | | II | 152 | Small atria | 4 | 2.6 |
| | | | | Large atria | 8 | 5.3 |
| | | | | Fibroid heart | 2 | 1.3 |
| | | | | Total number of fetuses with findings | 13 | 8.6 |
| | | | | Total number of normal fetuses | 139 | 91.4 |

## VIII. Experiment IV - Albino Rabbits

### A. Summary

Diets containing either frozen, thermally processed, cobalt irradiated, or electron irradiated beef were fed to groups of pregnant albino rabbits during the period of fetal organogenesis. Each type of beef was fed at dietary concentrations of either 35 or 70 percent beef (on a dry matter basis). Each beef diet was fed to 2 groups of pregnant animals. The experimental design included 2 control groups fed a standard stock ration.

Maternal body weight, reproductive effects (including early and late resorption sites, the number of viable fetuses, and the number of females with 1 or more resorption sites), fetal body weight, 24-hour survival of the young, and fetal development (external, skeletal, and internal) findings are summarized in Table XXXIII. The groups fed frozen, thermally processed, cobalt irradiated, or electron irradiated beef exhibited either body weight losses or reductions of body weight gains during Gestation Days 6 through 18 when the animals were on the test diets. These groups exhibited normal overall body weight gains during Gestation Days 0 through 29. The groups fed beef diets consumed 4 to 25 percent less food than that consumed by the control groups. The food consumption reductions observed in the groups of albino rabbits fed diets containing beef were expected, as beef does not comprise part of the normal diet of these animals. Three (2.1 percent) of the CGF (35%) I group fetuses

were observed with external abnormalities. These 3 fetuses were all from the same CGF (35%) I group doe. This observation was not attributed to the ingestion of the diet for this group. There were no external abnormalities noted in the CGF (35%) II group which received the same diet, and there were no external abnormalities observed which could be attributed to the ingestion of the test diet in the groups fed the diet containing 70 percent of the same beef. The CGF (35%) I, CGF (70%) I and II, and the CGT (35%) I group fetuses exhibited a slight increase in the percent of fetuses with skeletal abnormalities. The increase in skeletal abnormalities in these groups was due to an increase in the number of fetuses with incompletely ossified frontal and/or parietal bones (a finding observed among fetuses obtained from control New Zealand albino rabbits used in similar teratogenic studies conducted in this laboratory). Thirty to 100 percent of the fetuses exhibiting incompletely ossified frontal and/or parietal bones from each of these groups, were obtained from the same litter. No other findings differing from those normally observed for pregnant albino rabbits of this strain in this laboratory were noted.

The ingestion of diets containing frozen, thermally processed, cobalt irradiated, or electron irradiated beef resulted in no overall body weight changes which could be attributed to the test diets. The groups fed beef diets consumed 4 to 25 percent less food than that consumed by the control groups. The animals fed diets containing 70 percent beef generally consumed amounts of food comparable to those consumed by the animals fed

diets containing 35 percent beef. There were no changes in the data related to reproduction which could be attributed to the ingestion of diets containing beef. No deaths or abnormal behavioral reactions were noted among any of the animals in this phase of the investigation. The body weights of fetuses obtained from females fed diets containing beef were comparable to those of fetuses obtained from females fed the control diet (standard stock ration). Fetal external, skeletal, and internal development was considered normal in all groups fed either beef diets or control diets. Feeding diets containing frozen, thermally processed, cobalt irradiated, or electron irradiated beef to pregnant albino rabbits during the period of fetal organogenesis did not induce a teratogenic response in this test system.

TABLE XXXIII

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rabbits

Summary of Findings

| Group | (Beef Content) | | Maternal Body Weights Gestation Days: 6-18 | 0-29 | Reproductive Effects: Resorption Sites (Early) | (Late) | Number of Viable Fetuses | Number of Females With 1 or More Resorption Sites | Fetal Body Weight | 24-Hour Survival of the Young | Fetal Development: External | Skeletal | Internal |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Control | (None) | I | - | - | - | - | - | - | - | - | - | - | - |
| | | II | - | - | - | - | - | - | - | - | - | - | - |
| CGF | (35%) | I | + (D) | - | - | - | - | - | - | - | + | + | - |
| | | II | + (D) | - | - | - | - | - | - | - | - | - | - |
| CGF | (70%) | I | + (D) | - | - | - | - | - | - | - | - | + | - |
| | | II | + (D) | - | - | - | - | - | - | - | - | + | - |
| CGT | (35%) | I | + (D) | - | - | - | - | - | - | - | - | + | - |
| | | II | + (D) | - | - | - | - | - | - | - | - | - | - |
| CGT | (70%) | I | + (D) | - | - | - | - | - | - | - | - | - | - |
| | | II | + (D) | - | - | - | - | - | - | - | - | - | - |
| TGCO | (35%) | I | + (D) | - | - | - | - | - | - | - | - | - | - |
| | | II | + (D) | - | - | - | - | - | - | - | - | - | - |
| TGCO | (70%) | I | + (D) | - | - | - | - | - | - | - | - | - | - |
| | | II | + (D) | - | - | - | - | - | - | - | - | - | - |
| TGEL | (35%) | I | + (D) | - | - | - | - | - | - | - | - | - | - |
| | | II | + (D) | - | - | - | - | - | - | - | - | - | - |
| TGEL | (70%) | I | + (D) | - | - | - | - | - | - | - | - | - | - |
| | | II | + (D) | - | - | - | - | - | - | - | - | - | - |

Key
- = normal findings
+ = findings other than normal
(D) = decrease

B. Procedure

1. Experimental Animals

The animals employed in the study were New Zealand albino rabbits. Each doe was housed individually for 18 days prior to being employed in the investigation.

2. Organization of Groups

A structural outline of the experiment is provided in Table XXXIV.

TABLE XXXIV

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rabbits

Outline of Experiment

| Group | Number of Pregnant Animals | Diet | % Beef* |
|---|---|---|---|
| Control I | 17 | None | - |
| Control II | 20 | None | - |
| CGF I | 18 | Frozen Beef | 35 |
| CGF II | 20 | Frozen Beef | 35 |
| CGF I | 20 | Frozen Beef | 70 |
| CGF II | 20 | Frozen Beef | 70 |
| CGT I | 20 | Thermally Processed Beef | 35 |
| CGT II | 18 | Thermally Processed Beef | 35 |
| CGT I | 15 | Thermally Processed Beef | 70 |
| CGT II | 15 | Thermally Processed Beef | 70 |
| TGCO I | 16 | Cobalt Irradiated Beef | 35 |
| TGCO II | 18 | Cobalt Irradiated Beef | 35 |
| TGCO I | 15 | Cobalt Irradiated Beef | 70 |
| TGCO II | 20 | Cobalt Irradiated Beef | 70 |
| TGEL I | 19 | Electron Irradiated Beef | 35 |
| TGEL II | 19 | Electron Irradiated Beef | 35 |
| TGEL I | 16 | Electron Irradiated Beef | 70 |
| TGEL II | 16 | Electron Irradiated Beef | 70 |

* Dietary levels are based on dry matter weight.

3. Breeding

Gestation Day 0 was the day of insemination. Each female received an intravenous injection containing 2.0 mg of pituitary luteinizing hormone per kg of body weight and was inseminated with 0.7 ml of diluted, pooled semen from proven bucks. Bred does were housed individually in hutches for the remainder of the investigation.

4. Exposure and Feeding

All diets were prepared in the manner outlined in section III of this report. Animals in control groups I and II were offered the standard stock rabbit ration utilized at this laboratory, as were the test group does prior to and following the treatment period. The does of each group were offered their respective diets fresh daily from the 6th day of their gestation period through the 18th day (a total of 13 days of exposure). Individual food consumption was measured and recorded daily during the treatment period (Gestation Days 6-18). All animals were allowed food and water ad libitum.

5. Body Weight Data

The body weight data reported include the mean body weights for each group on Days 6 (initial exposure day), 9, 12, 15, and 18 (final day of exposure) of gestation, and sacrifice (Gestation Day 29).

6. Mortality and Reactions

Daily records of mortality and untoward behavioral reactions were maintained throughout the investigation.

7. Reproductive Effects

All females were sacrificed by cervical dislocation on the 29th day of gestation. An incision was made in the abdominal wall and the full extent of both uterine horns was exposed immediately. Fetal swellings and implantation sites were counted, special attention being paid to resorption sites or any other uterine abnormalities.

The number of viable fetuses present in the uterus was determined, spontaneous movement and a more ruddy color distinguishing live from dead animals.

8. Fetal Development

a. Body Weight

All fetuses were removed from the chorion after cutting the umbilical cord and then weighed.

b. External Examination

An external examination of the fetuses was conducted with special attention paid to detection of the following abnormalities: hydrocephaly, exencephaly, meningoencephalocele, simple meningocele, anophthalmia, microphthalmia, cleft lip, oblique facial cleft, micrognathia, external ear abnormalities in size, shape or position, unusual size or position of the limbs, number and disposition of the digits, umbilical hernia, gastroschisis, myelomeningocele, spina bifida and scoliosis.

c. Observation of Viable Young During Incubation

Immediately after external examination, the viable young were placed in an incubator at 37°C. Observations for viability, as indicated by respiratory and paw movements, were made hourly for 7 hours and again after 24 hours.

d. Fetal Internal and Skeletal Development

All young were examined by careful dissection. Particular attention was paid to any differences in size, shape, and orientation of the major organs and blood vessels. An examination of skeletal tissue was then performed employing a modified method for the demonstration of skeletal tissues in embryos as described by Hurley*.

* Hurley, Lucille, S., "Demonstration A-Alizarin Staining of Bone," (revised) Supplement to Teratology Workshop Manual, Berkeley, California, January 25-30, 1965, pp. 121-122.

C. Results

1. Body Weight Data

The mean body weight data are summarized in Table XXXV. The mean body weight gain data are presented in Table XXXVI. The groups fed frozen (CGF), thermally processed (CGT), cobalt irradiated (TGCO), or electron irradiated (TGEL) beef exhibited either body weight losses or reductions of body weight gains during treatment (Gestation Days 6-18). However, the animals from the groups fed diets containing beef exhibited overall (Gestation Days 0-29) body weight gains that were comparable to those normally observed for control New Zealand albino rabbits used in similar teratogenic studies conducted in this laboratory.

TABLE XXXV

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rabbits

Mean Body Weight Data

| Group | (Beef Content) | | Number of Does | Mean Body Weights (kg) Day Number: 0 | 6 | 9 | 12 | 15 | 18 | 29 |
|---|---|---|---|---|---|---|---|---|---|---|
| Control | (None) | I | 17 | 3.76 | 3.76 | 3.84 | 3.89 | 3.98 | 4.01 | 4.16 |
| | | II | 20 | 3.62 | 3.62 | 3.72 | 3.76 | 3.83 | 3.92 | 3.96 |
| CGF | (35%) | I | 18 | 3.73 | 3.73 | 3.66 | 3.67* | 3.77 | 3.76** | 4.02 |
| | | II | 20 | 3.72 | 3.70 | 3.67 | 3.69* | 3.78* | 3.78** | 4.06 |
| CGF | (70%) | I | 20 | 3.67 | 3.71 | 3.67 | 3.65* | 3.72* | 3.73** | 3.98 |
| | | II | 20 | 3.63 | 3.68 | 3.65 | 3.64** | 3.76* | 3.75** | 3.99 |
| CGT | (35%) | I | 20 | 3.82* | 3.89** | 3.83 | 3.91 | 4.00 | 4.02 | 4.21 |
| | | II | 18 | 3.85* | 3.92** | 3.86 | 3.90 | 3.97 | 4.02 | 4.17 |
| CGT | (70%) | I | 15 | 3.81 | 3.84 | 3.74 | 3.80 | 3.91 | 3.91 | 4.15 |
| | | II | 15 | 3.75 | 3.78 | 3.75 | 3.74 | 3.81 | 3.85 | 4.10 |
| TGCO | (35%) | I | 16 | 3.81 | 3.80 | 3.75 | 3.75 | 3.82 | 3.82* | 4.00 |
| | | II | 18 | 3.72 | 3.74 | 3.68 | 3.67* | 3.75* | 3.75** | 3.93 |
| TGCO | (70%) | I | 15 | 3.61 | 3.63 | 3.58* | 3.59** | 3.72* | 3.70** | 3.89 |
| | | II | 20 | 3.93** | 3.98** | 3.89 | 3.86 | 3.94 | 3.90 | 4.16 |
| TGEL | (35%) | I | 19 | 3.50* | 3.57 | 3.53** | 3.54** | 3.63** | 3.65** | 3.88 |
| | | II | 19 | 3.54 | 3.65 | 3.60* | 3.64* | 3.72* | 3.77** | 3.96 |
| TGEL | (70%) | I | 16 | 3.89* | 3.91** | 3.83 | 3.81 | 3.90 | 3.90 | 4.14 |
| | | II | 16 | 3.71 | 3.76 | 3.65 | 3.65* | 3.74* | 3.73** | 3.99 |

* Statistically significant intergroup difference at the 95 percent confidence level.
** Statistically significant intergroup difference at the 99 percent confidence level.

TABLE XXXVI

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rabbits

Mean Body Weight Gain Data

| Group | (Beef Content) | | Mean Body Weight Gains (g) Days 6-18 | Days 0-29 |
|---|---|---|---|---|
| Control | (None) | I | 250 | 400 |
| | | II | 300 | 340 |
| CGF | (35%) | I | 30 | 290 |
| | | II | 80 | 340 |
| CGF | (70%) | I | 20 | 310 |
| | | II | 70 | 360 |
| CGT | (35%) | I | 130 | 390 |
| | | II | 100 | 320 |
| CGT | (70%) | I | 70 | 340 |
| | | II | 70 | 350 |
| TGCO | (35%) | I | 20 | 190 |
| | | II | 10 | 210 |
| TGCO | (70%) | I | 70 | 280 |
| | | II | -80 | 230 |
| TGEL | (35%) | I | 80 | 380 |
| | | II | 120 | 420 |
| TGEL | (70%) | I | -10 | 250 |
| | | II | -30 | 280 |

2. Food Consumption

Results of the daily food consumption measurements are presented in Table XXXVII. The groups fed diets containing beef consumed 4 to 25 percent less food than that consumed by the control groups. The animals fed diets containing cobalt irradiated beef (TGCO groups) consumed slightly less food than that consumed by the animals fed diets containing frozen, thermally processed, or electron irradiated beef. The animals fed diets containing 70 percent beef generally consumed amounts of food comparable to those consumed by the animals fed diets containing 35 percent beef.

TABLE XXXVII

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rabbits

Mean Food Consumption Data

| Group | (Beef Content) | | Food Consumption (g/rabbit/day) Gestation Day: 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | Total Food Consumed Days 6-18 (g/rabbit) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Control | (None) | I | 170 | 170 | 170 | 167 | 159 | 153 | 167 | 157 | 159 | 170 | 170 | 170 | 168 | 2,150 |
| | | II | 170 | 170 | 170 | 168 | 160 | 155 | 168 | 162 | 161 | 168 | 168 | 169 | 168 | 2,157 |
| CGF | (35%) | I | 113 | 136 | 138 | 150 | 150 | 151 | 141 | 152 | 153 | 152 | 160 | 150 | 146 | 1,892 |
| | | II | 124 | 138 | 151 | 154 | 156 | 157 | 152 | 154 | 158 | 148 | 160 | 152 | 156 | 1,960 |
| CGF | (70%) | I | 79 | 136 | 143 | 150 | 149 | 144 | 145 | 152 | 152 | 156 | 164 | 163 | 156 | 1,889 |
| | | II | 71 | 123 | 142 | 160 | 158 | 156 | 166 | 157 | 155 | 136 | 164 | 162 | 163 | 1,913 |
| CGT | (35%) | I | 143 | 149 | 148 | 158 | 160 | 158 | 164 | 153 | 162 | 163 | 164 | 167 | 165 | 2,054 |
| | | II | 136 | 146 | 141 | 150 | 140 | 144 | 154 | 162 | 164 | 157 | 167 | 162 | 159 | 1,982 |
| CGT | (70%) | I | 132 | 131 | 132 | 154 | 156 | 147 | 160 | 167 | 161 | 156 | 161 | 151 | 149 | 1,957 |
| | | II | 143 | 130 | 138 | 163 | 165 | 164 | 167 | 169 | 153 | 147 | 156 | 151 | 160 | 2,006 |
| TGCO | (35%) | I | 109 | 107 | 109 | 112 | 116 | 120 | 111 | 144 | 135 | 131 | 131 | 148 | 152 | 1,625 |
| | | II | 127 | 145 | 138 | 139 | 132 | 134 | 122 | 144 | 140 | 154 | 144 | 145 | 158 | 1,822 |
| TGCO | (70%) | I | 110 | 134 | 132 | 141 | 136 | 105 | 117 | 130 | 134 | 147 | 145 | 162 | 154 | 1,747 |
| | | II | 110 | 133 | 136 | 132 | 128 | 134 | 133 | 146 | 143 | 143 | 148 | 152 | 158 | 1,796 |
| TGEL | (35%) | I | 153 | 159 | 147 | 152 | 159 | 162 | 160 | 155 | 164 | 165 | 162 | 159 | 165 | 2,062 |
| | | II | 143 | 150 | 143 | 133 | 150 | 156 | 159 | 159 | 162 | 163 | 169 | 166 | 165 | 2,018 |
| TGEL | (70%) | I | 130 | 149 | 150 | 156 | 147 | 140 | 151 | 148 | 159 | 158 | 163 | 168 | 158 | 1,977 |
| | | II | 132 | 129 | 127 | 148 | 131 | 126 | 132 | 152 | 155 | 162 | 155 | 166 | 161 | 1,876 |

3. Mortality and Reactions

There were no deaths among test or control animals during the investigation. No untoward behavioral reactions were observed among test or control animals.

4. Reproductive Effects

The data related to reproduction which were collected at the time of sacrifice on Gestation Day 29 are summarized in Table XXXVIII. These data include total implantation sites, number of resorption sites, number of live young, number of abortions, and numbers of resorption sites and of live young per 100 implantation sites. The data related to reproduction which were collected at the time of sacrifice revealed no effects which could be related to the ingestion of the test diets.

TABLE XXXVIII

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rabbits

Reproductive Effects

Summary of Results

| Group | (Beef Content) | | Number of Pregnant Does | Number of Implantation Sites | Number of Resorption Sites Early | Number of Resorption Sites Late | Number of Does Showing Resorptions | Number of Live Young | Number of Resorption Sites per 100 IS | Number of Live Young per 100 IS | Number of Fetuses Aborted | Number of Dose Showing Abortions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Control | (None) | I | 17 | 156 | 7 | 7 | 9 | 142 | 9.0 | 91.0 | 0 | 0 |
| | | II | 20 | 195 | 19 | 21 | 15 | 155 | 20.5 | 79.5 | 0 | 0 |
| CGF | (35%) | I | 18 | 161 | 9 | 12 | 11 | 140 | 13.0 | 87.0 | 0 | 0 |
| | | II | 20 | 182 | 4 | 9 | 8 | 169 | 7.1** | 92.9 | 0 | 0 |
| CGF | (70%) | I | 20 | 166 | 13 | 12 | 12 | 141 | 15.1 | 84.9 | 0 | 0 |
| | | II | 20 | 162 | 13 | 16 | 15 | 133 | 17.9 | 82.1 | 0 | 0 |
| CGT | (35%) | I | 20 | 205 | 10 | 15 | 13 | 180 | 12.2 | 87.8 | 0 | 0 |
| | | II | 18 | 179 | 3 | 8 | 8 | 168 | 6.1** | 93.9 | 0 | 0 |
| CGT | (70%) | I | 15 | 154 | 21 | 21 | 13 | 113 | 26.6** | 73.4 | 0 | 0 |
| | | II | 15 | 125 | 18 | 12 | 9 | 95 | 24.0** | 76.0 | 0 | 0 |
| TGCO | (35%) | I | 16 | 122 | 16 | 5 | 8 | 101 | 17.2 | 82.8 | 0 | 0 |
| | | II | 18 | 132 | 3 | 5 | 7 | 124 | 6.1** | 93.9 | 0 | 0 |
| TGCO | (70%) | I | 15 | 114 | 4 | 21 | 9 | 89 | 21.9 | 78.1 | 0 | 0 |
| | | II | 20 | 171 | 35 | 13 | 11 | 123 | 28.1** | 71.9 | 0 | 0 |
| TGEL | (35%) | I | 19 | 153 | 28 | 3 | 11 | 122 | 20.3 | 79.7 | 0 | 0 |
| | | II | 19 | 176 | 9 | 22 | 14 | 137 | 17.6 | 77.8 | 8 | 1 |
| TGEL | (70%) | I | 16 | 133 | 16 | 2 | 7 | 95 | 15.9 | 84.1 | 0 | 0 |
| | | II | 16 | 124 | 10 | 9 | 11 | 105 | 15.3 | 84.7 | 0 | 0 |

IS = Implantation Sites

* Statistically significant intergroup difference at the 95 percent confidence level.
** Statistically significant intergroup difference at the 99 percent confidence level.

5. Fetal Development

a. Body Weight

Fetal body weight data are presented in Table XXXIX. The body weights of the fetuses from all groups were considered normal for fetuses obtained from control New Zealand albino rabbits used in similar teratogenic studies conducted in this laboratory.

TABLE XXXIX

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rabbits

Summary of Progeny Body Weights

| Group | (Beef Content) | | Number of Rabbit Progeny | Mean Body Weights (g) |
|---|---|---|---|---|
| Control | (None) | I | 142 | 37.3 |
| | | II | 155 | 36.4 |
| CGF | (35%) | I | 140 | 35.2 |
| | | II | 169 | 36.0 |
| CGF | (70%) | I | 141 | 35.3 |
| | | II | 133 | 35.2 |
| CGT | (35%) | I | 180 | 33.1 |
| | | II | 168 | 32.6 |
| CGT | (70%) | I | 113 | 36.4 |
| | | II | 95 | 37.6 |
| TGCO | (35%) | I | 101 | 37.3 |
| | | II | 124 | 38.4 |
| TGCO | (70%) | I | 89 | 38.6 |
| | | II | 123 | 35.3 |
| TGEL | (35%) | I | 122 | 36.3 |
| | | II | 137 | 34.9 |
| TGEL | (70%) | I | 95 | 37.7 |
| | | II | 105 | 39.3 |

b. Fetal External Development

The results of the examinations for fetal external development are presented in Table XL. Three (2.1 percent) of the CGF (35%) I group fetuses were observed with external abnormalities. These 3 fetuses were all from the same CGF (35%) I group doe. This observation was not attributed to the ingestion of the diet for this group. There were no external abnormalities noted in the CGF (35%) II group which received the same diet. The types and incidences of external abnormalities observed in the other groups have been observed among fetuses obtained from control New Zealand albino rabbits used in similar teratogenic studies conducted in this laboratory . Examinations for fetal external development revealed no effects which could be attributed to the ingestion of the test diets.

TABLE XL

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rabbits

Gross Fetal Abnormalities

Summary of Results

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| Control | (None) | I | 142 | No external findings noted | - | - |
| | | II | 155 | No external findings noted | - | - |
| CGF | (35%) | I | 140 | Cervical elongation, enlarged neck (diameter), and bilateral talipes varus | 1 | 0.7 |
| | | | | Cervical elongation, enlarged neck (diameter), and unilateral talipomanus | 1 | 0.7 |
| | | | | Cervical elongation and enlarged neck (diameter) | 1 | 0.7 |
| | | | | Total number of fetuses with findings | 3* | 2.1 |
| | | | | Total number of normal fetuses | 137 | 97.9 |
| | | II | 169 | No external findings noted | - | - |
| CGF | (70%) | I | 141 | Acrania, bilateral talipomanus, bilateral ectrodactyly (forefeet), and unilateral talipes varus | 1 | 0.7 |
| | | | | Total number of fetuses with findings | 1 | 0.7 |
| | | | | Total number of normal fetuses | 140 | 99.3 |
| | | II | 133 | No external findings noted | - | - |

TABLE XL continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rabbits

Gross Fetal Abnormalities

Summary of Results

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| CGT | (35%) | I | 180 | Unilateral talipomanus | 1 | 0.6 |
| | | | | Total number of fetuses with findings | 1 | 0.6 |
| | | | | Total number of normal fetuses | 179 | 99.4 |
| | | II | 168 | Acrania | 1 | 0.6 |
| | | | | Total number of fetuses with findings | 1 | 0.6 |
| | | | | Total number of normal fetuses | 167 | 99.4 |
| CGT | (70%) | I | 113 | No external findings noted | - | - |
| | | II | | | | |
| | | II | 95 | Hemimelia | 1 | 1.0 |
| | | | | Total number of fetuses with findings | 1 | 1.0 |
| | | | | Total number of normal fetuses | 94 | 99.0 |
| TGCO | (35%) | I | 101 | No external findings noted | - | - |
| | | II | 124 | Edema and ascites | 1 | 0.8 |
| | | | | Total number of fetuses with findings | 1 | 0.8 |
| | | | | Total number of normal fetuses | 123 | 99.2 |
| TGCO | (70%) | I | 89 | No external findings noted | - | - |
| | | II | 123 | No external findings noted | - | - |

TABLE XL continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rabbits

Gross Fetal Abnormalities

Summary of Results

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| TGEL | (35%) | I | 122 | No external findings noted | - | - |
| | | II | 137 | No external findings noted | - | - |
| TGEL | (70%) | I | 95 | No external findings noted | - | - |
| | | II | 105 | Umbilical hernia | 1 | 1.0 |
| | | | | Total number of fetuses with findings | 1 | 1.0 |
| | | | | Total number of normal fetuses | 104 | 99.0 |

* The 3 abnormal CGF (35%) I group fetuses were all from the same doe.

c. Observation of Viable Young During Incubation

The numbers of young (both normal and deformed) surviving the 24-hour incubation period are presented in Table XLI. Prenatal exposure to the test diets did not affect the 24-hour survival of the young.

TABLE XLI

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rabbits

Summary of Observations of Viability of Young

24-Hour Incubation Period

| Group | (Beef Content) | | Number of Viable Young Hour: 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 24 | 24-Hour Viability Index* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Control | (None) | I | 142 | 138 | 138 | 138 | 138 | 138 | 138 | 135 | 131 | 92.2 |
| | | II | 155 | 151 | 151 | 151 | 151 | 151 | 151 | 148 | 145 | 93.5 |
| CGF | (35%) | I | 140 | 140 | 135 | 135 | 135 | 135 | 135 | 133 | 122 | 87.1 |
| | | II | 169 | 165 | 163 | 163 | 163 | 163 | 163 | 162 | 151 | 89.3 |
| CGF | (70%) | I | 141 | 132 | 129 | 126 | 126 | 126 | 126 | 126 | 126 | 89.4 |
| | | II | 133 | 130 | 129 | 129 | 129 | 129 | 129 | 129 | 129 | 97.0 |
| CGT | (35%) | I | 180 | 171 | 170 | 166 | 166 | 166 | 166 | 166 | 161 | 89.4 |
| | | II | 168 | 161 | 159 | 159 | 159 | 159 | 159 | 159 | 154 | 91.7 |
| CGT | (70%) | I | 113 | 111 | 111 | 111 | 111 | 111 | 111 | 110 | 99 | 87.6 |
| | | II | 95 | 87 | 86 | 86 | 86 | 86 | 86 | 85 | 83 | 87.4 |
| TGCO | (35%) | I | 101 | 100 | 95 | 93 | 93 | 93 | 93 | 93 | 93 | 92.1 |
| | | II | 124 | 121 | 120 | 120 | 120 | 120 | 120 | 120 | 117 | 94.4 |
| TGCO | (70%) | I | 89 | 88 | 87 | 86 | 86 | 86 | 86 | 86 | 86 | 96.6 |
| | | II | 123 | 114 | 110 | 110 | 108 | 108 | 108 | 106 | 106 | 86.2 |
| TGEL | (35%) | I | 122 | 117 | 117 | 112 | 112 | 112 | 112 | 111 | 111 | 91.0 |
| | | II | 137 | 122 | 118 | 117 | 117 | 117 | 117 | 117 | 117 | 85.4 |
| TGEL | (70%) | I | 95 | 93 | 91 | 91 | 91 | 91 | 91 | 89 | 87 | 91.6 |
| | | II | 105 | 104 | 102 | 102 | 101 | 101 | 100 | 98 | 98 | 93.3 |

* $\frac{\text{Number of Viable Young at 24 Hours}}{\text{Number of Viable Young at Birth}} \times 100$

d. Skeletal Development

A summary and interpretation of skeletal findings is presented in Table XLII. Observations of fetal skeletal development at caesarian section are presented in Table XLIII.

Those fetuses having sternum sections that were only partially stained with the calcium positive Alizarin dye were classified as incompletely ossified sections. Sternum sections that did not retain any of the dye were classified as non-ossified. These classifications are measures of the relative extent of fetal skeletal calcification at the time of sacrifice. Incompletely ossified sternum sections, non-ossified sternum sections, supernumerary ribs, and thickened ribs are classified as incidental skeletal findings. These incidental skeletal findings are normally observed in fetuses obtained from untreated control does. The incidences of incidental skeletal findings observed for the fetuses obtained from the TGCO (35%) I and II group does, from the TGEL (35%) I and II group does, and from the TGEL (70%) I and II group does were slightly increased. However, the incidences of incidental skeletal findings in these 6 groups were within the range observed for fetuses obtained from control New Zealand albino rabbits used in similar teratogenic studies conducted in this laboratory. The incidences of incidental skeletal findings observed in the other groups all compared favorably with those observed in the control groups.

The CGF (35%) I, CGF (70%) I and II, and the CGT (35%) I group fetuses exhibited a slight increase in the percent of fetuses with

skeletal abnormalities. The increase in skeletal abnormalities in these groups was due to an increase in the number of fetuses with incompletely ossified frontal and/or parietal bones (a finding observed among fetuses obtained from control New Zealand albino rabbits used in similar teratogenic studies conducted in this laboratory). Thirty to 100 percent of the fetuses exhibiting incompletely ossified frontal and/or parietal bones, from each of these groups, were obtained from the same litter. The types and incidences of the other skeletal abnormalities observed in any group either were considered normal for fetuses obtained from rabbits of this strain in this laboratory or were associated with a gross external abnormality. Observations of fetal skeletal development disclosed no effects which could be attributed to prenatal exposure to the test diets.

TABLE XLII

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rabbits

Fetal Skeletal Development

Summary and Interpretation of Findings

| Group | (Beef Content) | | Number of Fetuses | Number of Fetuses with Skeletal Findings (Abnormalities + Incidental Findings) | Number of Fetuses with Skeletal Abnormalities | Number of Fetuses with Incidental Findings Only | Number of Fetuses with no Findings | Total Fetuses Unaffected by Treatment |
|---|---|---|---|---|---|---|---|---|
| Control | (None) | I | 142 | 90 | 5 | 85 | 52 | 137 |
| | | | Percent: | 63.4 | 3.5 | 59.8 | 36.6 | 96.5 |
| | | II | 155 | 98 | 7 | 91 | 57 | 148 |
| | | | Percent: | 63.2 | 4.5 | 58.7 | 36.8 | 95.5 |
| CGF | (35%) | I | 140 | 71 | 8 | 63 | 69 | 132 |
| | | | Percent: | 50.7 | 5.7 | 45.0 | 49.3 | 94.3 |
| | | II | 169 | 84 | 1 | 83 | 85 | 168 |
| | | | Percent: | 49.7 | 0.6 | 49.1 | 50.3 | 99.4 |
| CGF | (70%) | I | 141 | 81 | 8 | 73 | 60 | 133 |
| | | | Percent: | 57.4 | 5.7 | 51.8 | 42.6 | 94.3 |
| | | II | 133 | 76 | 7 | 69 | 57 | 126 |
| | | | Percent: | 57.1 | 5.3 | 51.9 | 42.9 | 94.7 |
| CGT | (35%) | I | 180 | 87 | 9 | 78 | 93 | 171 |
| | | | Percent: | 48.3 | 5.0 | 43.3 | 51.7 | 95.0 |
| | | II | 168 | 95 | 6 | 89 | 73 | 162 |
| | | | Percent: | 56.5 | 3.6 | 53.0 | 43.6 | 96.4 |
| CGT | (70%) | I | 113 | 67 | 2 | 65 | 46 | 111 |
| | | | Percent: | 59.3 | 1.8 | 57.5 | 40.7 | 98.2 |
| | | II | 95 | 55 | 2 | 53 | 40 | 93 |
| | | | Percent: | 57.9 | 2.1 | 55.8 | 42.1 | 97.9 |
| TGCO | (35%) | I | 101 | 67 | 0 | 67 | 34 | 101 |
| | | | Percent: | 66.3 | 0.0 | 66.3 | 33.7 | 100.0 |
| | | II | 124 | 90 | 1 | 89 | 34 | 123 |
| | | | Percent: | 72.6 | 0.8 | 71.8 | 27.4 | 99.2 |
| TGCO | (70%) | I | 89 | 49 | 0 | 49 | 40 | 89 |
| | | | Percent: | 55.0 | 0.0 | 55.0 | 45.0 | 100.0 |
| | | II | 123 | 63 | 2 | 61 | 60 | 121 |
| | | | Percent: | 51.2 | 1.6 | 49.6 | 48.8 | 98.4 |
| TGEL | (35%) | I | 122 | 85 | 5 | 80 | 37 | 117 |
| | | | Percent: | 69.7 | 4.1 | 65.6 | 30.3 | 95.9 |
| | | II | 137 | 91 | 3 | 88 | 46 | 134 |
| | | | Percent: | 66.4 | 2.2 | 64.2 | 33.6 | 97.8 |
| TGEL | (70%) | I | 95 | 71 | 0 | 71 | 24 | 95 |
| | | | Percent: | 74.7 | 0.0 | 74.7 | 25.3 | 100.0 |
| | | II | 105 | 74 | 0 | 74 | 31 | 105 |
| | | | Percent: | 70.5 | 0.0 | 70.5 | 29.5 | 100.0 |

TABLE XLIII

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rabbits

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| Control | (None) I | 142 | Incompletely ossified sternum section(s) | 10 | 7.0 |
| | | | Non-ossified sternum section(s) | 20 | 14.1 |
| | | | Supernumerary ribs | 66 | 46.5 |
| | | | Thickened rib(s) | 8 | 5.6 |
| | | | Forked ribs | 1 | 0.7 |
| | | | Asymmetric sternum section(s) | 1 | 0.7 |
| | | | Cleft sternum section | 1 | 0.7 |
| | | | Split sternum section | 1 | 0.7 |
| | | | Supernumerary sternum section | 1 | 0.7 |
| | | | Total number of fetuses with findings | 90 | 63.4 |
| | | | Total number of fetuses with no findings | 52 | 36.6 |
| | II | 155 | Incompletely ossified sternum section(s) | 18 | 11.6 |
| | | | Non-ossified sternum section(s) | 17 | 11.0 |
| | | | Supernumerary ribs | 59 | 38.1 |
| | | | Thickened rib(s) | 18 | 11.6 |
| | | | Fused ribs | 1 | 0.6 |
| | | | Asymmetric sternum section(s) | 1 | 0.6 |
| | | | Fused sternum sections | 2 | 1.3 |
| | | | Cleft sternum section | 1 | 0.6 |
| | | | Split sternum section | 3 | 1.9 |
| | | | Total number of fetuses with findings | 98 | 63.2 |
| | | | Total number of fetuses with no findings | 57 | 36.8 |

TABLE XLIII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rabbits

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| CGF | (35%) | I | 140 | Incompletely ossified sternum section(s) | 10 | 7.1 |
| | | | | Non-ossified sternum section(s) | 35 | 25.0 |
| | | | | Supernumerary ribs | 27 | 19.3 |
| | | | | Thickened rib(s) | 7 | 5.0 |
| | | | | Fused ribs | 1 | 0.7 |
| | | | | Shortened rib | 1 | 0.7 |
| | | | | Cleft sternum section | 2 | 1.4 |
| | | | | Split sternum section | 2 | 1.4 |
| | | | | Incompletely ossified frontal and parietal bones | 3[a] | 2.1 |
| | | | | Total number of fetuses with findings | 71 | 50.7 |
| | | | | Total number of fetuses with no findings | 69 | 49.3 |
| | | II | 169 | Incompletely ossified sternum section(s) | 11 | 6.5 |
| | | | | Non-ossified sternum section(s) | 10 | 5.9 |
| | | | | Supernumerary ribs | 60 | 35.5 |
| | | | | Thickened rib(s) | 9 | 5.3 |
| | | | | Split sternum section | 1 | 0.6 |
| | | | | Total number of fetuses with findings | 84 | 49.7 |
| | | | | Total number of fetuses with no findings | 85 | 50.3 |

TABLE XLIII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rabbits

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| CGF | (70%) I | 141 | Incompletely ossified sternum section(s) | 13 | 9.2 |
| | | | Non-ossified sternum section(s) | 13 | 9.2 |
| | | | Supernumerary ribs | 57 | 40.4 |
| | | | Thickened rib(s) | 5 | 3.5 |
| | | | Shortened rib | 1 | 0.7 |
| | | | Dual ossification of sternum section(s) | 1 | 0.7 |
| | | | Fused sternum sections | 2 | 1.4 |
| | | | Split sternum section | 2 | 1.4 |
| | | | Incompletely ossified frontal and parietal bones | 3 | 2.1 |
| | | | Acrania, bilateral ectrodactyly (forefeet), and incompletely ossified cervical vertebrae | 1 | 0.7 |
| | | | Total number of fetuses with findings | 81 | 57.4 |
| | | | Total number of fetuses with no findings | 60 | 42.6 |

TABLE XLIII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rabbits

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| CGF | (70%) II | 133 | Incompletely ossified sternum section(s) | 12 | 9.0 |
| | | | Non-ossified sternum section(s) | 16 | 12.0 |
| | | | Supernumerary ribs | 52 | 39.1 |
| | | | Thickened rib(s) | 10 | 7.5 |
| | | | Angulated rib(s) | 1 | 0.8 |
| | | | Dual ossification of sternum section(s) | 1 | 0.8 |
| | | | Asymmetric sternum section(s) | 1 | 0.8 |
| | | | Split sternum section | 1 | 0.8 |
| | | | Incompletely ossified frontal and/or parietal bones | 3[b] | 2.2 |
| | | | Total number of fetuses with findings | 76 | 57.1 |
| | | | Total number of fetuses with no findings | 57 | 42.9 |

TABLE XLIII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rabbits

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| CGT | (35%) I | 180 | Incompletely ossified sternum section(s) | 14 | 7.8 |
| | | | Non-ossified sternum section(s) | 13 | 7.2 |
| | | | Supernumerary ribs | 63 | 35.0 |
| | | | Thickened rib(s) | 2 | 1.1 |
| | | | Dual ossification of sternum section(s) | 2 | 1.1 |
| | | | Incompletely ossified frontal and/or parietal bones | 7[c] | 3.9 |
| | | | Total number of fetuses with findings | 87 | 48.3 |
| | | | Total number of fetuses with no findings | 93 | 51.7 |

TABLE XLIII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rabbits

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|
| CGT | (35%) II | 168 | Incompletely ossified sternum section(s) | 17 | 10.1 |
| | | | Non-ossified sternum section(s) | 9 | 5.4 |
| | | | Supernumerary ribs | 75 | 44.6 |
| | | | Thickened rib(s) | 5 | 3.0 |
| | | | Angulated rib(s) | 1 | 0.6 |
| | | | Dual ossification of sternum section(s) | 1 | 0.6 |
| | | | Split sternum section | 1 | 0.6 |
| | | | Incompletely ossified frontal and parietal bones | 2 | 1.2 |
| | | | Acrania | 1 | 0.6 |
| | | | Incompletely ossified nasal bone | 1 | 0.6 |
| | | | Total number of fetuses with findings | 95 | 56.5 |
| | | | Total number of fetuses with no findings | 73 | 43.6 |

TABLE XLIII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rabbits

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| CGT | (70%) | I | 113 | Incompletely ossified sternum section(s) | 20 | 17.7 |
| | | | | Non-ossified sternum section(s) | 21 | 18.6 |
| | | | | Supernumerary ribs | 37 | 32.7 |
| | | | | Thickened rib(s) | 2 | 1.8 |
| | | | | Angulated rib(s) | 1 | 0.9 |
| | | | | Incompletely ossified frontal and parietal bones | 1 | 0.9 |
| | | | | Total number of fetuses with findings | 67 | 59.3 |
| | | | | Total number of fetuses with no findings | 46 | 40.7 |
| | | II | 95 | Incompletely ossified sternum section(s) | 7 | 7.4 |
| | | | | Non-ossified sternum section(s) | 10 | 10.5 |
| | | | | Supernumerary ribs | 40 | 42.1 |
| | | | | Dual ossification of sternum section(s) | 1 | 1.0 |
| | | | | Hemimelia (foreleg) | 1 | 1.0 |
| | | | | Total number of fetuses with findings | 55 | 57.9 |
| | | | | Total number of fetuses with no findings | 40 | 42.1 |

TABLE XLIII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rabbits

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| TGCO | (35%) | I | 101 | Incompletely ossified sternum section(s) | 28 | 27.7 |
| | | | | Non-ossified sternum section(s) | 10 | 9.9 |
| | | | | Supernumerary ribs | 48 | 47.5 |
| | | | | Total number of fetuses with findings | 67 | 66.3 |
| | | | | Total number of fetuses with no findings | 34 | 33.7 |
| | | II | 124 | Incompletely ossified sternum section(s) | 29 | 23.4 |
| | | | | Non-ossified sternum section(s) | 8 | 6.4 |
| | | | | Supernumerary ribs | 62 | 50.0 |
| | | | | Thickened rib(s) | 1 | 0.8 |
| | | | | Angulated rib(s) | 1 | 0.8 |
| | | | | Supernumerary sternum section | 1 | 0.8 |
| | | | | Total number of fetuses with findings | 90 | 72.6 |
| | | | | Total number of fetuses with no findings | 34 | 27.4 |

TABLE XLIII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rabbits

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| TGCO | (70%) | I | 89 | Incompletely ossified sternum section(s) | 17 | 19.1 |
| | | | | Non-ossified sternum section(s) | 9 | 10.1 |
| | | | | Supernumerary ribs | 26 | 29.2 |
| | | | | Total number of fetuses with findings | 49 | 55.0 |
| | | | | Total number of fetuses with no findings | 40 | 45.0 |
| | | II | 123 | Incompletely ossified sternum section(s) | 19 | 15.4 |
| | | | | Non-ossified sternum section(s) | 8 | 6.5 |
| | | | | Supernumerary ribs | 52 | 42.3 |
| | | | | Shortened rib | 1 | 0.8 |
| | | | | Incompletely ossified frontal and parietal bones | 1 | 0.8 |
| | | | | Total number of fetuses with findings | 63 | 51.2 |
| | | | | Total number of fetuses with no findings | 60 | 48.8 |

TABLE XLIII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rabbits

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| TGEL | (35%) | I | 122 | Incompletely ossified sternum section(s) | 38 | 31.1 |
| | | | | Non-ossified sternum section(s) | 14 | 11.5 |
| | | | | Supernumerary ribs | 56 | 45.9 |
| | | | | Thickened rib(s) | 2 | 1.6 |
| | | | | Asymmetric sternum section(s) | 3 | 2.4 |
| | | | | Cleft sternum section | 1 | 0.8 |
| | | | | Incompletely ossified frontal bones | 1 | 0.8 |
| | | | | Total number of fetuses with findings | 85 | 69.7 |
| | | | | Total number of fetuses with no findings | 37 | 30.3 |
| | | II | 137 | Incompletely ossified sternum section(s) | 42 | 30.6 |
| | | | | Non-ossified sternum section(s) | 8 | 5.8 |
| | | | | Supernumerary ribs | 59 | 43.1 |
| | | | | Thickened rib(s) | 1 | 0.7 |
| | | | | Fused sternum sections | 1 | 0.7 |
| | | | | Supernumerary sternum section | 1 | 0.7 |
| | | | | Incompletely ossified frontal and parietal bones | 1 | 0.7 |
| | | | | Total number of fetuses with findings | 91 | 66.4 |
| | | | | Total number of fetuses with no findings | 46 | 33.6 |

TABLE XLIII continued

TEST MATERIAL: Irradiated Beef

Teratogenic Study - Albino Rabbits

Fetal Skeletal Development

Skeletal Findings

| Group | (Beef Content) | | Fetuses Examined | Findings | Incidence | Percent of Total Examined |
|---|---|---|---|---|---|---|
| TGEL | (70%) | I | 95 | Incompletely ossified sternum section(s) | 46 | 48.4 |
| | | | | Non-ossified sternum section(s) | 20 | 21.0 |
| | | | | Supernumerary ribs | 37 | 38.9 |
| | | | | Total number of fetuses with findings | 71 | 74.7 |
| | | | | Total number of fetuses with no findings | 24 | 25.3 |
| | | II | 105 | Incompletely ossified sternum section(s) | 34 | 32.4 |
| | | | | Non-ossified sternum section(s) | 10 | 9.5 |
| | | | | Supernumerary ribs | 49 | 46.7 |
| | | | | Total number of fetuses with findings | 74 | 70.5 |
| | | | | Total number of fetuses with no findings | 31 | 29.5 |

a = The 3 pups with incompletely ossified frontal and/or parietal bones were from 1 litter.
b = Two of the 3 pups with incompletely ossified frontal and/or parietal bones were from 1 litter.
c = Two of the 7 pups with incompletely ossified frontal and/or parietal bones were from 1 litter.

e. Internal Development

Dissection of the young obtained from does fed frozen, thermally processed, cobalt irradiated, or electron irradiated beef revealed no gross internal abnormalities.