

Reproductive performance of dogs fed radappertized chicken for three years or more

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Introduction

One of the principle aspects of the U.S. Army's Animal Feeding Study Protocol for Irradiation Sterilized Test Foods (1) is to determine if a diet related effect can be demonstrated in the reproduction performance of dogs fed radappertized chicken for three years or more. All work was performed at the Gray Summit, Missouri farm of Raltech Scientific Services.

Methods

Study Outline. Twenty female and 10 male Beagle dogs per diet group were placed on a reproduction study for a period of 36 and 40 months, respectively. The females were mated during their second estrus and every estrus thereafter until they reached 32 months on study. From each litter thus produced, one male and one female pup were randomly selected at weaning to be continued on the diet for an additional 20 weeks. Hematology and clinical chemistry tests were performed on all parent animals at 3, 6, 9, 12, 18, 24, 30, and 36 months (also at 40 months for the males), and 3 and 6 months for the F_1 generation pups retained on study. Body weights were determined weekly for all on test dogs.

Processing of Chicken. Chicken was obtained from fresh broilers or fryers and fresh hens, with the proportion of hens to not exceed 15% of the total procurement. Breast, thighs, and legs were skinned and deboned by hand. The meat and skin were ground separately and blended to approximate natural proportions of light meat, dark meat, and skin (85% minimum meat and 15% maximum skin). Each 100 kg portion of the mixture was mixed with 0.75 kg sodium chloride, 0.3 kg sodium tripolyphosphate and 3.0 kg chipped ice, and stuffed into casings for enzyme inactivation to an internal temperature of 73-77°C. Three-fourths of the enzyme inactivated chicken was vacuum packed in cans and the remainder in flexible pouches, all were frozen immediately after packaging. One-third of the canned chicken was retained as the frozen control; one-third was thermally processed ($F_0=6, 115.6^\circ$ for 160 min), and one-third was irradiated with Cobalt-60 gamma rays. The chicken in the flexible pouches was irradiated with 10 MeV electrons. Average irradiation dose was 59 kGy (5.9 Mrad) with a range of 41-71 kGy and the temperature during irradiation was -40°C to 5°C . The thermally processed and irradiated chicken was stored at ambient temperature until use. Further details reference the procurements, processing, and packaging of the chicken are described in the Protocol (1).

Diets. The study consisted of five diet groups: (1) A Negative Control Group (N) receiving a commercial dry dog food, (2) a Frozen Control Group (F) receiving frozen chicken, (3) a Thermally Processed Treatment Group (T) receiving the chicken non-irradiated but "commercially sterilized" by heat for shelf stability when stored at ambient temperature, (4) a Cobalt 60 Radiation Treatment Group (G) receiving the CO-60 irradiated chicken stored at ambient temperature, and (5) an Electron Radiation Treatment Group (E) receiving the electron irradiated chicken stored at room temperature. The composition of the diets is shown in Table 1. Diets were prepared no more than 48 hours prior to feeding and were stored under refrigeration once prepared.

Table 1: Diet Composition (%)

Test Diet	Purina Lab Canine Diet	Frozen Chicken	Thermally Processed Chicken	Cobalt 60 Irradiated Chicken	Electron Irradiated Chicken
Negative Control (N)	100	-	-	-	-
Frozen Control (F)	65	35	-	-	-
Thermally Processed (T)	65	-	35	-	-
Cobalt 60 Irradiated (G)	65	-	-	35	-
Electron Irradiated (E)	65	-	-	-	35

Test Animals. A total of 100 female and 20 male Beagle dogs were purchased from a commercial source to utilize in the production of the test animals. The dogs were randomly divided into 5 groups of 20 female and four male each and placed on their respective test diet. Breeding of the dogs commenced after they had been on the test diets for 30 days. Selection of pups for the F_0 generation was random within litters, with the exception that weak or abnormal dogs were excluded. An attempt was made to select no more than one male and two females from any one litter. However, this was not achieved in all cases. A study group was considered complete when 20 females and 10 males had been selected.

Statistical Analyses. This study is presently ongoing and statistical analyses have not been performed on any of the data.

Results and Discussion. All F_0 female dogs have completed the reproduction phase of the study. While statistical analysis of the results are not available, the numbers of litters and pups listed in the following tables are complete. The number of litters per available bitch is shown in Table 2. Performance of the irradiated diets were comparable to the frozen control diet in percentage of first and second litters produced with the thermally processed diet being the lowest. While the percentage of third and fourth litters produced was much lower in the

F and E diets when compared to the G diet, this may well be a factor of the time limitation of the study. As can be seen in Table 3, the number of bitches producing three or more litters was much higher in the G diet group. However, when comparing the number of bitches producing at least two litters, the F, G, and E groups are essentially the same with the T group being somewhat lower.

Table 2: F₀ Dogs Reproduction

Diet Groups	N	F	T	G	E
Number of Bitches	20	20	20	20	20
Number of Losses ¹	2	1	0	0	0
First Litter ²	17/18	18/19	16/20	19/20	19/20
Percentage	94	95	80	95	95
Second Litter ²	11/17	17/18	12/16	18/19	17/19
Percentage	65	94	75	95	90
Third Litter ²	3/11	4/17	5/12	16/18	5/16 ³
Percentage	27	24	42	89	31
Fourth Litter ²	1/3	0/4	1/5	3/16	0/5
Percentage	33	0	20	19	0
No. Failed to Breed/Conceive	1 ⁴	1 ⁵	4	1 ⁵	1

1. Prior to Breeding

2. Number of Litters Produced Per Available Bitches

3. Dam #E010 died after producing two litters.

4. Hermaphrodite

5. Obese

The reproduction performance of each group reference number of pups born, number born alive and number weaned are given in Tables 4 thru 7 for each generation. Table 8 lists the values for all generations combined. As with the numbers of litters produced, there is no significant trend apparent in any of the diet groups. The irradiated test groups compare favorably with the frozen control group in all generations and in the comparison of the generations combined.

Table 5: F_{1b} Pups

TOTALS	N	F	T	G	E
Number Whelped	71	118	78	113	115
No. Born Alive	70	116	75	109	111
% Born Alive	99	98	96	97	97
No. Weaned	58	100	57	98	97
% Weaned	82	85	73	87	84

Table 6: F_{1c} Pups

TOTALS	N	F	T	G	E
Number Whelped	9	16	31	100	23
No. Born Alive	7	16	31	100	18 ¹
% Born Alive	78	100	100	100	78
No. Weaned	7	14	28	84 ²	15
% Weaned	78	88	90	84	87

1. Four pups in one litter of six were born dead.

2. One litter of pups born prematurely. All eight died within first 24 hours.

Conclusion. To date, in the study, no detrimental diet related effects have been noted in either of the irradiated chicken diet groups.

Reference

- 1) Animal Feeding Study Protocol for Irradiated Sterilized Test Foods. Office for the Wholesomeness of Irradiated Foods, U.S. Army Medical Research and Development Command, Washington, DC, 1975.

Table 3: F₀ Dogs-Litter Production/Birth

Diet	# With-Out Litters	# With 1 Litter	# With 2 Litters	# With 3 Litters	# With 4 Litters
N	3 ¹	6	8	2	1
F	2 ²	1	13	14	0
T	4	4	7	4	1
G	1	1	2	13	3
E	1	2	12 ³	5	0

1. Two females died prior to breeding and one other was a hermaphrodite.

2. One female died prior to breeding.

3. Female #E010 died after producing two litters.

Table 4: F_{1a} Pups

TOTALS	N	F	T	G	E
Number Whelped	110	119	99	108	128
No. Born Alive	97	107	93	100	122
% Born Alive	88	90	94	93	95
No. Weaned	69	88	68	89	96
% Weaned	63	74	69	82	75

Table 7: F_{1d} Pups

TOTALS	N	F	T	G	E
Number Whelped	2	0	7	23	0
No. Born Alive	2	0	7	21	0
% Born Alive	100	0	100	91	0
No. Weaned	2	0	3	20	0
% Weaned	100	0	43	87	0

Table 8: F₁ Pups - All Generations Combined

TOTALS	N	F	T	G	E
Number Whelped	192	253	215	344	266
No. Born Alive	176	239	206	330	251
% Born Alive	92	95	96	96	94
No. Weaned	136	202	156	291	213
% Weaned	71	80	73	85	80