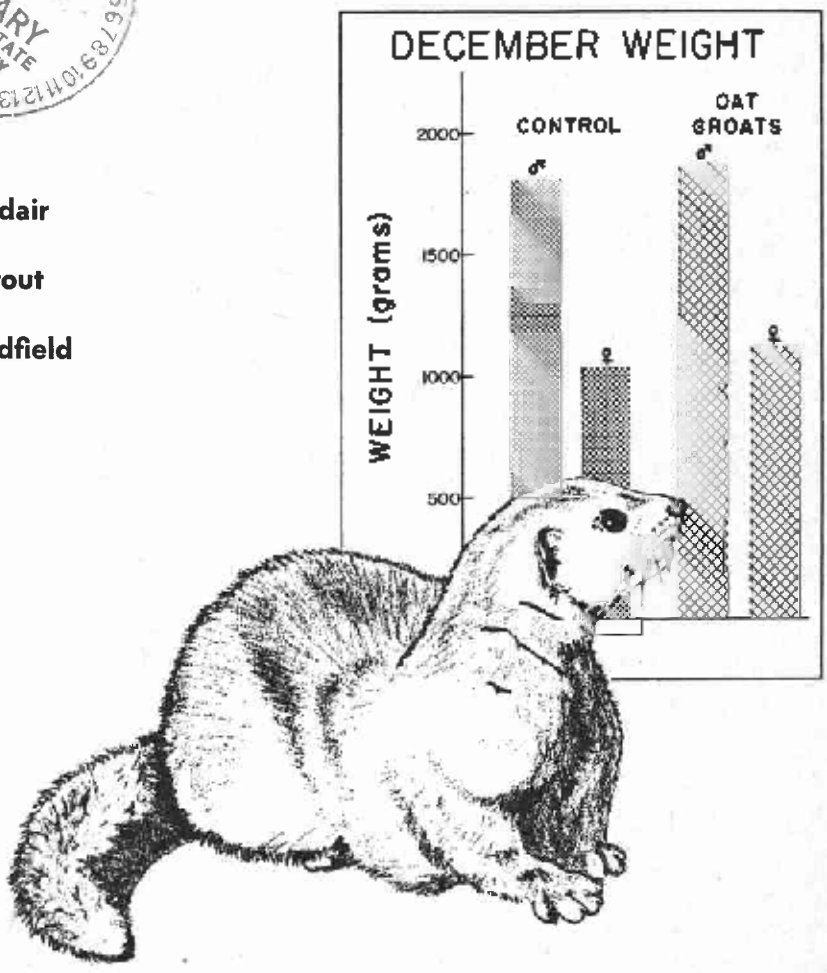
1961 Progress Report . . .

Experiments in Mink Nutrition

John Adair

F. M. Stout

J. E. Oldfield



Foreword

We are pleased to present our annual report of progress in mink research for 1961. Mink research, like that in other fields, is time consuming, expensive, and often unrewarding. Rarely indeed is a problem solved completely and finally. Instead there are complicating factors of heredity and environment interacting to confound and confuse results making interpretations difficult and application uncertain.

Survival and growth rate determine number and size of pelter mink to market. Fur quality is equally important. Economy of growth-promoting rations is meaningless without quality pelts. Management and ration determine environment but evidence indicates there are differences in hereditary susceptibility to certain fur abnormalities, which arise primarily from dietary causes or dietary disturbances. Thus, an interaction between genetic and nutritional factors must be recognized. These relationships must be understood, heritabilities determined, and causative agents identified. Observations of the *"what"* are not enough. We must know *"how"* and *"why"* these things happen. Solution to these complicated problems involves physiology, biochemistry, genetics, and statistics plus the ever-present key to success—good herd management. Experimental design and procedures require extensive care, time, and record-keeping to accomplish the maximum results from resources available.

-J. C. MILLER
Head, Department of
Animal Science

Contents

Test Results at a Glance

Test Group No.

1A The standard control diet containing horsemeat which has given consistent satisfactory results was fed as a yearly reference for comparative mink performance.

1B This control ration, revised by substituting a commercial beef offal product (Red Heart) for horsemeat, was used as a standard for comparison of all groups except 9B. Animal performance on this ration was generally satisfactory and feed costs were 8% below those noted for 1A.

1C Performance on a ration involving substitution of an all-plant low-protein cereal (OSU 52) for the basic cereal (OSU 46A) was good. Lower production costs coupled with trends toward improved size and fur characteristics were noted.

2 A ration similar to 1B plus the addition of 0.5% of a polyphosphate feed additive, "Nerzone," supported performance equivalent to the control with a significant increase noted in female size.

3A Substitution of 15% cooked wheat for an equal amount of sole in the control ration resulted in lower ration costs and animals of equivalent size. Fur color of males was improved although wet belly incidence was increased.

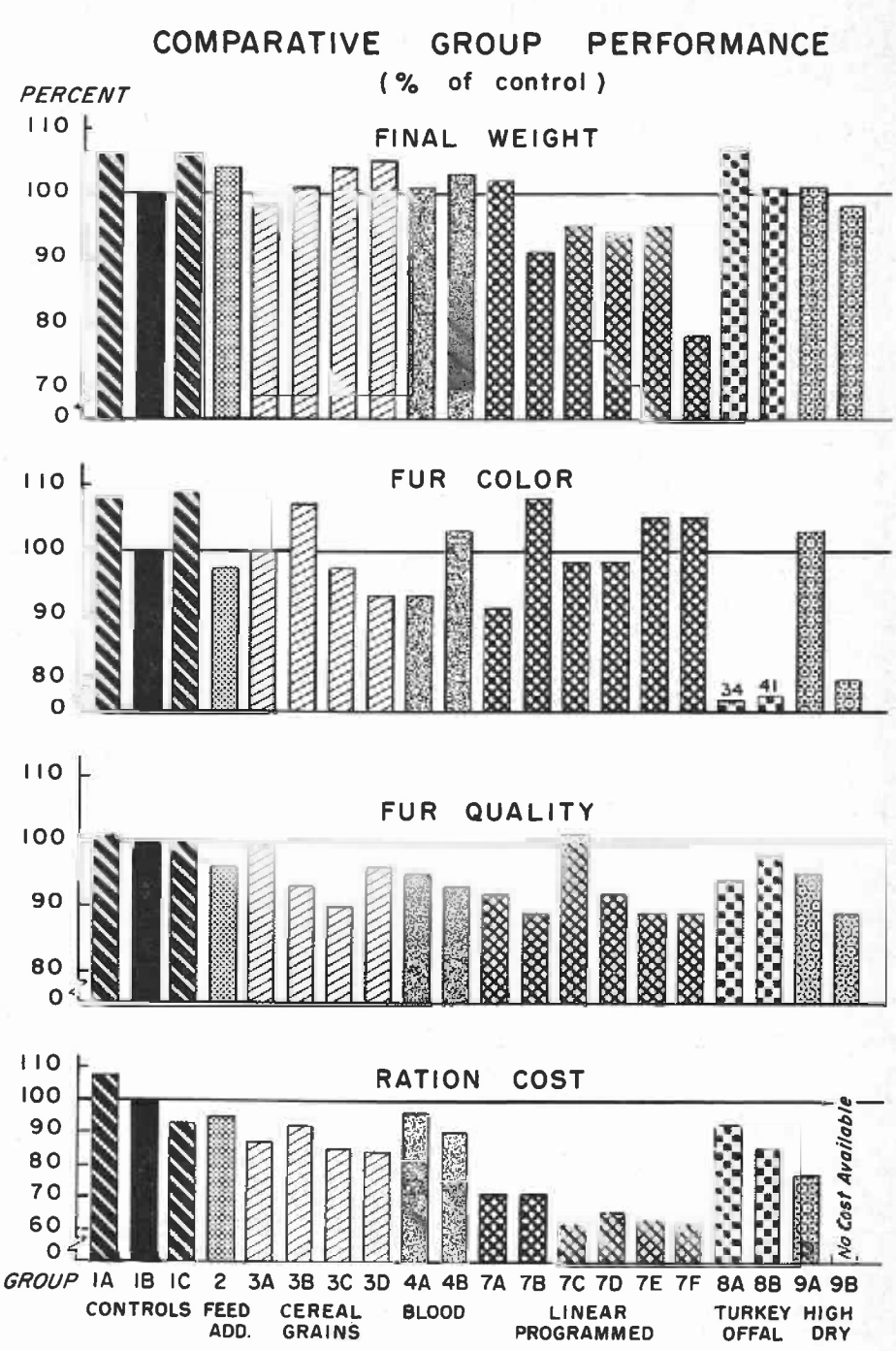
3B Inclusion of 15% cooked barley, replacing a like amount of sole in the control ration, gave better color but poorer quality than the cooked wheat ration. Ration cost was 8% below controls.

3C Substitution of 15% cooked oat groats, for an equal amount of sole in the control ration, resulted in growth increases particularly evident in animal length. Fur characteristics were somewhat poorer than those in the wheat and barley groups.

3D A ration containing 15% raw oat groats produced animals similar to those fed the cooked oat groats (3C); however, a lower incidence of wet belly was noted.

4A Whole beef blood at 20% replacing the sole portion of the control ration produced males of similar weights yet significantly longer than controls. Fur characteristics were similar except that female fur color was significantly reduced from control females.

4B Blood meal of beef and pork origin, supplying the same amount of dry nutrients as fresh blood in the preceding ration, resulted in animals similar to those on 4A. Fur color of males was significantly improved over those receiving fresh blood.


COMPARATIVE GROUP PERFORMANCE
(% of control)
PERCENT
FINAL WEIGHT
FUR COLOR
FUR QUALITY
RATION COST
110
100
90
80
70
60
0
34
41
No Cost Available
GROUP 1A 1B 1C 2 3A 3B 3C 3D 4A 4B 7A 7B 7C 7D 7E 7F 8A 8B 9A 9B
CONTROLS
FEED ADD.
CEREAL GRAINS
BLOOD
LINEAR PROGRAMMED
TURKEY OFFAL
HIGH DRY

Test Group No.

7A A ration electronically computed to specifications of 50% protein and 25% fat and supplying 90% of the nutrients from dried sources, produced mink of equal size but lower fur color and quality than the control at 29% lower feed costs.

7B A ration similar to 7A but lower (16.7%) in fat produced males superior in color and free from wet bellies although smaller in size. Females were significantly reduced in size and somewhat lower in fur color and quality. Pelt values were increased over controls at 29% lower feed cost.

7C A ration similar to 7A but specifying 40% protein and 20% fat resulted in smaller animals with good fur color and quality and a notable lack of wet bellies. Ration cost was 38% below the control.

7D A ration similar to 7A but specifying 40% protein and 13.3% fat resulted in animals of smaller size, comparable fur color, and somewhat lower fur quality than the control. No wet bellies were observed and ration costs were 35% below the control.

7E A ration similar to 7A but specifying 30% protein and 15% fat resulted in lack of size and quality of both males and females. Somewhat better fur color was noted for males. Ration costs were 37% below the control.

7F A ration similar to 7A but specifying 30% protein and 10% fat resulted in extremely small, short animals with good color but poor fur quality. Ration costs were 38% below the control.

8A Animals fed a ration of 68% turkey offal without feet including 9% of a low protein cereal (OSU 52) showed increased size over the control. Underfur greying caused significantly lower fur color ratings in all animals.

8B A ration similar to 8A with the cereal increased to 19% lowered ration costs 15% below the control. Underfur greying was evident in 88% of these animals indicating closeness to the critical turkey level.

9A A ration containing 80% dry ingredients resulted in animals of comparable size at ration costs 33% below the control. High incidence of wet bellies resulted in a depressed pelt evaluation.

9B A completely dry ration (1A dried) rehydrated immediately prior to feeding resulted in animals significantly poorer in fur characteristics. Occurrence of yellow fat disease suggested interference from fat rancidity.

Introduction

The complexity of nutritional problems facing the mink rancher is well illustrated by the involved experimental plan followed at the Oregon Agricultural Experiment Station during 1961. Research was divided into two broad areas: 1) Ration evaluation studies, and 2) fur abnormality and wet belly research. The former area included seven separate lines of approach; the latter four. In all, 30 separate groups of animals were fed rations containing 41 different ingredients. While the size of the groups is smaller than formerly, it is felt that the present plan of operation gives the opportunity to "screen" a greater number of problem areas. Those experiments giving promising results will be confirmed in further trials.

Approaches taken were as follows: 1) investigation of standard control diet composition, 2) effect of a polyphosphate emulsifier feed additive, 3) comparison of various cereal grains in mink diets at moderately-high levels, 4) feeding value of blood and bloodmeal, 5-6) investigation of fur abnormalities occurring when turkey waste or hake is fed, 7) application of linear programming in formulation of mink rations, 8) cereal supplementation designed for diets high in turkey offal, 9) investigation of diets largely composed of dry materials, and 10) red hip fur abnormality studies with pastel mink. Study of genetic aspects of wet belly incidence was conducted with sapphire mink and results will be reported separately.

Within each of these areas of approach there are one or more subgroups of animals devoted to different specific aspects of the problem. Results are reported separately for each treatment and are identified by a number (indicating area approach, as above) and a letter designating the specific sub-group.

Each test ration is described both in terms of the amounts of each feedstuff involved in the mixture and the chemical nutrients supplied, as determined by laboratory analyses. In this publication, for the first time, ration composition is listed in two ways: 1) as percentages of the complete wet diet, as fed, and 2) in terms of percentages of dry nutrients supplied. Both will be of practical value to the mink rancher—the former as a direct guide for ranch use and the latter as an accurate means of evaluating the effectiveness and economy of various ingredients.

Results are listed in terms of animal growth, which is presented in graphic form and fur color, quality and relative economies, which are tabulated. Differences in performance between groups have been subjected to statistical analysis and significance is described on this basis. In the growth charts, performance on the test diet is shown by a solid line and that on the standard control diet by a broken line. In some cases, as in the linear program study, comparison is made between various groups fed linear-programmed rations in addition to the control diet.

Twenty-five standard dark animals (13 males and 12 females) were included in each test group, with the exception of those on linear-programmed rations, which included 10 each. One hundred and two sapphire mink were devoted to wet belly research. In addition, a small herd of 29 pastel breeder animals has been developed for red-hip

studies. This year, from 650 kits weaned every one has served on some experimental treatment. Total kits born were 671, including 523 standard dark, 108 sapphire, and 40 pastel. Reproductive performance in terms of litter averages was 5.03 kits for darks, 5.00 for pastels, 5.40 for sapphires, or 5.08 overall. Twenty-seven males and 73 females were selected according to an index system, as breeders to perpetuate the herd. Results of these animals' performance on test were compiled from live data. Ration costs are expressed as percentages of control ration (1B) cost, rather than in direct dollar values. It is felt that feed costs, transportation, storage, and preparation costs vary so extensively from ranch to ranch that the former is the preferable system.

Acknowledgments

Many firms and individuals have contributed advice, materials, money or services in support of this research program. Special appreciation is acknowledged to the following:

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Triangle Milling Company, Portland, Oregon

Giulini Gmbr., Ludwigshaven am Rhein, West Germany

Olympia Brewing Company, Olympia, Washington

D. E. Nebergall Company, Albany, Oregon

Pacific Adhesives Company, Hillsboro, Oregon

Pilgrim Turkey Packers, Salem, Oregon

McCauley's Incorporated, Seattle, Washington

Stein-Hall and Company, Incorporated, New York, N. Y.

Diet Studies

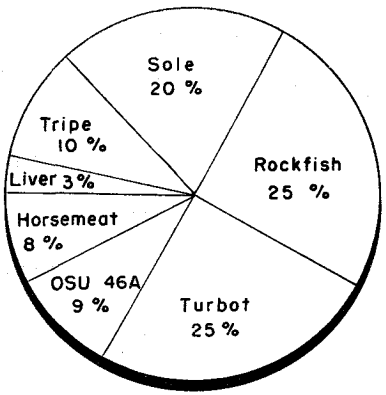
Standard Control

Test Group 1A

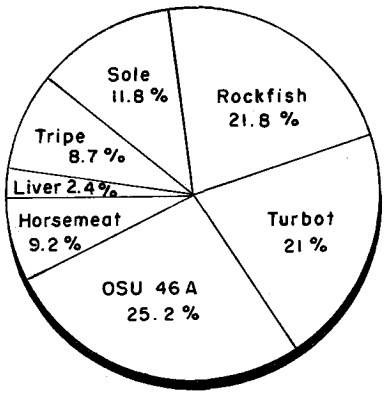
Objective: To provide a standard control ration compounded of ingredients which have consistently resulted in satisfactory growth and fur production. This ration has been fed for 3 years, and allows some year-to-year comparison.

Methods: 25 standard dark mink (13 males and 12 females) were fed this ration from July 26 to pelting.

Ration Composition %
(As Fed)



Ration Composition %
(Dry Basis)



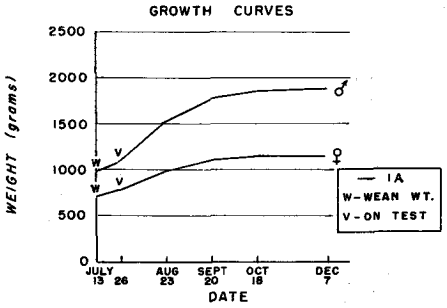
Proximate Analysis

	As Fed	*Dry Basis*
Dry Matter	29.4%	100.0%
Crude Protein	14.9	50.7
Crude Fat	6.4	21.7
Crude Fiber	0.6	1.9
Ash	3.0	10.3
Nitrogen Free Extract	4.5	15.4

Cereal Mix OSU 46A
(Composition as Fed)

	%
Wheat Germ	25.0
Alfalfa Meal	12.5
Skim Milk Powder	8.3
Meat Meal	16.6
Soybean Oil Meal	16.6
Ground Oat Groats	16.6
Brewer's Yeast	4.2
Fortafeed 2-4-9-c	0.4
Terramycin (TM-10)	0.25
Methionine	0.05

Results:



Production Data

	Males	*Females*
Final weight (gm.)	1893	1139
Weight gain (gm.)	801	343
Animal length (cm.)	43.7	37.0
Fur color*	177	183
Fur quality*	146	175
Weight of dried skin (gm.)	100	59
Length of dried skin (cm.)	67.5	57.3
Wet belly incidence (%)	23.1	0
Estimated pelt value ($)	24.94	12.33
Ration cost per mink (%) of control 1B)		108

* Fur color and quality, taken from dried skins, is rated from 100 (best) to 400 (poorest).

Conclusions: Since test group 1A was fed the same standard control diet, containing horse meat, as used in the past 2 years, it is interesting to compare year-by-year performance. In 1960, group performance on this diet was marred by high wet belly incidence (67%) in dark males. This year there were only 23% wet bellies in the males, strengthening the theory that this condition is under genetic, as well as nutritional, control. Correlation of wet belly incidence to growth rate is evident, since the final 1960 male weight was 137 grams higher than the current year's. Although there appear to be differences in growth and fur characteristics between groups 1A and 1B in favor of this group, they proved insignificant when analyzed statistically. Largely due to inclusion of horsemeat, costs of this diet were higher than all others investigated.

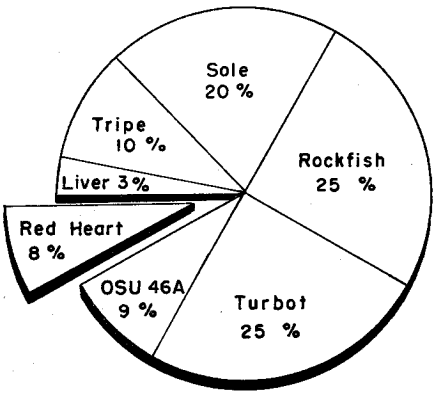
Revised Control

Test Group 1B

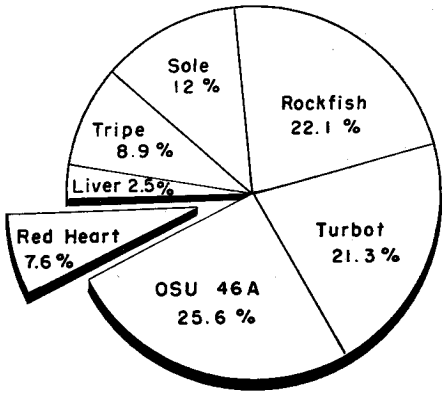
Objective: To evaluate a revised control diet in which a commercial beef product, "Red Heart," was substituted for the horse meat in ration 1A. This diet has been used as the standard for comparison in all groups except 9B.

Methods: 25 standard dark mink (13 males and 12 females) were fed this ration from July 26 to pelting.

Ration Composition %
(As Fed)



Ration Composition %
(Dry Basis)



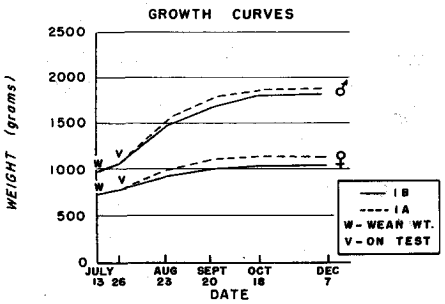
Proximate Analysis

	As Fed	*Dry Basis*
Dry Matter	29.0%	100.0%
Crude Protein	13.7	47.3
Crude Fat	6.7	23.2
Crude Fiber	0.6	2.0
Ash	3.1	10.6
Nitrogen Free Extract	4.9	16.9

Cereal Mix OSU 46A
(Composition as Fed)

	%
Wheat Germ	25.0
Alfalfa Meal	12.5
Skim Milk Powder	8.3
Meat Meal	16.6
Soybean Oil Meal	16.6
Ground Oat Groats	16.6
Brewer's Yeast	4.2
Fortafeed 2-4-9-c	0.4
Terramycin (TM-10)	0.25
Methionine	0.05

Results:



Production Data

	Males	*Females*
Final weight (gm.)	1810	1038
Weight gain (gm.)	744	262
Animal length (cm.)	43.4	37.1
Fur color*	231	175
Fur quality*	177	150
Weight of dried skin (gm.)	105	60
Length of dried skin (cm.)	67.8	55.5
Wet belly incidence (%)	38.5	8.3
Estimated pelt value ($)	20.77	12.79
Ration cost per mink (% of control)	100	

* Fur color and quality, taken from dried skins, is rated from 100 (best) to 400 (poorest).

Conclusions: Test group 1B provides an opportunity to assess direct replacement of horsemeat (as in group 1A) with a commercial beef offal product. The purpose of this experiment was to provide a standard control diet as satisfactory as, yet more economical than, that used previously; hence of more direct interest in ranch application. It is considered that this purpose was achieved. No significant differences in growth rate or fur characteristics occurred between this test group and 1A; however, feed costs were 8% lower. Wet belly incidence appears higher on this diet and this point will be checked further; however, it is possible that this may be due to inherent differences in the animals in this group rather than to diet alone. Test group 1B serves as the standard for comparison with other groups in the following pages.

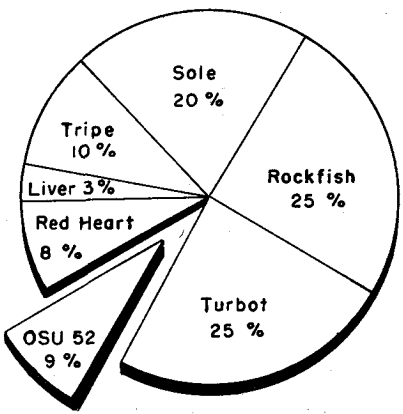
Revised Control

Test Group 1C

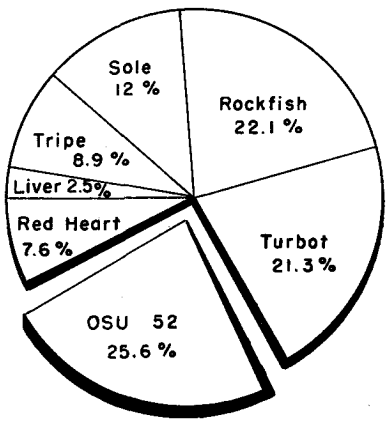
Objective: To evaluate a revised control diet in which an all-plant, low-protein cereal was substituted for a more highly-fortified cereal, in an attempt to verify 1960 results which indicated improved performance on this cereal.

Methods: 25 standard dark mink (13 males and 12 females) were fed this ration from July 26 to pelting.

Ration Composition %
(As Fed)



Ration Composition %
(Dry Basis)



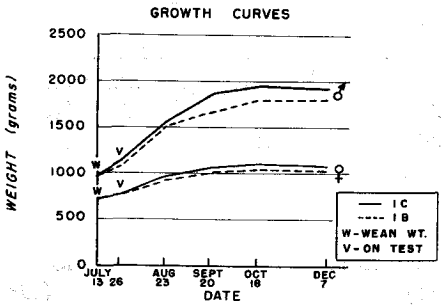
Proximate Analysis

	As Fed	*Dry Basis*
Dry Matter	29.9%	100.0%
Crude Protein	13.0	43.3
Crude Fat	6.3	21.1
Crude Fiber	0.6	2.1
Ash	2.8	9.4
Nitrogen Free Extract	7.2	24.1

Cereal Mix OSU 52
(Composition as Fed)

	%
Ground Oat Groats	65.0
Alfalfa Meal	10.0
Wheat Germ Meal	10.0
Soybean Oil Meal	10.0
Brewer's Yeast	4.3
Fortafeed 2-4-9-c	0.4
Terramycin (TM-10)	0.25
Methionine	0.05

Results:



Production Data

	Males	*Females*
Final Weight (gm.)	1934	1098
Weight gain (gm.)	812	328
Animal length (cm.)	44.1	37.1
Fur color*	192	158
Fur quality*	169	158
Weight of dried skin (gm.)	116	58
Length of dried skin (cm.)	71.8	55.9
Wet belly incidence (%)	53.8	0
Estimated pelt value ($)	21.85	13.13
Ration cost per mink (%) of control 1B)	93	

* Fur color and quality, taken from dried skins, is rated from 100 (best) to 400 (poorest).

Conclusions: Inclusion of an all-plant, low protein cereal in the diet for test group 1C reflects interest shown in such cereal following its successful use in high turkey offal diets in 1960. With the meat-fish diet employed in this group, this cereal also gave most satisfactory results. Size of animals in this group appeared generally larger than the control, though the difference proved statistically insignificant due largely to presence of 1 abnormally-small male in this group. Male pelt weights were significantly greater than the controls. Estimated pelt values were greater, and ration costs were lower than those for the controls. This performance justifies further investigation of cereal composition in relation to overall nutrient content of pelter mink diets.

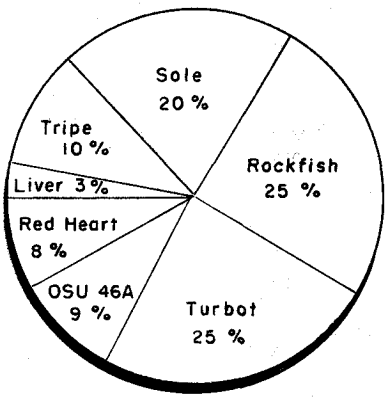
Ration Additive

Test Group 2

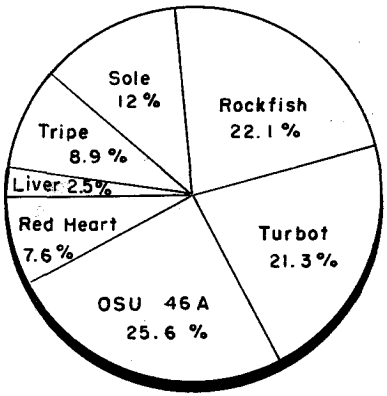
Objective: To test a polyphosphate emulsifying agent, "Nerzone," as a feed additive to a standard diet, designed to improve palatability, and as a means of improving production.

Methods: 25 standard dark mink (13 males and 12 females) were fed this ration from July 26 to pelting.

Ration Composition %
(As Fed)



Ration Composition %
(Dry Basis)



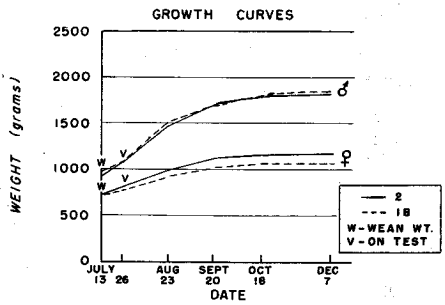
Proximate Analysis

	As Fed	*Dry Basis*
Dry Matter	29.5%	100.0%
Crude Protein	13.7	46.5
Crude Fat	7.1	23.9
Crude Fiber	0.5	1.8
Ash	3.7	12.5
Nitrogen Free Extract	4.5	15.3

Cereal Mix OSU 46A
(Composition as Fed)

	%
Wheat Germ	25.0
Alfalfa Meal	12.5
Skim Milk Powder	8.3
Meat Meal	16.6
Soybean Oil Meal	16.6
Ground Oat Groats	16.6
Brewer's Yeast	4.2
Fortafeed 2-4-9-c	0.4
Terramycin (TM-10)	0.25
Methionine	0.05

Results:



Production Data

	Males	*Females*
Final weight (gm.)	1799	1163
Weight gain (gm.)	706	354
Animal length (cm.)	44.0	37.4
Fur color*	238	183
Fur quality*	177	175
Weight of dried skin (gm.)	102	61
Length of dried skin (cm.)	67.9	57.5
Wet belly incidence (%)	38.5	8.3
Estimated pelt value ($)	20.00	12.33
Ration cost per mink (% of control)	95	

* Fur color and quality, taken from dried skins, is rated from 100 (best) to 400 (poorest).

Conclusions: Test group 2 illustrates effects of 0.5% "Nerzone" feed additive in the standard control diet. This material was intended to increase the moisture-holding capacity of the diet, thus keeping it from drying out on the wire. Results do not indicate significant performance differences between this group and the standard control. Although final female weights and weight gains were greater in this group, there was no significant difference in growth of the males in this group and group 1B. Neither fur characteristics nor incidence of wet bellies was significantly different from those items in the control animals. The cost of the feed additive was not included in ration cost evaluation; therefore, the figures listed should be increased somewhat.

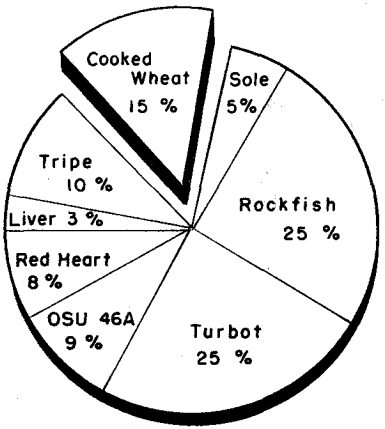
Cooked Wheat

Test Group 3A

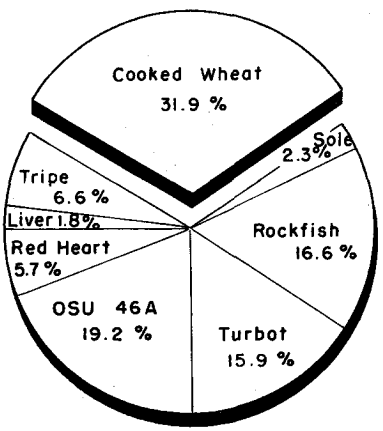
Objective: To evaluate inclusion of 15% cooked wheat (representative of a non-fibrous grain) in pelter mink rations as a means of lowering ration costs while maintaining or improving production.

Methods: 25 standard dark mink (13 males and 12 females) were fed this ration from July 26 to pelting.

Ration Composition %
(As Fed)



Ration Composition %
(Dry Basis)



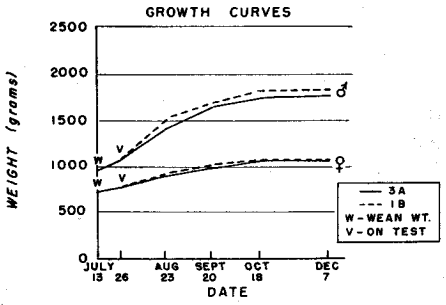
Proximate Analysis

	As Fed	*Dry Basis*
Dry Matter	31.5%	100.0%
Crude Protein	11.4	36.3
Crude Fat	5.3	16.9
Crude Fiber	1.4	4.4
Ash	2.3	7.2
Nitrogen Free Extract	11.1	35.2

Cereal Mix OSU 46A
(Composition as Fed)

	%
Wheat Germ	25.0
Alfalfa Meal	12.5
Skim Milk Powder	8.3
Meat Meal	16.6
Soybean Oil Meal	16.6
Ground Oat Groats	16.6
Brewer's Yeast	4.2
Fortafeed 2-4-9-c	0.4
Terramycin (TM-10)	0.25
Methionine	0.05

Results:



Production Data

	Males	*Females*
Final weight (gm.)	1737	1043
Weight gain (gm.)	660	273
Animal length (cm.)	44.2	38.0
Fur color*	177	233
Fur quality*	154	175
Weight of dried skin (gm.)	104	61
Length of dried skin (cm.)	66.8	56.6
Wet belly incidence (%)	61.5	8.3
Estimated pelt value ($)..	21.85	11.17
Ration cost per mink (%of control)	87	

* Fur color and quality, taken from dried skins, is rated from 100 (best) to 400 (poorest).

Conclusions: Increased use of cereal grains to improve pelter mink ration economy has been a subject of interest for several years. Test group 3A assesses the value of cooked wheat fed as 15% of the wet diet. It should be noted that this supplies considerably more than 15% of the diet nutrients on a dry basis. The wheat was cooked at the mill. Initially it was fed rolled but subsequently it was finely ground to allow for thorough and complete mixing in the diet, thus preventing wastage. Ration costs on this diet were only 87% of the control. Fur color in males was better and in females was poorer than the controls, although neither of these differences were significant. Size of males appeared less, though insignificantly so, than the controls, but wet belly incidence was higher. Estimated pelt values were higher for the males, lower for the females, than the controls, largely reflecting color differences.

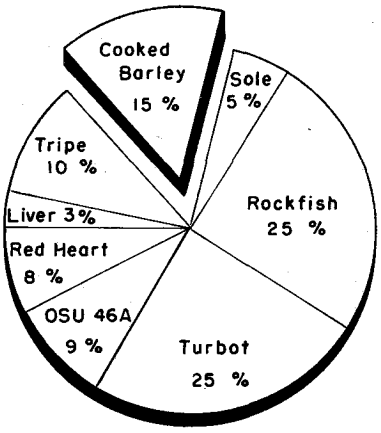
Cooked Barley

Test Group 3B

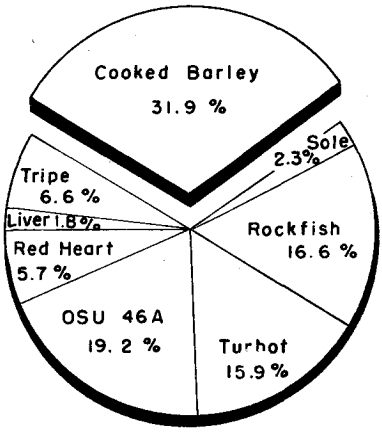
Objective: To evaluate inclusion of 15% cooked barley (representative of a fibrous grain) in pelter mink rations as a means of lowering ration costs while maintaining or improving production.

Methods: 25 standard dark mink (14 males and 11 females) were fed this ration from July 26 to pelting.

Ration Composition %
(As Fed)



Ration Composition %
(Dry Basis)



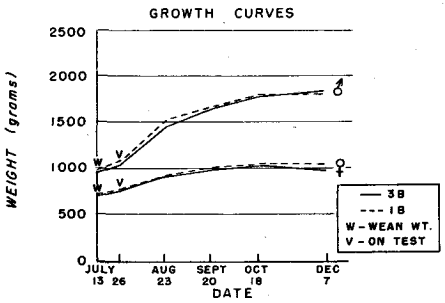
Proximate Analysis

	As Fed	*Dry Basis*
Dry Matter	32.0%	100.0%
Crude Protein	11.6	36.2
Crude Fat	5.2	16.2
Crude Fiber	1.7	5.4
Ash	2.2	6.8
Nitrogen Free Extract	11.3	35.4

Cereal Mix OSU 46A
(Composition as Fed)

	%
Wheat Germ	25.0
Alfalfa Meal	12.5
Skim Milk Powder	8.3
Meat Meal	16.6
Soybean Oil Meal	16.6
Ground Oat Groats	16.6
Brewer's Yeast	4.2
Fortafeed 2-4-9-c	0.4
Terramycin (TM-10)	0.25
Methionine	0.05

Results:



Production Data

	Males	*Females*
Final weight (gm.)	1827	980
Weight gain (gm.)	814	233
Animal length (cm.)	44.4	37.3
Fur color*	200	164
Fur quality*	193	182
Weight of dried skin (gm.)	100	57
Length of dried skin (cm.)	67.8	54.8
Wet belly incidence (%)	28.6	0
Estimated pelt value ($)	22.15	12.59
Ration cost per mink (% of control)	92	

* Fur color and quality, taken from dried skins, is rated from 100 (best) to 400 (poorest).

Conclusions: Test group 3B provides a direct comparison with 3A in choice of cereal grain. This group involved barley; 3A included wheat. The levels fed (15%) and the method of preparation were identical. Analyses of performance data showed no significant differences between groups 3A and B; however, there were apparent trends towards heavier male weights in the barley group than the wheat-fed group. Although barley is cheaper than wheat, ration costs were slightly higher for the barley group (although they were still below control costs). This may be accounted for either by actual higher food consumption or greater wastage when barley was included in the ration. Estimated pelt values were higher for both males and females on the barley diet than for those on the wheat diet. The reason for this is the lower wet belly incidence on the barley diet; however, the significance of this observation is not clear.

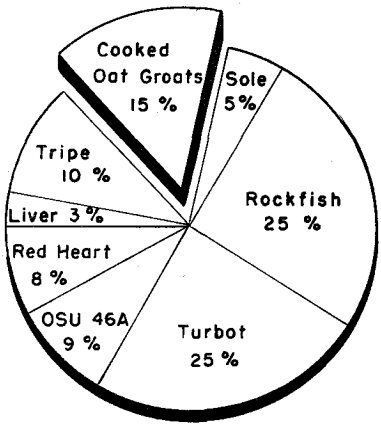
Cooked Oat Groats

Test Group 3C

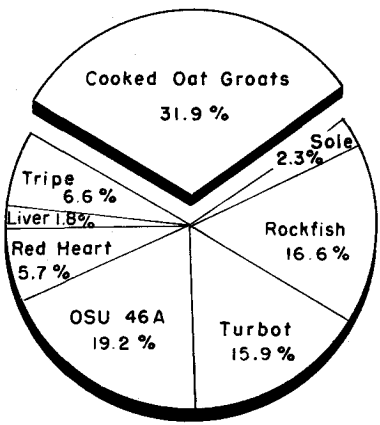
Objective: To evaluate inclusion of 15% cooked oat groats (representative of an improved product from a fibrous grain) in pelter mink rations as a means of lowering ration costs while maintaining or improving production.

Methods: 25 standard dark mink (13 males and 12 females) were fed this ration from July 26 to pelting.

Ration Composition %
(As Fed)



Ration Composition %
(Dry Basis)



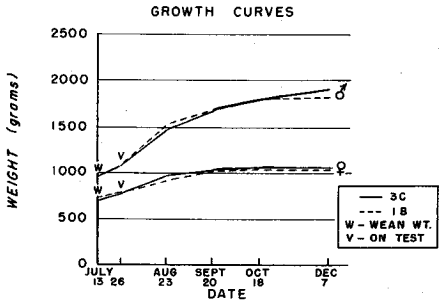
Proximate Analysis

	As Fed	*Dry Basis*
Dry Matter	35.0%	100.0%
Crude Protein	12.1	34.4
Crude Fat	5.8	16.5
Crude Fiber	1.0	3.0
Ash	2.5	7.2
Nitrogen Free Extract	13.6	38.9

Cereal Mix OSU 46A
(Composition as Fed)

	%
Wheat Germ	25.0
Alfalfa Meal	12.5
Skim Milk Powder	8.3
Meat Meal	16.6
Soybean Oil Meal	16.6
Ground Oat Groats	16.6
Brewer's Yeast	4.2
Fortafeed 2-4-9-c	0.4
Terramycin (TM-10)	0.25
Methionine	0.05

Results:



Production Data

	Males	*Females*
Final weight (gm.)	1905	1064
Weight gain (gm.)	808	289
Animal length (cm.)	45.3	36.8
Fur color*	200	225
Fur quality*	192	200
Weight of dried skin (gm.)	108	57
Length of dried skin (cm.)	68.7	55.7
Wet belly incidence (%)	53.8	0
Estimated pelt value ($)	21.28	11.00
Ration cost per mink (% of control)	85	

* Fur color and quality, taken from dried skins, is rated from 100 (best) to 400 (poorest).

Conclusions: Past years' performances have indicated the suitability of cooked oat groats in pelter mink diets and this group provides a comparison of oat groats with barley (3B) and wheat (3A). Again, levels (15%, wet basis) and methods of preparation were similar to those described for group 3A. Although significant growth rate differences were not demonstrated, there were trends toward larger males and females as compared to either the standard control or the other grain-fed groups. Males were significantly longer in this group than in the controls. Wet belly incidence increased over the control and over the barley-fed group, again paralleling growth rate. Fur characteristics were generally similar to those of the other grain-fed groups and estimated pelt values likewise did not differ significantly; however, female pelt values were significantly below controls. Ration cost was equivalent to that of the wheat-fed group and was below that of either the barley-fed group or control.

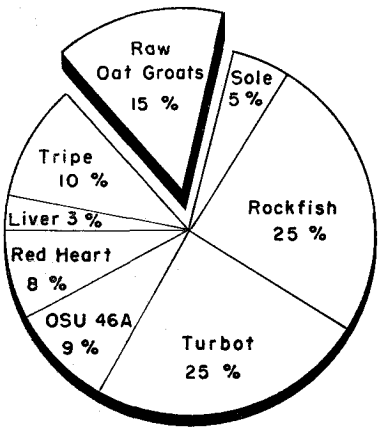
Raw Oat Groats

Test Group 3D

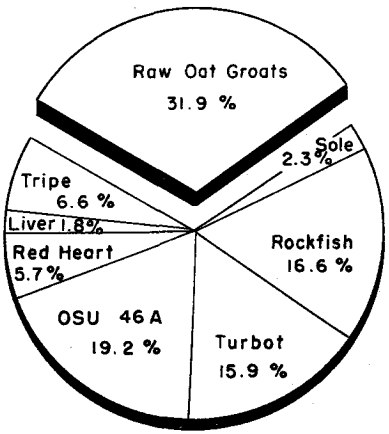
Objective: To evaluate raw oat groats fed as 15% of a ration for pelter mink. This diet allows an evaluation of cereal cooking and may be compared with the cooked product fed at the same level to Group 3C.

Methods: 25 standard dark mink (13 males and 12 females) were fed this ration from July 26 to pelting.

Ration Composition %
(As Fed)



Ration Composition %
(Dry Basis)



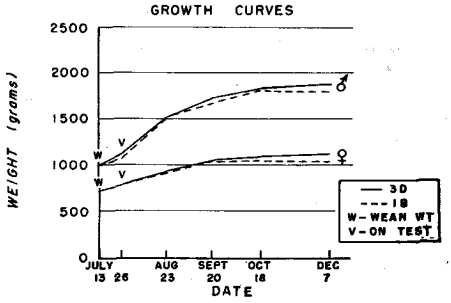
Proximate Analysis

	As Fed	*Dry Basis*
Dry Matter	33.8%	100.0%
Crude Protein	11.5	33.9
Crude Fat	5.7	16.9
Crude Fiber	0.8	2.3
Ash	2.7	8.0
Nitrogen Free Extract..	13.1	38.9

Cereal Mix OSU 46A
(Composition as Fed)

	%
Wheat Germ	25.0
Alfalfa Meal	12.5
Skim Milk Powder	8.3
Meat Meal	16.6
Soybean Oil Meal	16.6
Ground Oat Groats	16.6
Brewer's Yeast	4.2
Fortafeed 2-4-9-c	0.4
Terramycin (TM-10)	0.25
Methionine	0.05

Results:



Production Data

	Males	*Females*
Final weight (gm.)	1878	1117
Weight gain (gm.)	770	344
Animal length (cm.)	43.8	38.0
Fur color*	231	217
Fur quality*	154	200
Weight of dried skin (gm.)	111	61
Length of dried skin (cm.)	69.0	57.6
Wet belly incidence (%)	15.4	0
Estimated pelt value ($)	22.62	11.50
Ration cost per mink (% of control)	84	

* Fur color and quality, taken from dried skins, is rated from 100 (best) to 400 (poorest).

Conclusions: Test group 3D offers an evaluation of raw versus cooked grain for mink feeding. Its diet included 15% "raw" oat groats (although oats are subjected to some heat in removal of the hull) as compared with 15% cooked oat groats in an otherwise identical diet fed group 3C. Elimination of the cooking allowed a slight reduction in ration cost, at no apparent sacrifice in performance. Both growth and fur characteristics were similar on the raw and cooked oat groats diets, and were reflected in similar estimated pelt values. Wet belly incidence was low on this diet, even though good growth was obtained; however, more experimentation will be necessary to develop the relationship, if any, between cooking and occurrence of this problem.

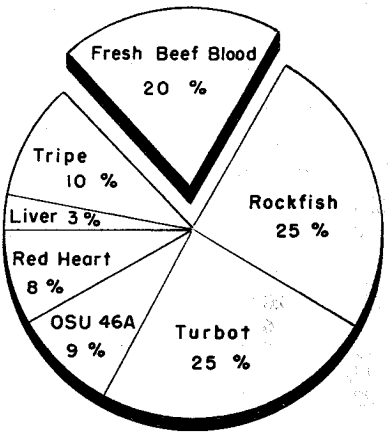
Whole Blood

Test Group 4A

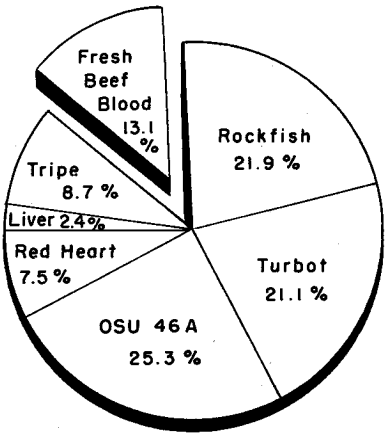
Objective: To test the inclusion of fresh-frozen beef blood at a 20% level (wet basis) replacing sole, in pelter mink rations.

Methods: 25 standard dark mink (13 males and 12 females) were fed this ration from July 26 to pelting.

Ration Composition %
(As Fed)



Ration Composition %
(Dry Basis)



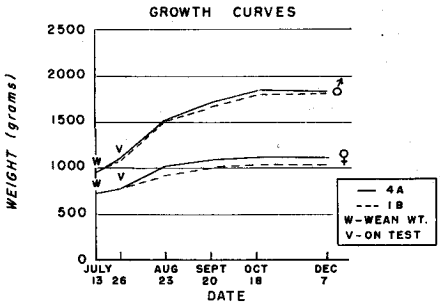
Proximate Analysis

	As Fed	*Dry Basis*
Dry Matter	32.0%	100.0%
Crude Protein	14.8	46.3
Crude Fat	7.6	23.9
Crude Fiber	0.9	2.8
Ash	2.5	7.8
Nitrogen Free Extract	6.2	19.2

Cereal Mix OSU 46A
(Composition as Fed)

	%
Wheat Germ	25.0
Alfalfa Meal	12.5
Skim Milk Powder	8.3
Meat Meal	16.6
Soybean Oil Meal	16.6
Ground Oat Groats	16.6
Brewer's Yeast	4.2
Fortafeed 2-4-9-c	0.4
Terramycin (TM-10)	0.25
Methionine	0.05

Results:



Production Data

	Males	*Females*
Final weight (gm.)	1837	1123
Weight gain (gm.)	731	328
Animal length (cm.)	45.7	38.1
Fur color*	215	233
Fur quality*	177	183
Weight of dried skin (gm.)	110	62
Length of dried skin (cm.)	68.6	59.2
Wet belly incidence (%)	30.8	0
Estimated pelt value ($)	22.16	11.38
Ration cost per mink (% of control)	96	

* Fur color and quality, taken from dried skins, is rated from 100 (best) to 400 (poorest).

Conclusions: In addition to its nutritive value, mainly as a source of protein, whole beef blood might be expected to aid palatability of mink diets. It was collected at a slaughter plant, frozen immediately, and thawed just prior to inclusion as 20% of the diet for this test group, replacing a like amount of sole. Male weights were similar, but females were larger on the fresh blood diet, but the differences were not generally significant. Male animal lengths were, however, significantly greater on this diet than on the control. Fur characteristics were similar to those of the control animals except in the instance of fur color in females on the blood diet which was significantly poorer. Ration costs, while below the control, were not as low as in the cereal groups (group 3 series). Overall performance is judged satisfactory enough to warrant further study of the feed use of fresh blood.

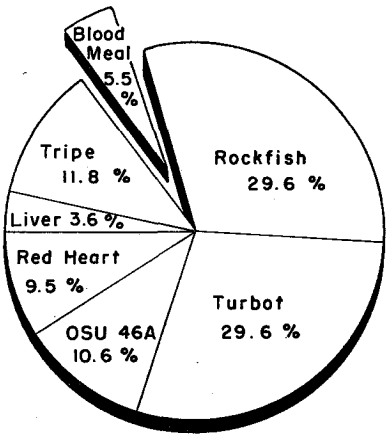
Blood Meal

Test Group 4B

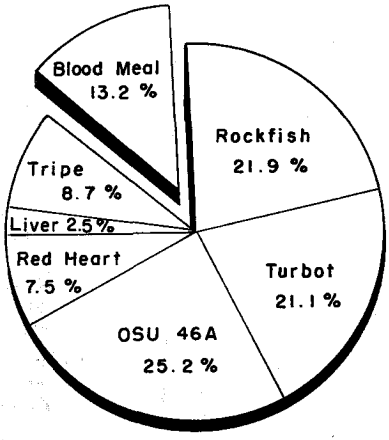
Objective: To test the inclusion of spray-dried beef and hog blood meal to supply the same dry matter content as the fresh blood in experiment 4A.

Methods: 25 standard dark mink (13 males and 12 females) were fed this ration from July 26 to pelting.

Ration Composition %
(As Fed)



Ration Composition %
(Dry Basis)



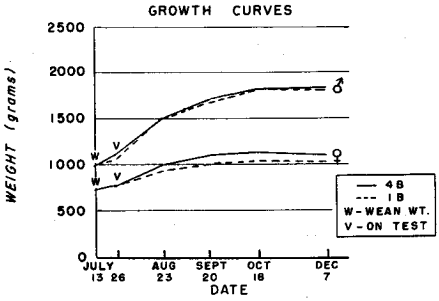
Proximate Analysis

	As Fed	*Dry Basis*
Dry Matter	32.9%	100.0%
Crude Protein	16.0	48.5
Crude Fat	6.2	18.9
Crude Fiber	0.6	1.8
Ash	2.7	8.3
Nitrogen Free Extract	7.4	22.5

Cereal Mix OSU 46A
(Composition as Fed)

	%
Wheat Germ	25.0
Alfalfa Meal	12.5
Skim Milk Powder	8.3
Meat Meal	16.6
Soybean Oil Meal	16.6
Ground Oat Groats	16.6
Brewer's Yeast	4.2
Fortafeed 2-4-9-c	0.4
Terramycin (TM-10)	0.25
Methionine	0.05

Results:



Production Data

	Males	*Females*
Final weight (gm.)	1824	1113
Weight gain (gm.)	709	318
Animal length (cm.)	45.7	38.8
Fur color*	162	233
Fur quality*	185	192
Weight of dried skin (gm.)	110	63
Length of dried skin (cm.)	68.3	58.3
Wet belly incidence (%)	46.2	8.3
Estimated pelt value ($)	23.52	11.07
Ration cost per mink (% of control)	90	

* Fur color and quality, taken from dried skins, is rated from 100 (best) to 400 (poorest).

Conclusions: An alternative to freezing as a method of preserving blood for mink feed use is drying into blood meal. Test group 4B was fed a diet similar to 4A except that beef and pork blood meal was used to supply the same amount of diet dry matter. A high-grade product was selected. This imparted some adhesive quality to the diet which aided in holding the feed on the wire and probably reduced wastage. Performance results were almost identical with those reported on the fresh blood diet (4A) with the exception that fur color was significantly improved in the males, and poorer in the females. As did the fresh blood diet, this one resulted in significantly longer males and a trend toward longer females. On the basis of the limited data available from this and the preceding test group, it would appear that either dried or fresh blood may be a satisfactory adjunct to pelter mink diets at the levels used.

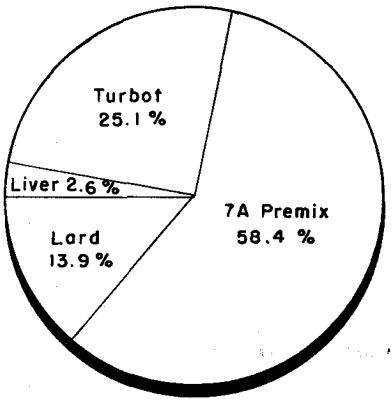
Linear Programming

Test Group 7A

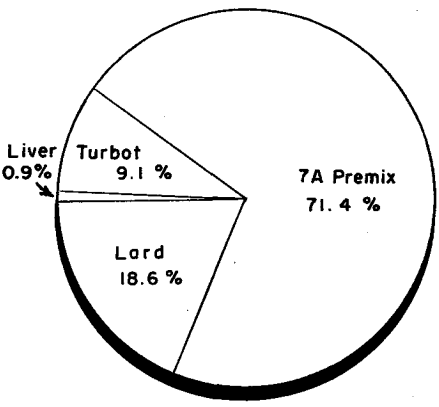
Objective: To test a ration formulated with an electronic computer to provide 50% crude protein (dry basis) and a protein:fat ratio of 2:1 in a "least cost" formula.

Methods: 10 standard dark mink (6 males and 4 females) were fed this ration from July 26 to pelting.

Ration Composition %
(As Fed)



Ration Composition %
(Dry Basis)



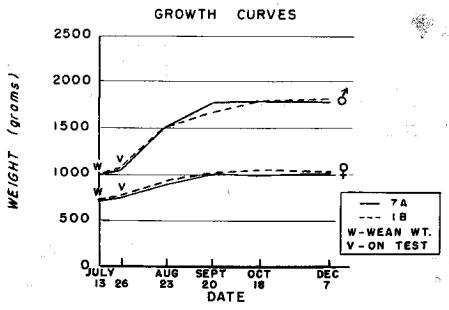
Proximate Analysis

	As Fed	*Dry Basis*
Dry Matter	43.5%	100.0%
Crude Protein	21.7	49.8
Crude Fat	8.9	20.5
Crude Fiber	1.2	2.8
Ash	2.7	6.3
Nitrogen Free Extract	9.0	20.6

Premix 7A
(Composition as Fed)

	%
Blood Meal	44.0
Wheat Bran	29.6
Herring Meal	20.6
Meat Meal	5.3
Tomato Pomace	0.5
Dicalcium Phosphate	0.05

Results:



Production Data

	Males	*Females*
Final weight (gm.)	1778	1015
Weight gain (gm.)	728	268
Animal length (cm.)	42.9	36.8
Fur color*	217	250
Fur quality*	200	175
Weight of dried skin (gm.)	101	63
Length of dried skin (cm.)	66.8	56.1
Wet belly incidence (%)	50.0	0
Estimated pelt value ($)	19.97	10.63
Ration cost per mink (% of control)	71	

* Fur color and quality, taken from dried skins, is rated from 100 (best) to 400 (poorest).

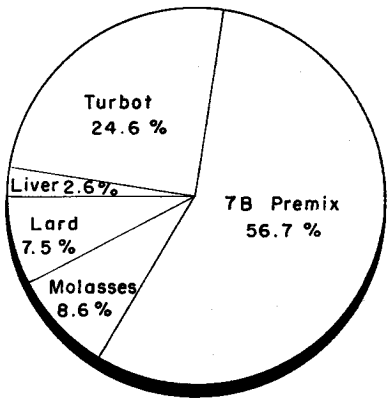
Conclusions: Test group 7A is the first of six groups devoted to an experiment in linear programming or use of the electronic computer in ration formulation. Such formulation is conducted by providing the computer with certain specifications regarding animal requirements and feedstuff values and requiring from it the ration combination that will meet the specifications at least cost. In this series of experiments the specifications were varied to include 3 protein levels (50%, 40%, 30%) and 2 ratios of protein to fat (2:1, 3:1). Group 7A received a 50% protein ration containing 90% of the nutrients from dry ingredients including 26% blood meal and 17% wheat bran as fed. Performance of the males was similar to the controls except wet belly incidence was increased, presumably due to high dietary fat level. Female performance resembled that of control females except that fur color was somewhat poorer. Ration cost was only 71% of the controls, largely due to the extensive use of dry ingredients.

Test Group 7B

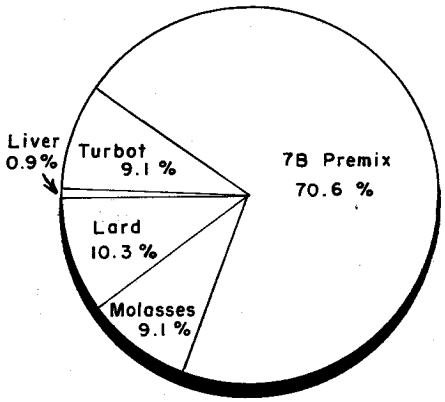
Objective: To test a ration formulated with an electronic computer to provide 50% crude protein (dry basis) and a 3:1 protein:fat ratio in a "least cost" formula.

Methods: 10 standard dark mink (6 males and 4 females) were fed this ration from July 26 to pelting.

Ration Composition %
(As Fed)



Ration Composition %
(Dry Basis)



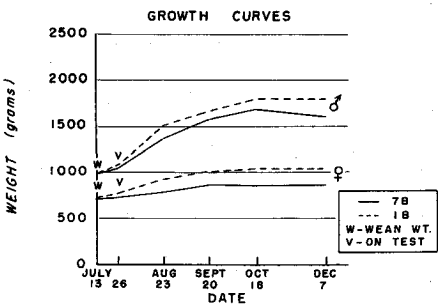
Proximate Analysis

	As Fed	*Dry Basis*
Dry Matter	43.8%	100.0%
Crude Protein	20.6	47.0
Crude Fat	6.5	14.8
Crude Fiber	1.2	2.8
Ash	2.5	5.7
Nitrogen Free Extract	13.0	29.7

Premix 7B
(Composition as Fed)

	%
Blood Meal	42.7
Wheat Bran	30.7
Herring Meal	20.8
Meat Meal	5.4
Tomato Pomace	0.4

Results:



Production Data

	Males	*Females*
Final weight (gm.)	1603	870
Weight gain (gm.)	558	145
Animal length (cm.)	42.9	36.8
Fur color*	167	200
Fur quality*	217	175
Weight of dried skin (gm.)	101	57
Length of dried skin (cm.)	65.9	53.6
Wet belly incidence (%)	0	0
Estimated pelt value ($)	25.58	11.63
Ration cost per mink (% of control)	71	

* Fur color and quality, taken from dried skins, is rated from 100 (best) to 400 (poorest).

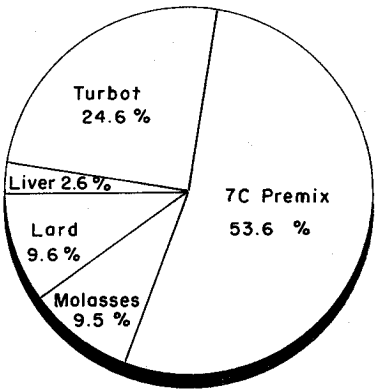
Conclusions: Test group 7B received a linear programmed ration designed to supply 50% crude protein and a protein:fat ratio of 3:1. This diet is similar to that fed group 7A except that the amount of lard is lowered—molasses making up the difference. A restriction was put on the maximum level of molasses at 10% of the diet; otherwise the computer would have used it more extensively due to its low price. Size of both males and females on this diet was depressed, that of females significantly so from the controls. Fur color tended to be improved over that exhibited by group 7A, in both males and females; however, quality was no better. Increased pelt value estimates were made in this group due largely to improved color and absence of wet bellies. In this latter connection it should be noted that the major difference between this ration and 7A was its lower fat content. Ration cost was only 71% of the controls.

Test Group 7C

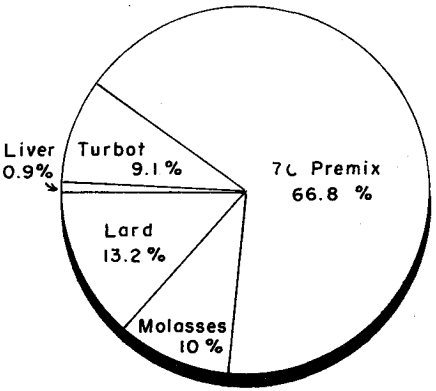
Objective: To test a ration formulated with an electronic computer to provide 40% crude protein (dry basis) and a 2:1 protein:fat ratio in a "least cost" formula.

Methods: 10 standard dark mink (6 males and 4 females) were fed this ration from July 26 to pelting.

Ration Composition %
(As Fed)



Ration Composition %
(Dry Basis)



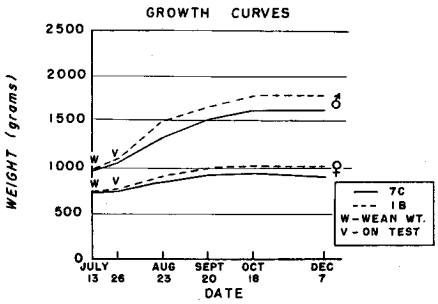
Proximate Analysis

	As Fed	*Dry Basis*
Dry Matter	43.2%	100.0%
Crude Protein	16.1	37.2
Crude Fat	7.9	18.4
Crude Fiber	1.4	3.2
Ash	2.9	6.7
Nitrogen Free Extract	14.9	34.5

Premix 7C
(Composition as Fed)

	%
Wheat Flour Middlings	26.7
Blood Meal	23.5
Herring Meal	22.0
Wheat Bran	20.9
Meat Meal	6.5
Tomato Pomace	0.4

Results:



Production Data

	Males	*Females*
Final weight (gm.)	1648	938
Weight gain (gm.)	605	193
Animal length (cm.)	43.0	36.1
Fur color*	217	200
Fur quality*	167	150
Weight of dried skin (gm.)	100	58
Length of dried skin (cm.)	66.4	54.0
Wet belly incidence (%)	0	0
Estimated pelt value ($)	24.33	12.00
Ration cost per mink (% of control)	62	

* Fur color and quality, taken from dried skins, is rated from 100 (best) to 400 (poorest).

Conclusions: The diet for group 7C was formulated to contain 40% crude protein and a 2:1 protein:fat ratio. Reduction in protein level from the previous two diets was accomplished mainly by substituting wheat flour middlings for blood meal and wheat bran. Tomato pomace was included in several of these computed rations, but at a very low level due to its high fiber content. Restrictions like this one on fiber level were introduced so that the machine would assemble suitable rations from a palatability and nutrient standpoint. Growth performance was somewhat reduced from 1B, though not significantly so, and neither males nor females were smaller than on the higher protein rations 7A and B. No wet bellies occurred in the males, and this is consistent with smaller sized animals, even though the diet contained 18.4% fat. Fur color and quality were slightly improved in males, similar in females to the control. Ration cost was reduced to 62% of the control cost: this was probably the most economical ration in terms of returns received.

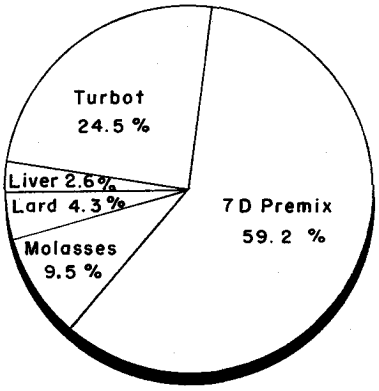
Linear Programming

Test Group 7D

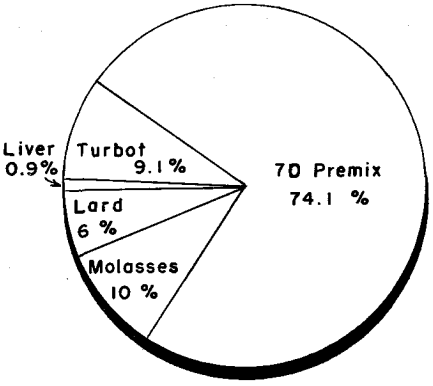
Objective: To test a ration formulated with an electronic computer to provide 40% crude protein (dry basis) and a 3:1 protein:fat ratio in a "least cost" formula.

Methods: 10 standard dark mink (6 males and 4 females) were fed this ration from July 26 to pelting.

Ration Composition %
(As Fed)



Ration Composition %
(Dry Basis)



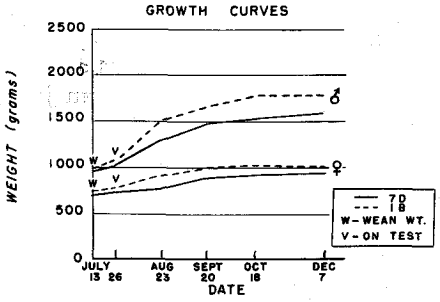
Proximate Analysis

	As Fed	*Dry Basis*
Dry Matter	40.2%	100.0%
Crude Protein	15.4	38.3
Crude Fat	4.3	10.8
Crude Fiber	1.0	2.8
Ash	2.6	6.5
Nitrogen Free Extract..	16.7	41.6

Premix 7D
(Composition as Fed)

	%
Wheat Flour Middlings	50.0
Herring Meal	19.8
Blood Meal	17.8
Meat Meal	6.1
Wheat Bran	5.9
Tomato Pomace	0.4

Results:



Production Data

	Males	*Females*
Final weight (gm.)	1618	963
Weight gain (gm.)	587	230
Animal length (cm.)	42.9	36.4
Fur color*	233	175
Fur quality*	183	200
Weight of dried skin (gm.)	94	58
Length of dried skin (cm.)	62.5	53.2
Wet belly incidence (%)	0	0
Estimated pelt value ($)	22.92	12.00
Ration cost per mink (% of control)	65	

* Fur color and quality, taken from dried skins, is rated from 100 (best) to 400 (poorest).

Conclusions: To insure a high quality of protein, the linear programming specified 15% herring meal and 0.9% fresh beef liver on a dry basis (equivalent to 3% fresh liver). Test group 7D received a 40% crude protein, 13.3% fat diet, formulated by reducing the lard and increasing the wheat flour middlings at the expense of wheat bran in previous diets. Influence of protein: fat ratios is apparent in these experiments, and considering the series of six together, the higher energy rations consistently improved growth—significantly so in the males. In this group, both males and females were slightly smaller, though not significantly so than 1B. Fur color and quality were generally similar to the controls. No wet bellies occurred and prices averaged about equal to the controls. Ration cost was 65% of control cost, since although the feed cost itself was lowered, consumption was increased.

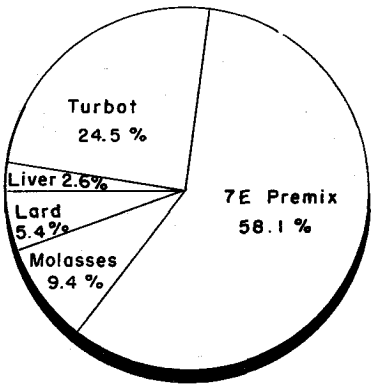
Linear Programming

Test Group 7E

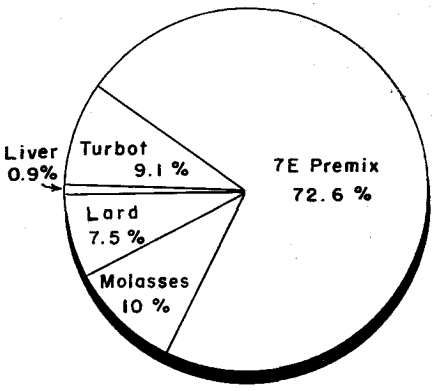
Objective: To test a ration formulated with an electronic computer to provide 30% crude protein (dry basis) and a 2:1 protein:fat ratio in a "least cost" formula.

Methods: 10 standard dark mink (6 males and 4 females) were fed this ration from July 26 to pelting.

Ration Composition %
(As Fed)



Ration Composition %
(Dry Basis)



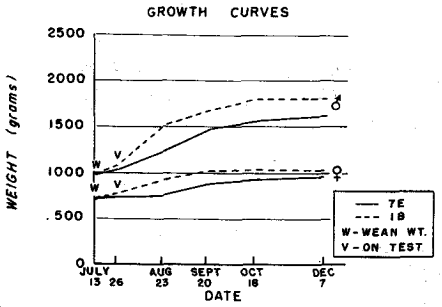
Proximate Analysis

	As Fed	*Dry Basis*
Dry Matter	40.4%	100.0%
Crude Protein	11.5	28.5
Crude Fat	5.0	12.4
Crude Fiber	1.1	2.6
Ash	2.7	6.7
Nitrogen Free Extract	20.1	49.8

Premix 7E
(Composition as Fed)

	%
Wheat Four Middlings	63.2
Herring Meal	20.1
Ground Milo	10.7
Meat Meal	4.8
Crab Meal	0.9
Dicalcium Phosphate	0.3

Results:



Production Data

	Males	*Females*
Final weight (gm.)	1643	973
Weight gain (gm.)	627	228
Animal length (cm.)	42.2	36.8
Fur color*	200	175
Fur quality*	217	175
Weight of dried skin (gm.)	91	55
Length of dried skin (cm.)	65.3	54.7
Wet belly incidence (%)	16.7	0
Estimated pelt value ($)	22.67	12.63
Ration cost per mink (% of control)	63	

* Fur color and quality, taken from dried skins, is rated from 100 (best) to 400 (poorest).

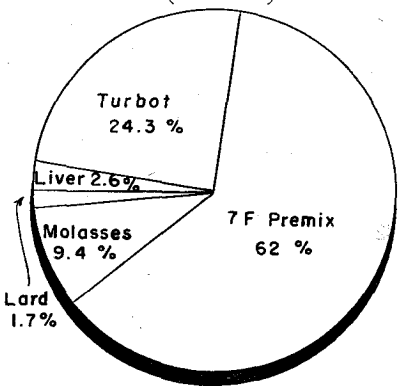
Conclusions: The lowest protein level (30%, dry basis) fed throughout the experiments is exemplified by diets fed test groups 7E and F. This group received 30% crude protein and 15% fat, which was arranged largely by eliminating blood meal and wheat bran and introducing lower-protein feeds like ground milo. Another restriction imposed in the formulation is illustrated by the small amount of crab meal allowed to keep the mineral content within prescribed limits. Reduction of dietary protein level from 40% to 30% did not depress either male or female weights, as long as an adequate energy level was maintained. Fur color was somewhat better and quality poorer in the males than in 1B males, while female fur characteristics were similar to the controls. Ration economy was again attained, since cost of this ration was only 63% of the control diet.

Test Group 7F

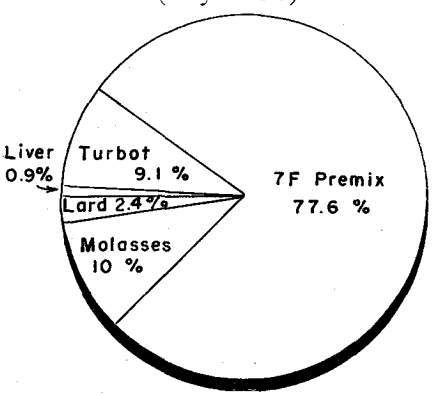
Objective: To test a ration formulated with an electronic computer to provide 30% crude protein (dry basis) and a 3:1 protein:fat ratio in a "least cost" formula.

Methods: 10 standard dark mink (6 males and 4 females) were fed this ration from July 26 to pelting.

Ration Composition %
(As Fed)



Ration Composition %
(Dry Basis)



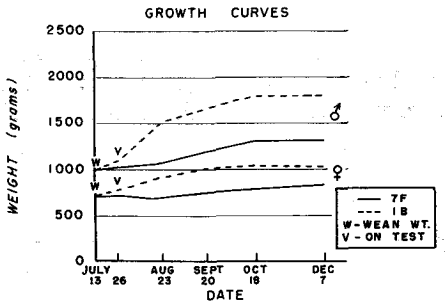
Proximate Analysis

	As Fed	*Dry Basis*
Dry Matter	40.1%	100.0%
Crude Protein	10.6	26.5
Crude Fat	3.2	8.1
Crude Fiber	1.1	2.7
Ash	2.4	6.0
Nitrogen Free Extract	22.7	56.7

Premix 7F
(Composition as Fed)

	%
Wheat Flour Middlings	55.7
Ground Milo	21.3
Herring Meal	18.9
Meat Meal	3.6
Dicalcium Phosphate	0.5

Results:



Production Data

	Males	*Females*
Final weight (gm.)	1307	848
Weight gain (gm.)	278	123
Animal length (cm.)	41.2	36.4
Fur color*	217	150
Fur quality*	217	175
Weight of dried skin (gm.)	77	49
Length of dried skin (cm.)	62.9	49.8
Wet belly incidence (%)	16.7	0
Estimated pelt value ($)	22.50	12.38
Ration cost per mink (% of control)	62	

* Fur color and quality, taken from dried skins, is rated from 100 (best) to 400 (poorest).

Conclusions: The diet fed test group 7F was similar in protein but lower in fat content than that fed group 7E. This contained 30% crude protein and 10% fat and was formulated by increasing ground milo content to 13% at the expense of lard. Lowering of the energy value by reduction of dietary fat apparently restricted growth of both males and females. Pelt length was significantly reduced from controls in both males and females. Fur color values were slightly improved, and quality values slightly lowered from those assessed group 1B; however, estimated pelt prices remained approximately equal to the controls. Ration cost was 62% of the control cost. Only one wet belly male occurred in this group.

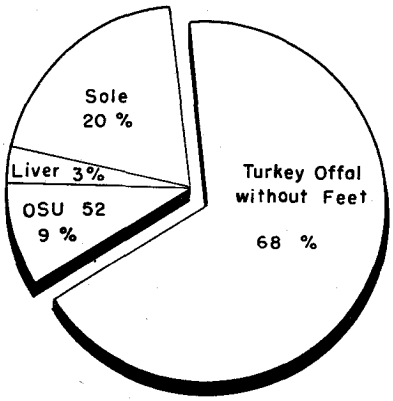
Turkey Offal

Test Group 8A

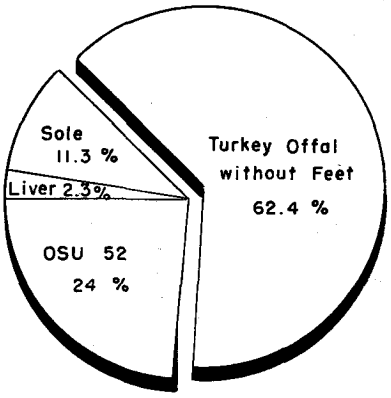
Objective: To evaluate a ration containing 68% turkey offal and a special, all-plant, low-protein cereal (OSU 52) fed at a 9% dietary level.

Methods: 25 standard dark mink (13 males and 12 females) were fed this ration from July 26 to pelting.

Ration Composition %
(As Fed)



Ration Composition %
(Dry Basis)



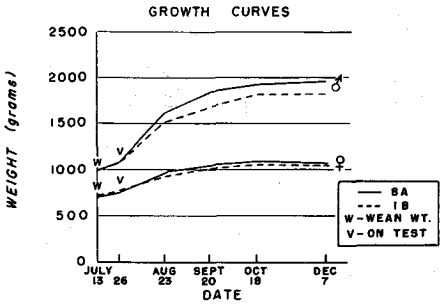
Proximate Analysis

	As Fed	*Dry Basis*
Dry Matter	32.3%	100.0%
Crude Protein	13.3	41.2
Crude Fat	8.6	26.5
Crude Fiber	0.5	1.6
Ash	2.0	6.1
Nitrogen Free Extract..	7.9	24.6

Cereal Mix OSU 52
(Composition as Fed)

	%
Ground Oat Groats	65.0
Alfalfa Meal	10.0
Wheat Germ Meal	10.0
Soybean Oil Meal	10.0
Brewer's Yeast	4.3
Fortafeed 2-4-9-c	0.4
Terramycin (TM-10)	0.25
Methionine	0.05

Results:



Production Data

	Males	*Females*
Final weight (gm.)	1967	1084
Weight gain (gm.)	900	342
Animal length (cm.)	45.3	37.9
Fur color*	400	400
Fur quality*	169	200
Weight of dried skin (gm.)	110	60
Length of dried skin (cm.)	70.6	57.8
Wet belly incidence (%)	69.2	8.3
Estimated pelt value ($)	9.89	5.49
Ration cost per mink (% of control)	92	

* Fur color and quality, taken from dried skins, is rated from 100 (best) to 400 (poorest).

Conclusions: Successful performance in 1960 on a diet containing 50% turkey offal without feet and 9% of a special cereal (OSU 52) suggested a confirmatory trial with the same cereal and a higher level (68%) of the turkey product. In test group 8A size of both males and females tended to be larger than on the control diet, and this type of growth has been characteristic of turkey offal diets in the past; however, improvement did not reach statistical significance. Again, paralleling higher dietary fat level and increased growth, wet belly incidence increased in the males. Fur quality was rated significantly poorer in the females. The dominant feature of this group was the appearance of underfur greying or banding (referred to as "turkey waste syndrome") which occurred consistently throughout the dark mink. This situation resulted in significant lowering of fur color ratings and consequent lowering of estimated pelt values. It should be emphasized that these observations apply to standard dark and not to mutation mink.

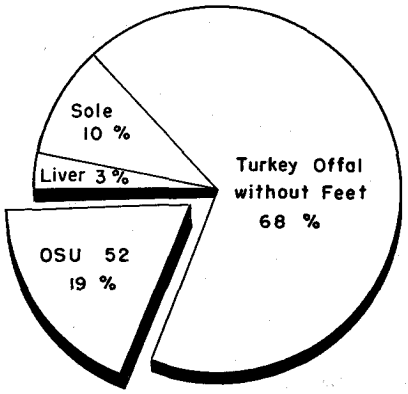
Turkey Offal

Test Group 8B

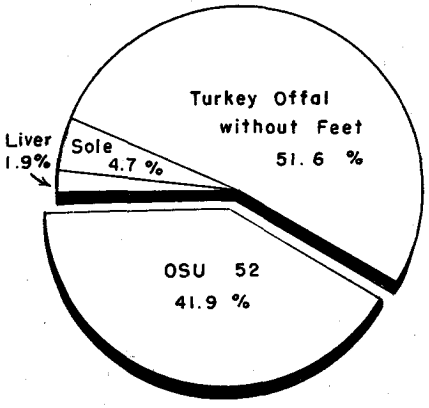
Objective: To evaluate an increased level (18%) of special cereal (see Group 8A) fed with a diet containing 68% turkey offal.

Methods: 25 standard dark mink (13 males and 12 females) were fed this ration from July 26 to pelting.

Ration Composition %
(As Fed)



Ration Composition %
(Dry Basis)



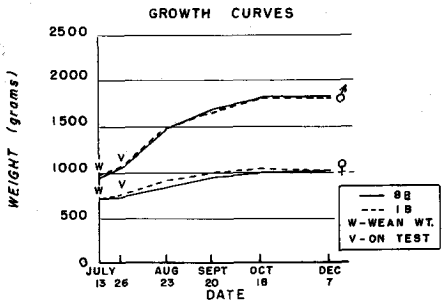
Proximate Analysis

	As Fed	*Dry Basis*
Dry Matter	38.1%	100.0%
Crude Protein	13.2%	34.5%
Crude Fat	10.5	27.7
Crude Fiber	0.8	2.2
Ash	2.2	5.8
Nitrogen Free Extract	11.4	29.8

Cereal Mix OSU 52
(Composition as Fed)

	%
Ground Oat Groats	65.0
Alfalfa Meal	10.0
Wheat Germ Meal	10.0
Soybean Oil Meal	10.0
Brewer's Yeast	4.3
Fortafeed 2-4-9-c	0.4
Terramycin (TM-10)	0.25
Methionine	0.05

Results:



Production Data

	Males	*Females*
Final weight (gm.)	1849	1030
Weight gain (gm.)	796	283
Animal length (cm.)	45.4	37.8
Fur color*	400	358
Fur quality*	162	183
Weight of dried skin (gm.)	109	60
Length of dried skin (cm.)	69.7	56.8
Wet belly incidence (%)	46.2	0
Estimated pelt value ($)	12.12	7.04
Ration cost per mink (% of control)	85	

* Fur color and quality, taken from dried skins, is rated from 100 (best) to 400 (poorest).

Conclusions: Test group 8B was designed to test a high turkey-offal diet with an elevated level of the special OSU 52 cereal. Performance was quite similar to that of group 8A containing the lower cereal level except that fur quality was somewhat improved, and wet belly incidence was reduced. These improvements resulted in increased pelt value estimates for both males and females; however, the values remained significantly lower than the controls by reason of the underfur color deficiency. Ration cost for group 8B was down to 85% of the controls, suggesting that when a satisfactory method of controlling the "turkey waste syndrome" is found, this diet may be an economically satisfactory one.

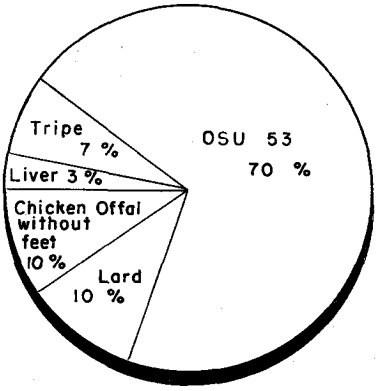
High Dry

Test Group 9A

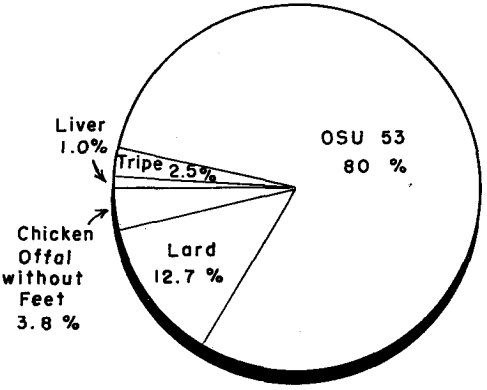
Objective: To test a ration composed of 80% dry ingredients (meals, etc.) and formulated to approximate the nutritional specifications of the control ration.

Methods: 25 standard dark mink (13 males and 12 females) were fed this ration from July 26 to pelting.

Ration Composition %
(As Fed)



Ration Composition %
(Dry Basis)



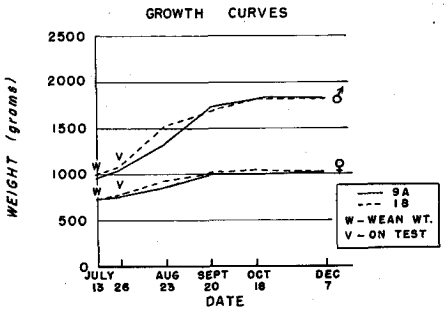
Proximate Analysis

	As Fed	*Dry Basis*
Dry Matter	41.2%	100.0%
Crude Protein	17.2	41.8
Crude Fat	8.7	21.1
Crude Fiber	0.8	1.9
Ash	3.9	9.4
Nitrogen Free Extract	10.6	25.8

Cereal Mix OSU 53
(Composition as Fed)

	%
Wheat Germ	5
Alfalfa Meal	2
Skim Milk Powder	5
Soybean Oil Meal	10
Ground Oat Groats	20
Herring Meal	40
Meat Meal	15
Brewer's Yeast	1
Beet Pulp	2
Guar Gum	0.7
Fortafeed 2-4-9-c	0.09
Terramycin (TM-10)	0.05
Methionine	0.01

Results:



Production Data

	Males	*Females*
Final weight (gm.)	1808	1024
Weight gain (gm.)	719	260
Animal length (cm.)	45.3	38.0
Fur color*	192	200
Fur quality*	192	170
Weight of dried skin (gm.)	109	58
Length of dried skin (cm.)	68.6	56.4
Wet belly incidence (%)	83.3	10.0
Estimated pelt value ($)	17.98	11.55
Ration cost per mink (% of control)	77	

* Fur color and quality, taken from dried skins, is rated from 100 (best) to 400 (poorest).

Conclusions: Experience with high cereal grain diets in 1961 and with high dry-matter diets in 1960 has suggested advantages to be gained in terms of ration economy by use of such materials. Group 9A therefore tests the use of a diet containing 80% dry materials and adjusted to 20% fat (dry basis) by addition of lard. Ration cost per animal was considerably reduced to 77% of the standard control. Animal performance was reasonably good. In weight, both males and females closely resembled the controls, and in length the males in this group were significantly improved over the control group. Wet belly incidence was very high in the males and this may have some significance in relation to the added fat content of the diet. It should be noted, however, that total ration fat content was lower than in ration 8A, while wet belly incidence was higher. Largely as a result of the wet bellies, estimated pelt values were depressed in the males.

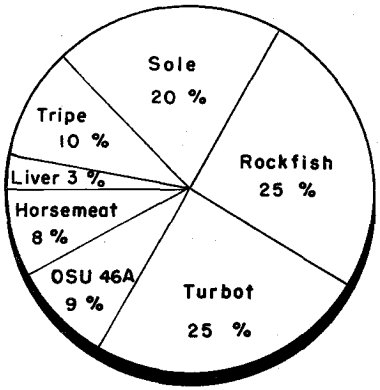
High Dry

Test Group 9B

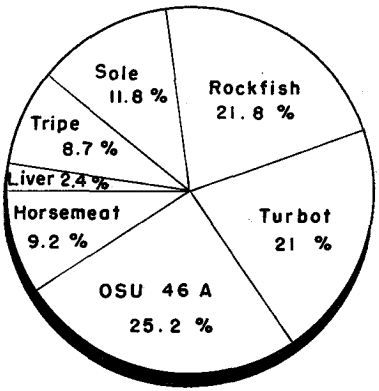
Objective: To test performance on a completely dehydrated ration. This experiment involved the standard control diet (see Group 1A) dried by an azeotropic process and rehydrated just prior to feeding.

Methods: 25 standard dark mink (12 males and 13 females) were fed this ration from July 26 to pelting.

Ration Composition %
(As Fed)



Ration Composition %
(Dry Basis)



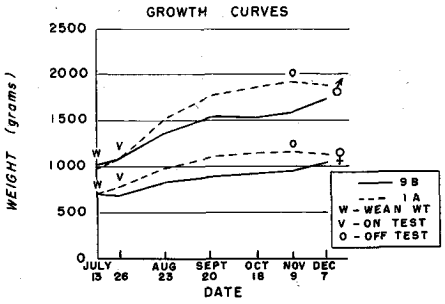
Proximate Analysis

	As Fed	*Dry Basis*
Dry Matter	45.5%	100.0%
Crude Protein	21.9	48.2
Crude Fat	8.9	19.4
Crude Fiber	1.0	2.3
Ash	5.3	11.6
Nitrogen Free Extract	8.4	18.5

Cereal Mix OSU 46A
(Composition as Fed)

	%
Wheat Germ	25.0
Alfalfa Meal	12.5
Skim Milk Powder	8.3
Meat Meal	16.6
Soybean Oil Meal	16.6
Ground Oat Groats	16.6
Brewer's Yeast	4.2
Fortafeed 2-4-9-c	0.4
Terramycin (TM-10)	0.25
Methionine	0.05

Results:



Production Data

	Males	*Females*
Final weight (gm.)	1739	1052
Weight gain (gm.)	647	337
Animal length (cm.)	45.1	38.4
Fur color*	309	210
Fur quality*	200	200
Weight of dried skin (gm.)	107	58
Length of dried skin (cm.)	68.8	55.7
Wet belly incidence (%)	63.6	10.0
Estimated pelt value ($)	13.82	10.81
Ration cost—	Not available	

* Fur color and quality, taken from dried skins, is rated from 100 (best) to 400 (poorest).

Conclusions: One method of approaching dry ration investigation is to take a standard, adequate mink diet and dry it to a powder—rehydrating before feeding. Through the courtesy of the VioBin Corporation the original standard diet (as fed group 1A) was dried and its fat content extracted. The two portions were mixed together in original proportions and water and small amounts of beet pulp and gum guar added as binders before feeding. Although female performance was fairly satisfactory growth-wise, male gains were significantly less than the control. Fur color and quality was significantly poorer in the males, less so in the females. Wet belly incidence was high in the males. Five "cotton" animals appeared in this group, and on pelting many carcasses showed evidence of yellow fat. The latter observation indicates that in addition to dehydration, a second variable, fat rancidity, was imposed upon these mink making it impossible to assess the effects of feeding a completely dry ration.

Research With Fur Abnormalities

Cotton-Fur Abnormality

It has been a common observation, both commercially and at the Oregon Agricultural Experiment Station Experimental Fur Farm, that cotton mink can occur on rations other than those containing known causative fishes such as hake and whiting. In 1960, no cotton mink were produced when mink were fed rations imposing various types of nutritional stress, such as restricted energy, low vitamin fortification, or rancid fat. The most noticeable effect of these stress-type rations was interference with normal growth. In 1958, however, four cotton mink were produced on a ration containing 25% tuna scrap, rancid to the point of causing death loss by yellow fat disease. Resulting cotton mink showed typical characteristics (achromotrichia of the underfur, failure of normal growth and anemia) of cotton mink produced on hake rations.

A similar experience occurred this year. Ration 9B, originally designed to test mink performance on a completely dehydrated feed, provided an unintended rancid feed resulting in production of five cotton mink in addition to yellow fat disease in most animals. Blood values of these cottons showed presence of varying degrees of anemia, which was corrected by an injection of iron dextran. This suggests the possibility of an iron deficiency precipitated as a result of poor fat quality. In another case, hemoglobin level of a cotton mink which occurred on a normal control ration (1C) was raised from 9.8 to 17.1 grams percent by injection of 1 cc. of iron dextran containing 50 mg. of iron. This mink was from a family previously recognized as susceptible to cotton fur. This evidence, while not conclusive, supports the view that cotton mink may arise from several seemingly unrelated causes which actually may act as a common point to produce similar results.

Hake and whiting-containing rations have been shown to induce iron deficiency in mink consuming them, thus causing cotton fur. This abnormal condition can be prevented by iron injection or by heat treatment of the responsible fish; iron salts fed are not effective in prevention. The inference from these observations is that hake contains a factor, destroyed by heating, which makes dietary iron physiologically unavailable.

To obtain information on the manner in which this inhibitory factor acts to make iron unavailable, trials were established to analyze excretory patterns of iron in mink fed either normal or raw-hake-containing rations. Values from a preliminary trial involving six mink (three each on a normal and cotton-causing ration) indicate that cotton animals are excreting about 50% more urinary iron and 20% less fecal iron than normal mink. One interpretation of these limited data might be that intestinal absorption of iron is not the inhibitory mechanism, but rather there is some interference with retention or utilization of iron.

A second trial involving excretory iron patterns of 8 animals over a 3-day period substantiated results of the first trial. Data indicate that urinary iron excretion is greater in hake-fed mink than in normal mink. On an average these mink are excreting 62% more iron via the kidneys than are normal mink. Concentration of iron in the urine is likewise greater (overall 78% more iron per unit of urine). These

data show that there is a difference in the kidneys' ability to excrete iron in these two groups of mink. If iron is bound to a hake protein the combination product may be more filterable than the normal plasma iron compound, transferrin. Further, plasma iron levels may be higher in hake-fed mink resulting in a greater differential and more iron excretion. These points require further study.

The daily fecal iron excretion is 47% less for mink fed the cotton-causing rations. About half of this amount results from the smaller volume of fecal material excreted (23% less weight for the hake-fed mink); however, the remainder of the deficiency results from a lowered fecal-iron concentration. There could be several explanations for a decreased iron concentration in the feces of this group. One possibility is that more of the iron in the feed is being absorbed by the animals. This is inconsistent with the thinking that the primary difficulty in this anomalous condition is an interference with iron absorption. However, it is conceivable that the site of interference occurs after iron is taken into the circulatory system. This explanation is supported to some degree by the observed increase in iron excretion from the kidneys of cotton mink.

A more plausible explanation which has certain supporting data is that the higher concentration of iron in the feces of normal animals is a result of a more efficient utilization of the ingested food and lessened excretory volume. Average food consumption for hake-fed mink was 170 grams; for normal mink 369 grams. The fecal matter excreted represents 50% of the ingested food for the former group and 30% for the latter group, demonstrating a more efficient digestion for normal mink. This increased efficiency would serve to concentrate fecal iron for normal as compared to cotton mink. In order to precisely establish this point, extremely accurate records of iron ingestion are necessary which is not an easy task with mink. Studies are currently being conducted to elucidate the points in question, including more precise investigation of iron absorption, and determination of plasma and liver iron levels. Knowing these values will help greatly in determining where the interference lies.

Red-Hip

To determine which factors are responsible for the red-hip fur abnormality in mink, a nucleus herd of 19 (6 males and 13 females) pastel breeder mink were obtained prior to the 1961 breeding season. These animals represented two strains of normal pastels and a third strain in which the animals were either actively showing red-hip or had previously produced red-hip kits.

From matings made with intent to maintain and concentrate blood lines of these strains, 40 kits were produced. No kits resulted from matings of two red-hip females to a red-hip male; however, 4 carrier females had 23 kits sired by a red-hip male. If this characteristic is genetically influenced these kits can be considered as carriers of red-hip susceptibility. Four normal females produced 17 kits by normal males. All kits were placed on a similar ration (control ration 1B) July 26 and remained on this feed until they were pelted in early December. There was no evidence of the red-hip abnormality occurring in either red-hip carrier or normal animals at any time during the experimental period.

Earlier experiments here showed importance of genetic factors in the condition and this view is strengthened by the widely observed higher susceptibility of pastel mink as compared with other mink types. Nevertheless the view has been expressed that environmental influence—ration composition and management, for example—is of even greater importance. Analysis of data obtained previously indicates that red-hip mink are not so likely to occur on rations providing physiological stress sufficient to depress growth, whereas adequate rations are more conducive to red-hip formation.

Turkey Waste

The "turkey waste syndrome" was first observed at the Oregon State Experimental Fur Farm in 1959 in dark mink fed rations containing 70% of turkey offal. A very high percentage of these mink exhibited a greying of the underfur, which was distinct from cotton fur in that pigment depletion was not so severe and quite often restricted to a peripheral band. Associated physiological abnormalities such as reduced body size and anemia were not detected. 1960 trials verified the production of abnormal fur coloration on rations high in turkey offal and specifically implicated the feet as causative, since rations containing 50% of turkey waste without feet produced normally colored mink whereas those containing 50% of turkey with feet and shanks produced 88% abnormally pigmented mink.

Since removal of the causative factor was coincident with removal of a portion of the product (the feet and shanks), it was speculated that causation was a matter of dietary interference or imbalance and not one of deficiency. Quite often interfering agents are inactivated by heating (for example, iron-interfering (CF) factor present in Pacific hake and thiaminase of certain fishes which destroys vitamin B_1). In testing the possibility of a heat-labile factor, 10 dark mink were fed a ration containing 70% of turkey with feet which had previously been heated to 200 degrees F. Interestingly, not one of these animals developed an abnormal fur color as opposed to a control group fed 70% of the same product, uncooked, which resulted in all abnormally colored mink. This experiment supports the view of the presence of an agent in turkey waste which acts to interfere very specifically with pigment production. It also demonstrates that cooking offers a practical solution to the problem for the mink farmer who desires to feed turkey waste at these high levels.

Evidence in 1960 trials that turkey feet were primarily responsible for the condition has not been substantiated by data obtained this year, as 47 mink fed rations containing 70% of turkey waste without feet showed greying of underfur. It would now appear that the factor is present throughout the turkey product but probably more concentrated in the feet and shank portion.

The effect of feeding mink high percentages of other types of poultry offal on fur coloration was not known; therefore, a group of 10 experimental mink was fed a ration containing 70% of chicken offal including heads, viscera, and feet. At the end of the experimental feeding period all mink in this group were normally pigmented, suggesting that turkey alone is responsible for the decreased pigment production. Continuation of this work will involve determination of the nature of the interference, i.e. nutrients which are involved, etc., and determination of levels which can be fed safely.