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COMPARISON OF THE MICHIGAN 2B AND MC NENNY 13-4 DIETS FOR FINGERLING BROOK TROUT

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Introduction

The dry, pelleted diets, which are now used in most trout hatcheries, are not completely satisfactory. The problem is to formulate a diet of dry ingredients which will contain all of the essential food elements present in fresh meat. In 1956, Dr. E. F. Grassl developed a "dry" diet which he designated as the Michigan 2B formula. Since then, studies made by various agencies in the United States have greatly increased the knowledge about diet requirements of trout, and new products have been developed.

One of the newer diets that has given encouraging results with rainbow trout was developed by the U. S. Bureau of Sport Fisheries and Wildlife; it is known as the McNenny formula. This formula has been changed in recent years. The McNenny 13-3 preparation was followed, in 1964, by the McNenny 13-4 which included a greater quantity of certain vitamins as the major change. (The ingredients of the McNenny 13-4 and the Michigan 2B diets are given at the end of this report.) The McNenny

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13-4 was replaced with a 13-5 formula in 1965, after the present test was completed.

In July 1964, Mr. Max A. Hunt, Regional Fisheries Supervisor for Region II, suggested that a comparison of Michigan 2B and McNenny 13-4 diets be made on fingerling brook trout at the Grayling and Oden hatcheries. The principal objective of this study was to compare the vitality of fish on the two diets, as reflected by microhematocrit and hemoglobin values. Rates of food conversion and mortality also were considered.

Methods

At Grayling, on July 30, 1964, one group of fingerling brook trout was divided into four lots of 12,100 fish each and these lots were placed in four raceways of identical size and individual water supply. Two lots were fed a diet of Michigan 2B pellets and two lots received a diet of McNenny 13-4 pellets. With the exception of August, when the pellet diet of all lots was supplemented with meat, the fish received only the dry diets. At the end of each month a random sample from each lot was weighed. Microhematocrits were taken of 10 fish from each lot at the end of September, October, November, and December; hemoglobin was recorded for 10 fish from each lot at the end of November and December. This test was terminated at the end of December because ice conditions on the raceways made it very difficult to obtain a random sample of fish.

At Oden, the procedure was the same as employed at Grayling, except that each lot contained 8,000 fish and no meat was fed in August. Also, since ice did not interfere, the study extended through January 1965.

In both tests, specimens for blood samples were collected at random from a large number of fish held in a seine in the raceway. Because the red blood cells may increase under lowered oxygen content of the water, we took the precaution of holding test fish in small containers for less than 5 minutes. Blood was collected in heparinized capillary tubes from the caudal artery of unanesthetized fish after excision of the peduncle in the region of the adipose fin. The sampling technique is mentioned so that blood values obtained in later studies may be compared with those reported in this test. Anesthetization of fish with MS-222 increases microhematocrit values about 20%. Hemaglobin was expressed as grams per 100 ml when read on a Spencer Hb-meter.

Fish culturists at both hatcheries fed the fish and helped to collect specimens for each monthly examination.

Results

A comparison of the microhematocrit values (Table 1) failed to demonstrate any appreciable difference between the two diets. The mean values at Oden showed a difference of 0.6 in favor of the Michigan formula; at Grayling, the difference was 1.8 in favor of the McNenny

13-4 formula. However, both diets at Oden gave higher readings than at Grayling.

The only indication that the McNenny 13-4 could produce stronger brook trout was the higher hemoglobin readings. At both hatcheries the McNenny pellets had a 1.7 higher average reading than the Michigan pellets.

Conversion values were rather good for both diets. At Oden, food conversion was slightly better among the fish fed Michigan 2B pellets, but the highest mortality at either station was sustained by these two lots of fish at Oden which were fed the 2B. Mortality among all other lots of fish in the test was less than 1%.

Discussion

The blood picture of hatchery trout may be slightly different at various hatcheries, so normal values must be established at each hatchery before comparisons can be made. In a test made in 1964 at Grayling, hematocrit values for 40 unanesthetized brook trout averaged 29.2, and this might be taken as the normal value for Grayling. In the present study at Grayling, hematocrits of fish fed Michigan 2B averaged 30.1 and those of fish fed McNenny 13-4 averaged 32.9 Although the McNenny 13-4 was slightly higher, both averages fall within the range (28-35) which is considered to be normal for brook trout at this station. At Oden, hematocrits were about the same for fish on both diets, but were higher (35.0) than those at

Grayling. Normal hematocrit values are not known for trout at Oden, but Snieszko (1960) has reported a normal range of 32-40 for brook trout.

Mean hemoglobin values for the fish at Oden and Grayling were quite similar for both respective diets, but values were higher among the fish fed McNenny 13-4 pellets. For McNenny fish the values were in the higher part of the normal range (Snieszko, 1960). For fish on the Michigan 2B diet, the values were below normal. Probably the fish on McNenny 13-4 were stronger fish, but this would have to be investigated by stamina tests. Fish culturists at Oden reported that McNenny fish fed more avidly and appeared to be more vigorous than the Michigan 2B fish.

Food conversion and mortality rates (Table 1) among fish fed the two diets were remarkably close at Grayling. At Oden, however, conversion among the fish fed Michigan 2B pellets was slightly better than among those fed McNenny 13-4. Also at Oden, the mortality rate for the fish fed Michigan 2B pellets was considerably higher than that of any other lot at either station. Among the trout in Lot 1, where the mortality was 14%, the greatest loss occurred from gill trouble shortly after the test began. The loss between July 13, 1964 and August 31, 1964, was 11.4%; the loss from August 31, 1964 to February 2, 1965, was only 2.2%. Mortality in Lot 2 was 1.3% for the first period mentioned above, and 2.2% for the second period.

Summary

No significant differences in hematocrit, mortality or conversion were apparent between fingerling brook trout fed McNenny 13-4 pellets and those fed Michigan 2B pellets at Oden and Grayling hatcheries during a 5-month period. Hemaglobin values were low among fish fed Michigan 2B pellets. This suggests a greater vitality among the fish fed McNenny 13-4 pellets, but further tests would be necessary to substantiate this observation.

Literature cited

Snieszko, S. F., 1960. Microhematocrit as a tool in fishery research and management. U. S. Fish and Wildl. Serv., Spec. Sci. Rep., Fish. 341, 15 p.

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Table 1.--Comparison of data obtained by feeding Michigan 2B and McNenny 13-4 diets to fingerling brook trout at Oden and Grayling hatcheries

Date	Lot	Diet	Pounds of food	Weight gain (pounds)	Food conversion	Hematocrit*	Hb**	Percentage mortality
				ODEN				
7-13-64	1	2B	2,075	1,049	2.0	38.8	7.4	14.0
to	2	2B	2,029	1,236	1.6	32.4	6.2	3.5
2-2-65			Average		1.8	35.6	6.8	8.8
	3	13-4	2,075	947	2.2	34.6	8.7	0.41
	4	13-4	2,029	946	2.1	35.4	8.3	0.32
			Average		2.2	35.0	8.5	0.37
				GRAYLING				
7-30-64	1	2B	2,115	958	2.2	30.9	6.4	0.73
to	2	2B	2,115	929	2.3	29.3	7.0	0.71
1-5-65			Average		2.2	30.1	6.7	0.72
	3	13-4	2,115	970	2.2	32.5	8.0	0.86
	4	13-4	2,115	882	2.4	33.3	8.8	0.87
			Average		2.3	32.9	8.4	0.86

* Average value from 10 fish in each lot.

** Expressed as grams of hemoglobin per 100 ml of blood.

MICHIGAN 2B FORMULA

Formula		Pounds
A. Wheat gray shorts (wheat flour middlings)		500
Protein	15.00% minimum	
Ash	3.00% "	
Fat	3.00% "	
(NFE) Carbohydrate	60.00% "	
Crude fiber	6.50% maximum	
B. Dried skim milk (spray process only)		100
Protein	34.00% minimum	
Fat	1.00% maximum	
Carbohydrates	50.00%	
Ash	8.00%	
Moisture	7.00%	
C. Brewers dried yeast		80
Protein	40.00% minimum	
Fat	1.20% maximum	
Fiber	2.50% "	
Carbohydrates	35.00% minimum	
D. Dried torula yeast (feed grade) (Lakes States Yeast Corp., Rhinelander, Wisconsin)		60
Protein	40.00% minimum, moisture free basis	
E. Iodized salt		40
Iodine	0.007% minimum	
F. Red fish meal and/or white fish meal, finely ground		720
Protein	55.00% minimum	
Fat	7.00% "	
Fiber	2.00% maximum	
Moisture	10.00% "	
G. Condensed fish solubles		30
Solids	50.00% minimum	
Protein	31.00% "	
H. Fortified dried corn fermentation solubles		30
Fiber	10.00%	
Protein	26.00%	
Fat	7.00%	
Riboflavin	45.40 mg/lb	
Calcium pantothenate	100.00 mg/lb	
Niacin	100.00 mg/lb	
Choline chloride	2500.00 mg/lb	
Vitamin B-12	0.15 mg/lb	
I. Cottonseed meal, prime quality, solvent extracted		460
Protein	41.00% minimum	
	Total	2,020 lbs*

* 20 lbs per ton lost in processing.

MC NENNY 13-4 FORMULA

A. Fish food mixture shall be composed of the following items in the proportionate quantities per hundred pounds:

1.	White fish meal, vacuum dried, maximum fat 5% minimum protein 58%, immediate past season	28
2.	Pulverized oat hulls	12
3.	Shrimp meal, Gulf Coast, immediate past season. Composed of finely ground meal made from the complete shrimp except for the tail which is taken off for canning	10
4.	Dried skim milk, spray process	10
5.	Steam dried Brewer's yeast	9
6.	Dried condensed fish solubles (Dynasol 80M or equal)	5
7.	Defatted soy flour	5
8.	Corn fermentation solubles	5
9.	Dehydrated alfalfa meal, 17% protein	4
10.	A. & D. feeding oil, feed grade (no guarantee of "A" or "D" potency necessary)	4
11.	Blood flour	2
12.	Dried kelp meal	2
13.	Vitamin Premix #4	4

VITAMIN PREMIX #4 Ingredients	Guaranteed potency per pound of Premix (milligrams)
D-calcium panthotenate	600.0
Pyridoxine	150.0
Riboflavin	600.0
Choline	40,000.0
Niacin	6,250.0
Folic acid	100.0
Thiamine	75.0
Inositol	6,250.0
p-Aminobenzoic acid	250.0
Biotin	5.0
Vitamin B_{12}	0.25
Menadione sodium bisulfite	125.0
Ascorbic acid	3,000.0
D-Alpha tocopherol acetate	2,000.0
Vitamin D_3 activity	16,000.0 ICU
Vitamin A activity (from vitamin A palmitate in gelatin beadlets)	75,000.0 USP units
Ethoxyquin	2,300.0
Ferrous carbonate	225.0
Copper sulphate	22.0

MYVAMIX (Distillers Products Industries) or Type F-50 shall be used. No substitutes will be allowed.