THE EFFECT OF COBALT CHLORIDE ON THE PRODUCTION OF CHANNEL CATFISH FINGERLINGS

by

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INTRODUCTION

Channel catfish (Ictalurus punctatus) have been raised commercially on a large scale basis since the early 1950's. At that time, commercial fish growers were harvesting on an average, 266 kg/ha/year of catfish when the fish recieved supplemental feed (Swingle 1954). In 1976, farmers were harvesting 2,240 - 2,800 kg/ha/year of channel catfish (Anon. 1977). Today, a reasonable expectation is a harvest rate of 5190 kg/ha/year (Waldrop and Smith 1980).

Early commercial channel catfish feeds were composed of soybean oil cake, peanut cake, fish meal, meat and bone meal, brewers' byproducts and grains and grain byproducts. It was not known at that time however, which nutrients in these ingredients were essential and which were not (Stickney 1977). Nutritional studies on channel catfish were initiated in the early 1960's to make those determinations. Today, considerably more is known about the fish's dietary requirements, but there still exists many areas where additional nutritional information is required.

Little is known about the requirements of fish for trace minerals. It has been assumed however, that the various elements required by higher animals are also required for fish and they have been routinely included as trace-mineral supplements in diet formulations for fish (Halver 1976).

The purpose of this study was to determine whether the addition of cobalt to channel catfish fingerling production ponds is of benefit in improving growth and survival and if there is an indication for dietary additions of cobalt in the rations of channel catfish fingerlings.

In order to achieve the above objectives, a two phase study was undertaken. The first phase of the study was a pond fertilization experiment having an experimental design similar to that reported by a Russian investigator (Sukhoverkhov 1966) in that identical treatment levels of cobalt (in the form of $CoCl_2$) and similar aged fish were used. The primary intended difference between the experimental procedure employed here and that employed by Sukhoverkhov is the species of fish. Channel catfish were used in this experiment while common carp (Cyprinius carpio) were used in the earlier experiment.

The second phase of the sudy was a feeding trial utilizing diets composed of purified ingredients and designed after the National Research Council's (NAS/NRC 1977) vitamin test diet for catfish. Vitamin B_{12} level in the one test diet designed to contain a significant amount of the vitamin conforms with the level recommended by the National Research Council (1977) for "complete" diets of warmwater fishes. Cobalt levels in the diets containing the mineral were chosen taking account of the recommendations of several researchers (Sukhoverkhov 1966, Ghosh 1975, Havelka 1970 and Shabalina 1964) for various species and the National Research Council's recommendation for cobalt content of purified diets for warmwater fishes.

LITERATURE REVIEW

LITERATURE REVIEW

A review of the literature reveals that the mineral requirements of fishes have been studied to a limited extent.

Dove (1972) and Pappas (1972) fed channel catfish fingerlings rations having three different ratio levels per experiment of calcium/phosphorous and found that fish fed the highest Ca/P ratios (1.5 : 0.9 and 2.8 : 1.8 percent respectively) showed greatest retention of the two minerals as well as magnesium and other ash. In addition, those fish fed the highest Ca/P ratio levels grew more than fish fed lower levels over the same time period. Pappas (1972) also found that the use of dicalcium phosphate resulted in better growth than when just plant and animal sources of calcium were used.

Using rainbow trout (Salmo gairdneri), Ketola (1975a) found that supplements of either dicalcium phosphate or an ash prepared from fish protein concentrate added to a basal diet containing 32 percent protein solely in the form of conventional soybean meal caused significantly improved growth, feed conversion, and mineralization of bone in young of the year fish.

Murakami (1967) reported that the dietary addition of .5 percent calcium monohydrogen phosphate prevented or effectively healed cranial deformity and other associated disorders of the skeleton in young hatchery-reared common carp recieving a formulated commercial diet or other dry feeds.

According to Lovell (1977a), channel catfish can absorb significant quantities of calcium from the water if adequate dietary phosphorous is provided and the calcium content of their environment is at least 5 ppm. In aquarium studies with a level of 35 ppm $CaCO_3$ in the water, channel catfish benefitted only slightly from dietary calcium (Lovell 1977a). Both common carp and rainbow trout appear to be able to absorb the calcium that they require from environmental water containing at least 16 - 20 ppm calcium (Ogino and Kanizono 1975). Japanese eels (Anguilla japonica) however seem to be unable to absorb sufficient calcium and therefore require dietary calcium (Lovell 1977a) with the level required appearing to be 2.7 g Ca/kg dry diet (Nose and Arai 1976).

Ketola (1975b) reported that inorganic phosphorous supplementation of up to 0.6 percent of the diet increased growth rate and bone ash content of young Atlantic salmon (Salmo salar) fed diets containing mainly dehulled soybean meal and other plant materials.

Researchers at Auburn University (Lovell 1976), using an all plant basic diet containing 0.22 percent non-phytin phosphorous, found that fish fed the basic diet supplemented with at least 0.3 percent phosphorous from dicalcium phosphate gained 12 percent more weight in a 6 month feeding period than those fish recieving no such supplement. It also was found that there is no improvement in growth when higher levels of phosphorous are added to the diet. The conclusion was drawn that levels beyond 0.52 percent available phosphorous in the diet of channel catfish are not necessary.

Excepting calcium and phosphorous requirements, relatively few investigations relating to the mineral requirements of fishes in general (Halver 1976, Dove 1972) and of channel catfish in particular (Stickney 1977) have been carried out.

One of the first recorded mineral deficiency symptoms in fishes was described more than 60 years ago when two species, rainbow trout and brook trout (Salvelinus fontinalis) were reared on diets deficient in iodine (Gaylord and Marsh 1914). The fish developed a proliferation of thyroid tissue and a typical goitre. Intermediate stage thyroid proliferations could be reduced by adding adequate levels of iodine to the fish's diet.

Shaw, et al. (1975) found no relationship between the dietary level of sodium chloride and the growth or feed conversion efficiency in Atlantic salmon smolts in either fresh or sea water. Similarly, feed intake and feeding efficiency was not demonstratably affected by varying the level of dietary sodium chloride in feeds for rainbow trout (Macleod 1978).

No increase in growth, weight, feed conversion ratio or difference in carcass moisture level was observed in channel catfish fed diets containing up to 2.00 percent sodium chloride over those fish fed the basal diet containing 0.06 percent sodium chloride (Murray and Andrews 1979).

The addition of up to 57.3 mg percent of iron to prepared diets fed to yellowtail (Seriola quinqueradiata) gave beneficial results including increased weight gain and elevation of the blood serum iron level (Ikeda, et al. 1973).

A diet deficient in iron fed to Japanese eels and red seabream (Pagrus major) resulted in hypochronic microcytic anemia in both species. The requirement of iron in the diet of eel was postulated to be 170 mg/kg dry diet (Nose and Arai 1976).

Daily addition of supplemental ferrous sulfate to the diets of swordtail (Xiphophus helleri) and platyfish (Xiphophus maculatus) resulted in both increased weight gain and hematocrit levels of both species. Mortality from hatching to maturity also was significantly decreased by additions of ferrous iron. Ferric salt was not, however, judged to be effective as a dietary addition (Roeder and Roeder 1966).

Common carp were fed diets with and without supplemental iron additions for 105 days (Sakamoto and Yone 1978). Within that time period, no significant differences in growth rate, condition factor or feed efficiency were observed between the two groups of fish. However, the specific gravity, hemoglobin content and hematocrit value of the blood were lower in those fish fed the diet without iron supplement.

Common carp fingerlings fed purified diets lacking zinc exhibited deficiency symptoms of poor appetite, growth rate and increased mortality rate. The dietary requirement of common carp fingerlings for zinc appeared to be 15 - 30 ppm (Ogino and Yang 1979).

In a 10-day feeding trial (Chiou and Ogino 1976), fed common carp a magnesium-free diet, causing depression of appetite, sluggish movement, convulsions, spasmodic swimming and high mortality. The minimum requirement of common carp for dietary magnesium was estimated to be 0.4 - 0.5 g/kg; maximum growth was attained at 0.6 - 0.7 g/kg.

Japanese eels showed no specific signs of magnesium deficiency except poor appetite and slower growth and the red seabream was found not to require dietary magnesium (Nose and Arai 1976).

Dietary magnesium levels were found to affect appetite, growth, movement and contents of ash magnesium and calcium of the whole body and vertabrate of rainbow trout fingerlings fed purified diets for 6 weeks (Ogino, et al. 1978). In addition, histological changes were recognized in the muscle, pyloric ceaca and gill filament structure of those fish fed the magnesium deficient diet.

Red seabream were fed diets with or without supplements of aluminum, zinc, manganese, copper, cobalt and iodine for a 90 day period (Sakamoto and Yone 1978). No significant differences were observed in the following variables between the two groups: growth rate, feed efficiency, condition factor hematocrit value, hemoglobin content and red blood cell count. No pathological change was found in the organs of the group of fish fed a diet without the combined mineral supplement.

Sukhoverkhov (1966) reported that the addition of 3.0 g cobalt chloride ($CoCl_2$) per ton of feed resulted in an increase in growth rate of 30 percent in fingerling common carp. He also found that the application of $CoCl_2$ as a fertilizer to earthen ponds increased the production of common carp from 0.24 ton/ha to 0.45 ton/ha.

Other investigators have also reported beneficial uses of cobalt in diets of fishes. Ghosh (1975) reported that mullet (Mugil parsia) fry responded to the addition of $CoCl_2$ to their diet with improved growth and survival with the optimal cobalt dosages ranging from 0.6 - 1.0 ppm. Shabalina (1964) reported that dietary addition of $CoCl_2$ twice a week at a rate of 50 mg/kg live weight of fish resulted in an increased growth rate among rainbow trout fingerlings and that twice a week addition of 3.0 mg $CoCl_2$/kg live weight of fish resulted in increased growth rate among yearlings of the species. Havelka (1970) recommended that 1.0 mg $CoCl_2$/kg live weight of fish be added to the diet of fry and two year old common carp. Such additions resulted in increased resistance of the carp against infections. Frolova (1961) reported that addition of 0.08 mg cobalt/kg of fish to the diet of common carp increased the erythrocyte and hemoglobin content of the blood. Farberov (1965) reported that addition of $CoCl_2$ to their diet increased the growth rate, productivity, food consumption and level of vitamin B_{12} in common carp. Tominatik and Batyr (1967) reported that dietary supplements of cobalt decreased the mortality of common carp fingerlings and increased the erythrocyte and the hemoglobin content of the fish's blood.

PHASE 1

(POND FERTILIZATION EXPERIMENT)

METHODS and MATERIALS

The first phase of this study began on July 18, 1979 when 7,000 channel catfish fry[1] having an average weight of 0.045 g were stocked into each of 0.07 ha earthen ponds. The above rate of stocking was used because it appears to be near the average number of channel catfish fry commonly stocked by commercial fish growers (Grizzel, et al. 1969, Brown, et al. 1969, Tiemeier and Devoe 1973, and Lee 1973). The ponds had been filled with water and fertilized at the rate of 45 kg/ha of 20 - 20 - 5 fertilizer (Table 1) following the recommendation of Swingle (1965) one week prior to stocking.

Table 1. Composition of bulk fertilizer (20 - 20 - 5) used in pond cobalt fertilization experiment.

Ingredient	Composition	Weight (kg)
Ammonium nitrate	33% N	19.4
Ammonium phosphate	11% N, 48% P	17.3
Muriate of potash	50% K	8.3
Total		45.0

Three weeks after the fry were stocked, $CoCl_2$ was added to the water at the rate of 5.0 kg/ha into each of two ponds and 10.0 kg/ha into one pond. Two ponds served as control ponds and recieved no $CoCl_2$ (Table 2). The $CoCl_2$ was dissolved in distilled water prior to application to the ponds. The ponds again were fertilized at a rate of 45 kg/ha of 20 - 20 - 5 fertilizer one day after application of the $CoCl_2$. No further treatment excepting main-

1. Supplied by Kansas Fish and Game Commission.

tenance of water level was then applied to the ponds or fish during this study.

The ponds were drained on October 19, 1979 and all of the fish were collected. Approximately 150 fish randomly chosen from each pond were weighed and measured for total length. The number of surviving fish per pond was estimated by dividing the total weight of fish recovered from each pond by the mean weight of the fish from the particular appropriate pond. The resulting data was analyzed by means of simple linear regression.

Table 2. Cobalt chloride ($CoCl_2$) treatment level of ponds in pond fertilization experiment.

Pond	Pond Number	Treatment Level kg $CoCl_2$/ha
TCFL # 27	1	0.0
TCFL # 11	2	0.0
TCFL # 9	3	5.0
TCFL # 7	4	5.0
TCFL # 3	5	10.0

RESULTS and DISCUSSION

The data collected from this experiment (Table 3) was analyzed in order to determine if significant differences existed between growth and survival of fish subjected to different treatment levels of $CoCl_2$. The analyses were computed using simple linear regression of mean length, mean weight, average condition (K_{TL}) and survival of the fish against treatment levels. A simple linear regression of mean length against survival of the fish was also computed.

A graph of the data utilizing the percentage of surviving fish per cm group is illustrated in Figure 1. A total length range of 3 cm was found between fish in all ponds with 7 cm being the minimum size fish recovered and 10 cm being the maximum size. No significant difference ($P < 0.05$) in mean length between treatment levels was found (Figure 2). The range in mean length of fish between treatments was 0.9 cm.

Mean weight of the fish at the end of the experiment ranged from 4.96 to 7.04 g (a total mean weight range of 2.08 g). No significant difference (P 0.05) was found to exist in mean weight of fish between treatment levels (Figure 3).

The average survival of fry in all five of the experimental ponds was 23.0 % with a range of 5.6 %. The survival of the channel catfish fry was not found to be significantly ($P < 0.05$) related to the treatment level of $CoCl_2$ (Figure 4).

Average condition of the fish at the end of the experiment was estimated by computing a condition factor (K_{TL}) relating the mean weight (g) of fish in a pond to the mean total length (cm) of those fish (Table 3). It was determined that the $CoCl_2$ treatments had no significant ($P < 0.05$)

influence on the average condition of the fish (Figure 5). Furthermore, a visual inspection of the fish at the time of harvest revealed no apparent differences between treatments in number of morphologically atypical fish.

A significant ($P < 0.05$) inverse relationship between growth of the fish (where growth is represented by mean length at the end of the experiment) and survival did exist however (Figure 6).

It was therefore concluded that the treatment of ponds with $CoCl_2$ at the levels used in this experiment, has no discernible effect on the survival or growth of channel catfish fry cultured in earthen ponds.

Table 3. Fertilization of ponds with $CoCl_2$ experiment data.

Pond Number	$\bar{X}$ weight	$\bar{X}$ length	Survival	K_{TL}
1	7.04 g	8.4 cm	20.9 %	1.18
2	5.04 "	7.8 "	25.4 "	1.06
3	4.96 "	7.7 "	28.4 "	1.09
4	6.65 "	8.5 "	19.8 "	1.08
5	6.74 "	8.6 "	20.3 "	1.06

$K_{TL} = (100 \times \bar{X}\text{ weight})/(\bar{X}\text{ length})^3$ (modified from Hile 1936)

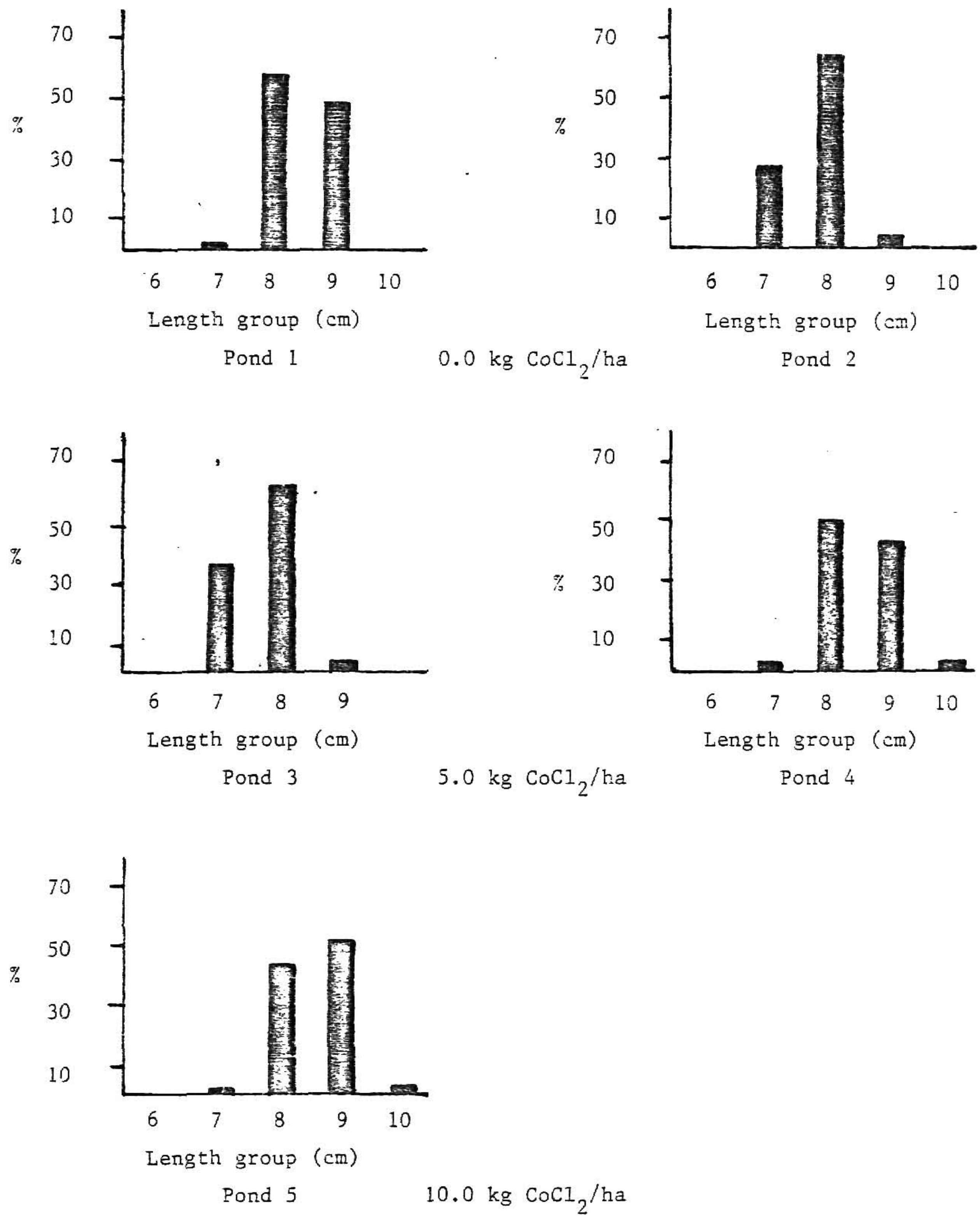


Figure 1. Percentage of channel catfish fingerlings per length group X (X.0 - X.9 cm) harvested from pond fertilization experiment.

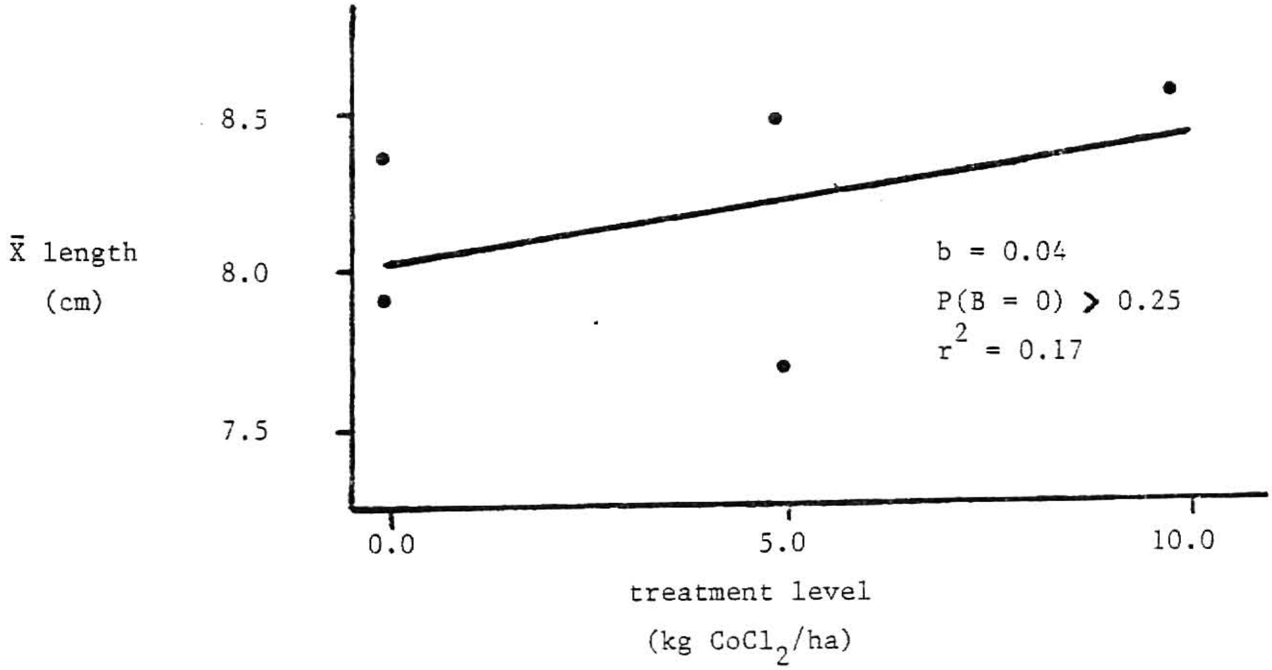


Figure 2. $CoCl_2$ treatment level of ponds vs. mean length of harvested fish.

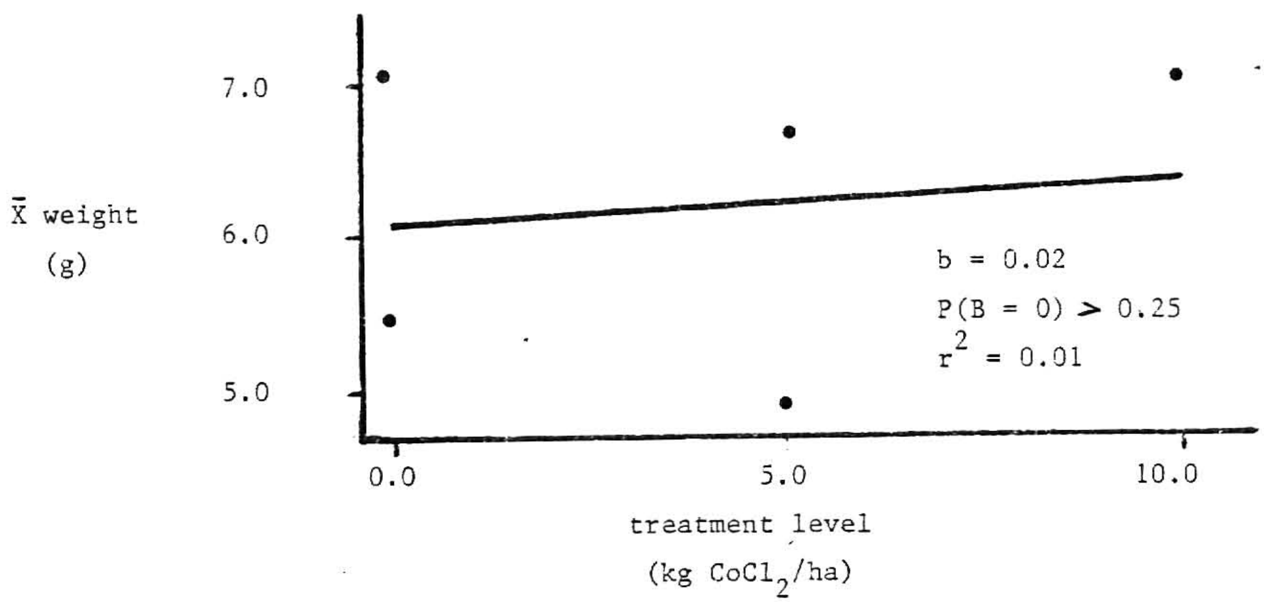


Figure 3. $CoCl_2$ treatment level of ponds vs. mean weight of harvested fish.

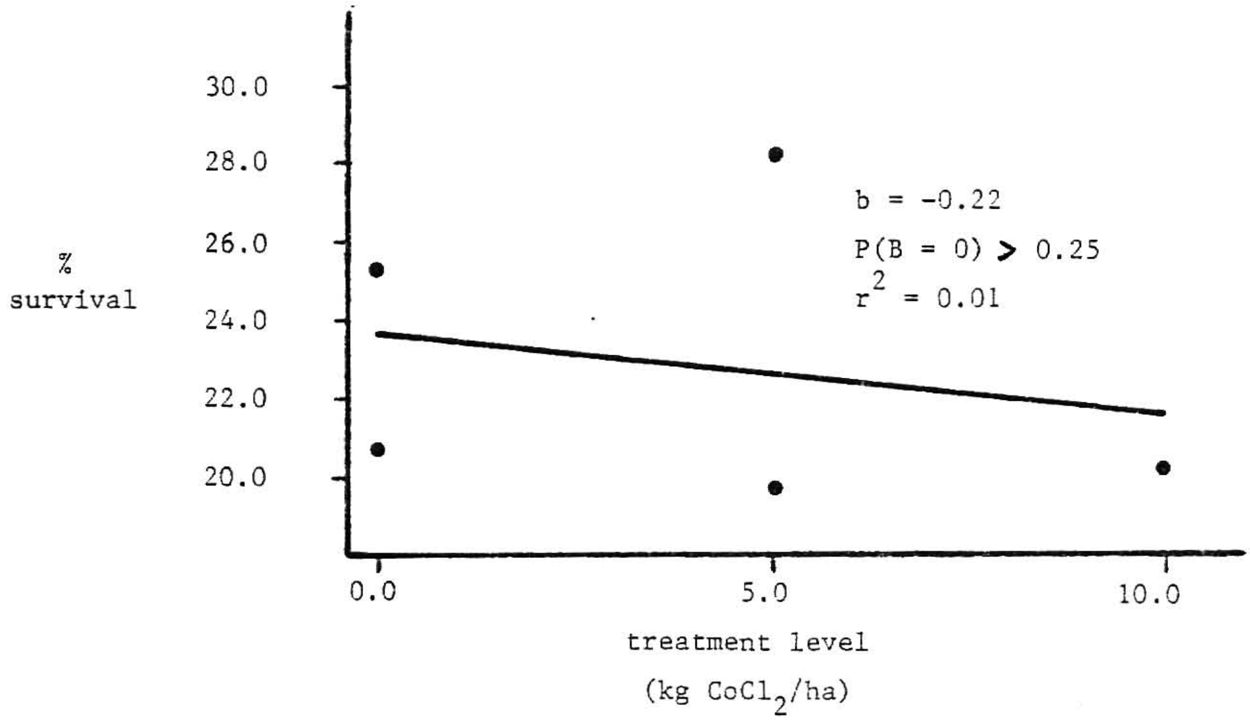


Figure 4. $CoCl_2$ treatment level of ponds vs. channel catfish fry survival

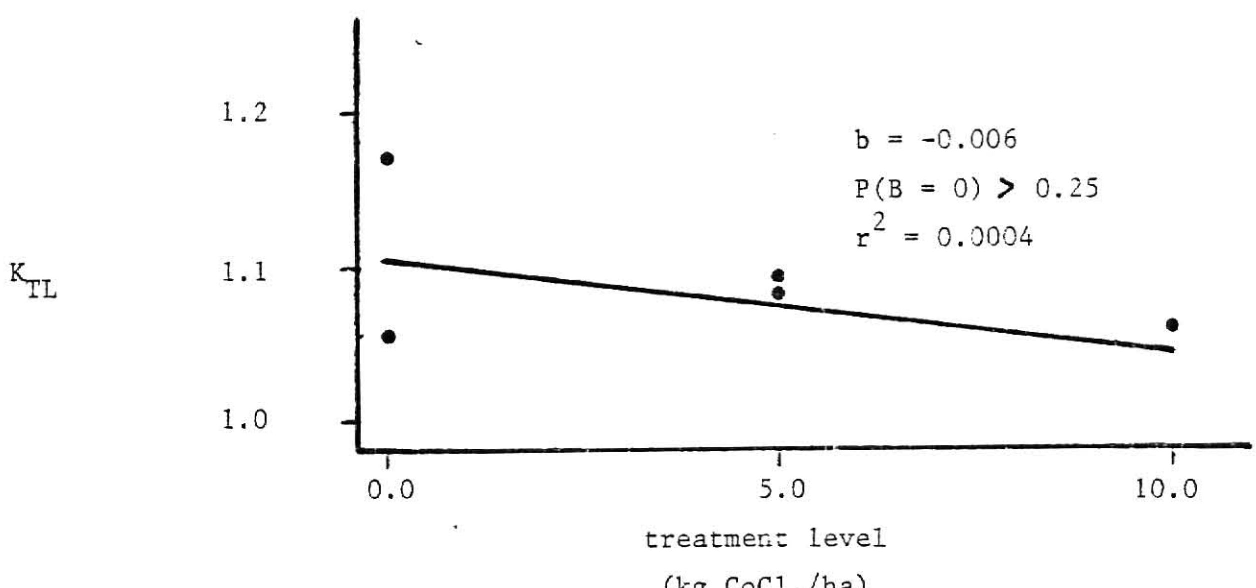
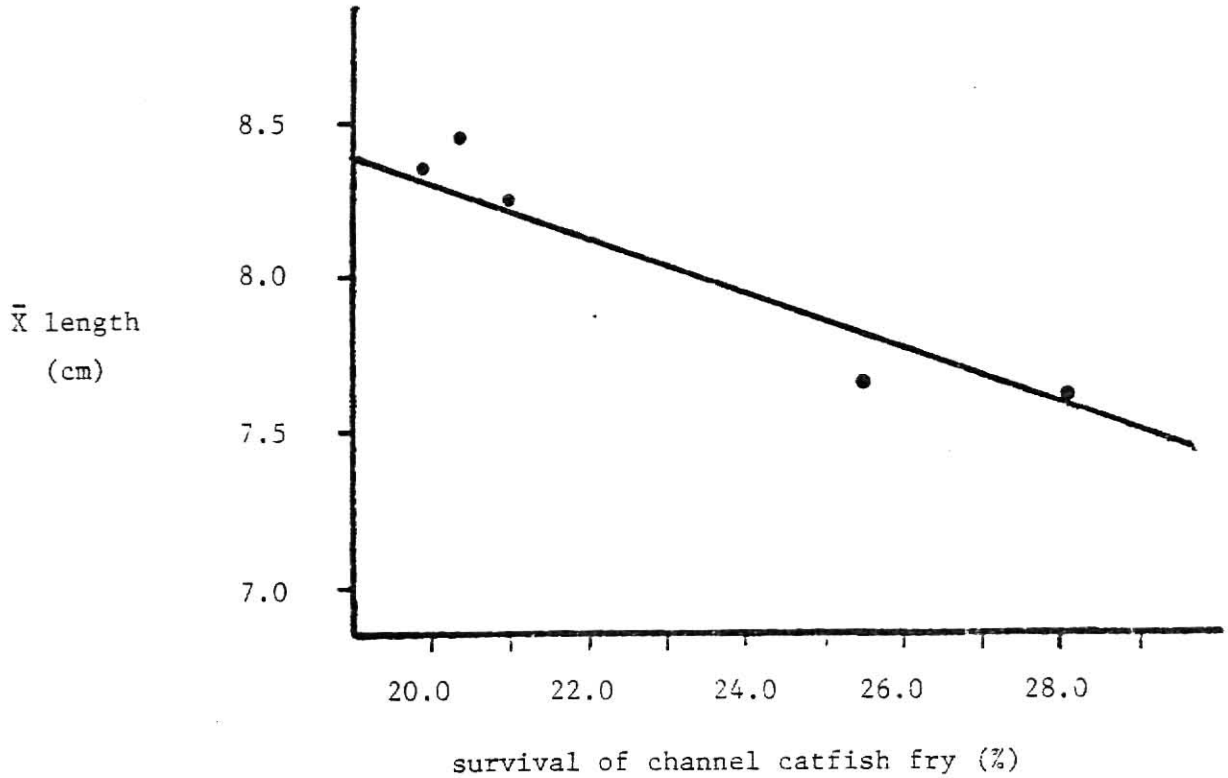


Figure 5. $CoCl_2$ treatment level of ponds vs. average condition (K_{TL}) of harvested fish.



survival (%)	20.9	25.4	28.4	19.8	20.3
mean length (cm)	8.4	7.8	7.7	8.5	8.6

Analysis of Variance:

H_0: B = 0 H_A: B ≠ 0

Source of variation	Sum of Squares	DF	Mean Square
Total	0.70	4	
Linear regression	0.67	1	0.67
Residual	0.03	3	0.01

$F = 67.0$

$F_{0.05(1)1,3} = 10.1$ therefore, H_0 is rejected

$P(B = 0) < 0.005$

Figure 6. Relationship between survival of fish in pond fertilization experiment and growth (as mean length at end of the experiment) of the fish.

PHASE 2

(PURIFIED DIET EXPERIMENT)

METHODS and MATERIALS

The second phase of this study was conducted over a 22 week period beginning on February 4, 1980 and ending on July 11, 1980.

Four rectangular fiberglass tanks, each holding 500 liters, were used for this research. Each tank was equipped with water supply, a standpipe drain and a thermostatically controlled heater element which maintained a water temperature of 25 C. The water (supplied to each tank at a rate of approximately 1.5 l/minute) was from the city of Manhattan's domestic water supply. The water was passed through an activated charcoal filter in order to remove residual chlorine prior to introduction to the experimental tanks. Each tank was aerated by a single air-stone using compressed air from a common source for all five tanks.

The channel catfish fingerlings used were obtained from the control ponds (ponds 1 and 2) at the conclusion of the previous phase of this research. The fish were held in a semi-starved condition for 108 days until the start of this phase of the experiment. The fish were treated 1 week prior to introduction into the experimental tanks with a combination of 0.1 mg/l malachite green and 25 mg/l formalin (Leteux and Meyer 1972, Schachte 1974) to eliminate possible enzootic protozoan parasites.

The experimental diets were prepared by adding differing levels of $CoCl_2$ and vitamin B_{12} (Table 4) to the basal diet presented in Table 5. Diet 1 consisted of the basal diet with no added vitamin B_{12} or $CoCl_2$; diet 2 had 0.3 mg $CoCl_2$/kg feed added; diet 3 had 3.0 mg $CoCl_2$/kg feed added; and diet 4 consisted of the basal diet with 20 ug B_{12}/kg feed added. The diet ingredients were blended, mixed with sufficient water to effectively pellet and extruded into 3.5 mm diameter by 10 mm length pellets. The pelleted feed was cooled for approximately one hour, bagged and then stored at -15 C until fed.

The fish in each treatment were fed once daily, 7 days per week at a daily rate varying from 5 percent at the beginning of the experiment and decreasing to 3 percent at the end of the experiment following the recommendations of Lovell (1977b) for feeding catfish fingerlings. The calculations for the feeding rates were based on the percent of live weight of all fish in the tank. The rations were adjusted as necessary in order to maintain this rate of feeding.

Table 4. $CoCl_2$ and vitamin B_{12} level of the test diets.

Diet	$CoCl_2$	Vitamin B_{12}
1	0.0 mg/kg	1.2 ug/kg
2	0.3 "	1.2 "
3	3.0 "	1.2 "
4	0.0 "	21.2 "

Table 5. Composition of the basal diet.

Ingredient	Percentage
Vitamin-free casein[1]	41
Dextrin	9
Soybean oil	9
Cellulose	33
Carboxymethyl cellulose	3
Vitamin B_{12}-free vitamin mix[2]	4
Co-free mineral mix[2]	1

1. Assayed by producer (United States Biochemical Corporation Cleveland, Ohio) to contain 3 ug B_{12}/kg.

2. Table 6

Table 6. Vitamin and mineral mixes used in purified diet feeding trial.

6.1 Vitamin B_{12}-free vitamin mix

Vitamin	Amount per kg dry basal diet	
Vitamin A activity	5,500	IU
Vitamin D_3 activity	1,000	IU
Vitamin E	50	IU
Vitamin K	10	mg
Choline	550	mg
Niacin	550	mg
Riboflavin	20	mg
Pyridoxine	20	mg
Thiamine	20	mg
D-Calcium pantothenate	50	mg
Biotin	0.1	mg
Ascorbic acid	100	mg
Inositol	100	mg

These amounts are the recommended allowances (NAS/NRC 1977) for vitamins in complete diets for warmwater fishes with the exception that 20 ug of vitamin B_{12} per kg dry diet is also recommended.

6.2 Cobalt free mineral mix (Rogers and Harper 1965)

Mineral	percent
Ammonium Molybdate $4H_2O$	0.003
Calcium Carbonate	29.290
Calcium Phosphate $2H_2O$	0.0430
Cupric Sulfate	0.156
Ferric Citrate $6H_2O$	0.623
Magnesium Sulfate $7H_2O$	9.980
Manganese Sulfate H_2O	0.121
Potassium Iodide	0.0005
Potassium Phosphate	34.310
Sodium Chloride	25.060
Sodium Selenite $5H_2O$	0.002
Zinc Chloride	0.020

Each group of fish were weighed in aggregate at 7 weeks and again at 18 weeks. During the 22'nd week, all fish of one treatment group (diet 4) died overnight. This mortality was believed to have been caused by a temporary failure of the air supply to that particular tank.

All of the dead fish from the diet four treatment were then weighed individually within 24 hours of the time of death. All of the fish in the remaining three treatments were individually weighed approximately 12 hours later ie. approximately 36 hours after their last feeding. Feeding of the fish then ceased and the experiment was terminated at that time.

RESULTS and DISCUSSION

Results of the experiment are presented in Table 7. Single factor analysis of variance (Table 8) was employed to test for differences of weight of the fish between the four treatments.

Table 7. Purified diet feeding trial data.

	$\bar{X}$ weight (g)				weight range (g)	s (g)
Diet	Day 0	Day 49	Day 126	Day 158	Day 158	Day 158
1	3.6	18.1	42.8	60.7	13 - 109	22.9
2	4.4	18.2	41.0	59.3	27 - 78	15.0
3	4.4	21.8	45.8	63.2	26 - 127	26.5
4	3.9	17.8	40.2	57.9	23 - 118	25.9

s = standard deviation of sample weights.

Table 8. Analysis of variance of weights of channel catfish fingerlings in purified diet feeding trial at the termination of the experiment.

ANOVA

Source	SS	DF	MS
Total	51,566.75	99	
Groups	231.43	3	77.143
Error	51,335.32	96	534.743

$$F = MS_{Groups}/MS_{Error} = 0.1443$$

$$F < 1.0$$

Conclusion: No significant difference exists between treatments.

The mean net weight gain over all four treatment groups was 56.2 g (an average gain of 0.36 g/fish/day). No differences were found for food utilization between the treatments. There were however, obvious differences in growth rate within the treatments as indicated by the wide range of final weights for all four groups of fish. Until the loss of the entire diet 4 group of fish, survival among all four groups of fish had been 100 %.

No significant difference ($F < 1.0$) in growth was found between the fish fed the B_{12} deficient diets and those fed the B_{12} complete diet. Since the fish died during the 22'nd week of the experiment, insufficient time may have elapsed to observe significant differences. Dupree (1966) reported that channel catfish fingerlings fed vitamin B_{12} deficient diets do not show deficiency symptoms for the first 21 weeks of feeding. Further, the only apparent symptoms noted in the above study (Dupree 1966) after 36 weeks were slightly reduced feeding and reduced growth of the fish fed B_{12} deficient diets.

The major, and possibly, only role of cobalt in the physiology of animals is as a constituent of vitamin B_{12} (Maynard and Loosli 1969). Therefore, one would not expect a significant difference between growth of those fish fed cobalt containing diets and those fed diets devoid of cobalt before a deficiency of vitamin B_{12} is observed. No such difference was observed among the fish in this experiment.

It is concluded that channel catfish fry and small fingerlings may be fed diets devoid of vitamin B_{12} and cobalt chloride with no adverse effects on growth and survival. Since channel catfish normally spawn during June over most of the culture range (Kansas, Arkansas and Mississippi), approximately 120 to 150 days of growing season remain during the year of hatching. For this length of time, experimental test results show that diets may be spared B_{12} and cobalt without adversely affecting growth of fish.

It would be best to include vitamin B_{12} into the diets of larger fingerlings being cultured for food fish or where the culture period exceeds 158 days and approaches the time interval that Dupree (1966) found to elapse before a decline in the growth rate of channel catfish fingerlings fed diets devoid of vitamin B_{12} until further studies regarding the requirements of the fish for the vitamin are carried out.

Probably the most necessary study regarding this requirement is one designed to show whether inorganic cobalt in the diet has a sparing effect on the vitamin B_{12} requirement of channel catfish.

SUMMARY of CONCLUSIONS

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1. Cobalt chloride ($CoCl_2$) was ineffective as a pond fertilizer for improving production of channel catfish fingerlings in this study at rates reported to be effective for improving production of common carp.

2. Dietary deficiencies of vitamin B_{12} have no apparent effect on the growth of channel catfish fingerlings in tanks fed purified diets for at least the first five months of deficiency.

3. Channel catfish fry and small fingerlings may be fed diets devoid of vitamin B_{12} and cobalt chloride for the period of approximately one growing season with no adverse effects on growth and survival.

4. Further testing of additions of cobalt chloride to the diets of channel catfish fingerlings is needed.

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THE EFFECT OF COBALT CHLORIDE ON THE PRODUCTION OF CHANNEL CATFISH FINGERLINGS

by

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ABSTRACT

This study evaluated cobalt chloride ($CoCl_2$) as a pond fertilizer compound and dietary supplement for production of channel catfish (Ictalurus punctatus) fingerlings.

The first phase of the study consisted of a pond fertilization experiment conducted at the Tuttle Creek Fisheries Research Laboratory, Kansas State University, Manhattan, Kansas. Three 0.07 ha earthen ponds were stocked with 7,000 channel catfish fry per pond and were fertilized with $CoCl_2$ at those rates (5.0 kg/ha in two ponds and 10.0 kg/ha in one pond) reported to be effective for increasing production of common carp (Cyprinius carpio) in the Soviet Union. Two 0.07 ha earthen ponds served a control ponds and were stocked with 7,000 channel catfish fry per pond also, but were not treated with $CoCl_2$. Following a 3 month growing period, the fish were collected, counted, weighed and measured for total length. $CoCl_2$ was found to be ineffective as a pond fertilizer compound for increasing either growth or survival of the fish.

The second phase of the study was a purified diet feeding trial experiment. Four purified diets were prepared and fed to groups of approximately 25 channel catfish fingerlings in 500 liter aquaria during a 22 week period. The five diets consisted of an identical basal diet supplemented with varying levels of $CoCl_2$ and vitamin B_{12} (0.0 mg $CoCl_2$/kg and 0.0 mg vitamin B_{12}/kg added to diet 1; 0.3 mg $CoCl_2$/kg and 0.0 mg vitamin B_{12}/kg added to diet 2; 3.0 mg $CoCl_2$/kg and 0.0 mg vitamin B_{12} added to diet 3; and 0.0 mg $CoCl_2$/kg and 20.0 mg vitamin B_{12} added to diet 4). No difference in growth rate was found between the four groups of fish. It was concluded that neither inorganic cobalt nor vitamin B_{12} deficiency had any apparent affect on the

growth of channel catfish fingerlings under the conditions of this experiment.

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