CHAPTER 10

Fish in the Raising of Mink

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I. In the Ranch Diet

A. In the Natural Diet

A major part of the fat, protein, and mineral content of the world's commercial mink ranch diet is provided by fish and fish products. As a rough estimate it can be stated that ranch mink consume over one-third of a billion pounds of fish and fish scrap annually.

Examination of the visceral tracts of wild mink is one means of obtaining an indication of the dietary tastes of the mink. Studies of this type have shown that fish and crayfish comprise approximately one-third of the natural diet of the mink (Hamilton, 1936; Høie, 1954). Mammals (mice, muskrats, rabbits, and moles), birds, insects, and reptiles complete the diet of the mink in the wild.

B. In the Commercial Ranch Diet

Geographic and economic factors determine the composition of the mink's diet on the commercial mink ranch. Such ranches located near abundant sources of fish will use diets containing a high proportion of fish and fish scrap. Inland mink ranch diets generally contain a small proportion of fish products and a high percentage of beef, pork, and poultry by-products. For example, the mink rancher located on the

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Pacific coast of North America may feed a diet containing 10% cereal mix, 5% liver, 15% meat products, and 70% fish and fish scrap. On the other hand, the mink rancher located in the midwestern United States will usually use a diet made up of 20% cereal mix, 10% liver, 20% tripe (beef rumen), 25% fish, and 25% horsemeat, rabbits, and poultry by-products. A similar relationship between the composition of the mink ranch diet and geographic area has been noted in Norway (Rimeslatten, 1958). The species of fish present in the commercial mink ranch diet, as well as the percentage of fish in that diet, is determined by geographic factors. The utilization of fresh-water fish in the mink's diet is primarily limited to ranches of inland North America. Salt-water fish are used extensively on mink ranches in Japan, the Scandinavian countries, and the Atlantic and Pacific coastal areas of the United States and Canada.

1. *Fresh-Water Fish*

In order of their relative importance to the mink industry, the most common species of fresh-water fish used on North American mink ranches are: fresh-water smelt (*Osmerus mordax*), Lake Superior herring (*Leucichthys artedi*), sheepshead (*Aplodinotus grunniens*), carp (*Cyprinus carpio*), Lake Michigan chub (*Leucichthys artedi*), blue pike (*Stizostedion vitreum glaucum*), yellow perch (*Perca flavescens*), burbot (*Lota lota maculosa*), black bullhead (*Ameiurus melas*), sucker (*Catostomus commersonnii*), and alewife (*Pomolobus pseudoharengus*). The majority of these fish species are cooked prior to feeding to the mink. Cooking of these fish is necessary for the destruction of the thiamine- (vitamin B_1) destroying enzyme present in these fish. Lake Superior herring, sheepshead, Lake Michigan chub, blue pike, and yellow perch are nonthiaminase fish and therefore are not generally cooked before feeding to the mink.

2. *Salt-Water Fish*

More than half of the mink feed used by the world's mink industry originates from the sea. In Japan the fish most widely used for mink feed are the flatfish (Pleuronectidae) (Inukai, 1958). The greater part of the fish and fish scrap used for mink feeding in Scandinavia comes from the cod family (Gadidae) (Rimeslatten, 1958). Fish used in Scandinavian mink ranch diets include: cod (*Gadus callarias*), haddock (*Gadus aeglefinus*), whiting (*Gadus merlangus*), coalfish (*Gadus virens*), herring (*Clupea harengus*), mackerel (*Scomber scombrus*), stone biter (*Anarrhichas lupus*), lumpfish (*Cyclopterus lumpus*), and flounder (*Pleuronectes platessa*). The herring must be cooked before feeding to the mink because of the presence of the thiaminase enzyme. The fish

scrap consists of the whole fish with the fillet and liver removed. The primary fish fed to the mink in the Atlantic coastal region of North America is the Atlantic whiting (*Merluccius bilinearis*). Small quantities of cod (*Gadus morrhua*), haddock (*Melanogrammus aeglefinus*) and rosefish (*Sebastes marinus*) are also fed to the mink. Mink ranchers on the Pacific coast of North America use many varieties of fish in their ranch diets. Fish used in this area include: turbot (*Atheresthes stomias*), red rockfish (*Sebastodes ruberrimus*), black rockfish (*Sebastodes melanops*), petrale sole (*Eopsetta jordani*), English sole (*Parophrys vetula*), slime sole or Dover sole (*Microstomus pacificus*), rex sole (*Glyptocephalus zachirus*), sand sole (*Psettichthys melanostictus*), sand dab (*Citharichthys sordidus*), rosefish (*Sebastodes alutus*), and Pacific hake (*Merluccius productus*). Studies have been conducted at the Fur Animal Nutrition Laboratory at Oregon State College on the nutritional value of a number of these salt-water fish. Superior fur production has been noted in dark mink placed on diets containing high percentages of red rockfish or black rockfish. Turbot is an excellent fish for growth of the mink kits but is not satisfactory for fur production (Adair and Davis, 1957).

3. *Fish Meal*

At the present time only small quantities of fish meal are used in commercial mink ranch diets. Studies at the Royal Agricultural College, Vollebekk, Norway, have shown that it is possible to obtain good growth, fur production, and reproduction with mink on diets containing as much as 8% of a quality fish meal (Rimeslatten, 1958). Recent studies conducted in the United States indicate that excellent growth and fur production may be obtained with mink on ranch diets containing 6–7% of a quality fish meal (Leoschke, 1958b). In these experiments the fish meal contributed approximately one-fourth of the protein consumed by the mink. Digestibility studies with mink showed that the protein digestibility of the fish meal used in the experimental feeding trials was equal to that of Atlantic whiting (87.3%). These studies point toward an increased use of fish meal in the practical mink ranch diets of the future.

II. Nutritional Problems in Feeding Fish

A. Chastek Paralysis and the Thiaminase Enzyme

A number of distinct nutritional problems have been found to be related to the feeding of fish to mink. The first important nutritional disease of fur-bearing animals related to the feeding of fish was noted on the fox ranch of J. S. Chastek of Glencoe, Minnesota, in 1932 (Green

and Evans, 1940). Fox placed on a diet containing 18% frozen carp developed a paralysis within a few weeks and died. Research on the disease showed that it was of nutritional origin. The paralysis was the direct result of a thiamine (vitamin B_1) deficiency brought on by feeding fish containing a thiaminase (thiamine-destroying) enzyme. This was encountered in the carp. It not only destroyed thiamine in the fish body but also a significant portion of this vitamin present in other components of the ranch diet. A thorough study has been made on the distribution of the thiaminase enzyme in fish (Deutsch and Hasler, 1943). The enzyme seems to be confined primarily to certain types of freshwater fish. However, the taxonomic correlation as to presence or absence of this destructive factor within certain families of fish is not constant. Ocean herring is the only salt-water fish known to contain the thiaminase enzyme. The risks involved may, however, easily be removed either by the cooking of the fish or by following a planned feeding schedule. The majority of ranchers cook the fish at 180–200°F. for 15 min., which is required to destroy the thiaminase enzyme. Ranchers are able to use raw thiaminase fish if they limit the feeding of these fish to 2 or 3 days a week. Mink placed on this feeding program are able to obtain adequate thiamine from the diet on the days in which the diet does not contain thiaminase fish.

B. Yellow Fat Disease

An important mink disease of nutritional origin related, in part, to the feeding of fish is known as steatitis or the yellow fat disease. The disease affects only young mink and usually appears after weaning when the kits are consuming large quantities of food. Steatitis appears suddenly without warning. Mink kits may go off feed on one day and be dead on the following morning. Affected kits move with a peculiar, unsteady gait. At postmortem, the subcutaneous fat has a characteristic yellow-brown discoloration. There is a direct correlation between the incidence of yellow fat disease and the presence of rancid fish or horsemeat in the diet. Research studies have indicated that a low dietary level of vitamin E and a high dietary level of unsaturated fatty acids are prerequisites for the development of yellow fat disease in the kits (Gorham *et al.*, 1951; Lalor *et al.*, 1951). Horse fat and fish fat are potent sources of the unsaturated fatty acids. Yellow fat disease can be prevented by supplementing the diet with ample amounts of vitamin E (10–20 mg. of α-tocopherol per mink per day). Kits fed alewife, ocean herring, mackerel, and Lake Michigan chubs are particularly prone to the development of yellow fat disease (Belcher *et al.*, 1958; Rimeslatten, 1958). Mink fed large quantities of fish liver may also develop the disease.

C. Cotton Mink

In recent years a new nutritional disease has appeared to plague the mink industry. The disease is responsible for the development of cotton mink pelts. Cotton pelts are characterized by a depigmented (white), curly underfur. Preliminary studies indicate that cotton mink have low hemoglobin levels (Adair and Davis, 1957). In the United States the incidence of cotton mink has been correlated with the presence of large quantities of Atlantic whiting in the diet (Adair, 1956). In Norway the disease has been noted when the feed contains a high percentage of coalfish (Rimeslatten, 1958). Mink fed large quantities of fish liver may also develop cotton pelts. The exact nutritional factors responsible for the production of cotton mink are unknown. When cooked Atlantic whiting or coalfish is used cotton pelts do not develop. In a recent experiment, cotton mink were noted in a group of mink fed a diet containing 20% Pacific hake. However, cotton pelts were not produced in another group receiving a similar diet but containing eviscerated Pacific hake (Adair and Davis, 1957). It is possible that a heat-labile factor, bacterial or chemical, present in the intestinal tract of the Pacific hake was responsible for the production of the cotton pelts. Excellent quality pelts have been produced with mink on diets containing moderate levels (20–30%) of Atlantic whiting. Until the exact origin of this disease is known, it is recommended that the level of Atlantic whiting be limited to a maximum of 30% of the diet.

D. Fish and Fat in the Diet

The level of fat in the mink's diet is of critical importance in the economic production of quality pelts, this being the principal factor controlling the feed consumption. If the level of fat is too low, the amount of feed consumed is high and the growth of the kits retarded. On the other hand, if the level of fat is too high, the feed consumption of the mink may be restricted to the point of reducing the size and quality of the pelt. Experimental studies have shown that the optimum level of fat in the diet of the growing mink is 25% on a dehydrated basis (Leoschke, 1958a). The primary problem relative to mink ranch diets containing high levels of fish is generally one of the fat level being too low rather than too high. The problem of low-fat mink diets is especially common on mink ranches using large quantities of cod, haddock, Atlantic whiting, Pacific hake, fresh-water smelt, and sucker. Satisfactory fat levels may be maintained in these diets by the addition of tallow or lard to the diet. High-fat diets may be found on ranches using a high proportion of Lake Michigan chubs or turbot in the diet.

III. Handling Fish

A number of factors must be considered in the handling and processing of fish for distribution to and within the mink industry.

A. Sanitation

Rigid sanitary procedures are necessary in the processing of fish for mink feeding. A quality fish product can only be produced by careful handling and immediate freezing of the fish. Low palatability of the fish for the mink is the most common problem associated with unsanitary processing procedures. A correlation may exist between the improper preparation of fish for mink feeding and the disease known as cotton mink.

B. Rancid Fish

The development of rancidity in stored fish is one of the major difficulties of the present mink industry. Conditions easily become acute by the fact that the kits are particularly susceptible to yellow fat disease. This usually develops on ranches feeding fish or horsemeat that has been in storage for many months. However, the disease has been known to occur on mink ranches feeding fish stored for less than two months. Rancidity may be minimized by proper and rapid fish processing and by storage of the fish at low temperatures. Quality fish products should not be stored for more than three months prior to feeding. Although considerable thought has been given to the use of antioxidants in the processing of fish earmarked for mink feeding, no exact studies have been made on the problem at the present date. Yellow fat disease and fish products of low palatability for the mink are the direct consequences of suboptimal conditions for fish processing and in storage procedures.

C. Processing of Fish Meal

Fish meal has not been used extensively within the mink industry. However, quality fish meal products are beginning to gain the attention of the mink rancher. The problem of heat damage of fish proteins during the processing of fish meal must be given primary consideration. Many studies have shown that certain amino acids present in proteins, especially lysine and arginine, are heat-labile (Allison, 1949). Heat processing methods may either result in actual destruction of these amino acids or may bind the amino acids within the protein in a manner which reduces their availability to the digestive processes of the animal's body. The problem of heat damage to proteins is of critical importance in the field of mink nutrition. The passage of food through the digestive system of the mink is completed in less than eight hours (Wood, 1956). Thus, it

is essential that amino acids be readily available to the digestive enzymes of the mink. Recent experimental work has shown that arginine, a heat-labile amino acid, is of critical importance in the fur development of the mink (Leoschke and Elvehjem, 1954).

The stability of the fish oils present in fish meal is another problem to be considered in the processing of fish meal for the mink industry. The correlation between rancid fish fat and the yellow fat disease of the mink has already been stressed. The problem of the stability of fish oils present in fish meal may be resolved by the use of suitable antioxidants or, preferably, by the removal of the oils by solvent extraction procedures. Fat-stabilized fish meal and fat-free, solvent-extracted fish flour have been found to be equal in nutritional value to Atlantic whiting for the growth and fur production of the mink (Leoschke, 1958b).

References

Adair, J. (1956). Mink nutrition research. *Oregon State Coll. Agr. Expt. Sta. Progr. Rept. No.* **6**.

Adair, J., and Davis, K. G. (1957). 1956 mink nutrition research. *Oregon State Coll. Agr. Expt. Sta. Misc. Paper No.* **41**.

Allison, J. B. (1949). Biological evaluation of proteins. *Advances in Protein Chem.* **5**, 194-196.

Belcher, J., Evans, E. V., and Budd, J. C. (1958). The feeding of fresh-water fish to mink. *Ontario Agr. and Vet. Coll. Research Rept. No.* **1**.

Deutsch, H. F., and Hasler, A. D. (1943). Distribution of a vitamin B_1 destructive enzyme in fish. *Proc. Soc. Exptl. Biol. Med.* **53**, 63-65.

Gorham, J. R., Baker, G. A., and Norris, B. (1951). Observations on the etiology of yellow fat disease in mink: preliminary report. *Vet. Med.* **46**, 100-102.

Green, R. G., and Evans, C. A. (1940). A deficiency disease of foxes. *Science* **92**, 154-155.

Hamilton, W. J. (1936). The food of wild mink. *Am. Fur Breeder* **8**(12), 14-15.

Høie, J. (1954). Experiments with feeding mink little fresh food (meat and fish). (In Norwegian.) *Norsk Pelsdyrblad* **21**, 2-16.

Inukai, T. (1958). Personal communication. Faculty of Agriculture, Hokkaido University, Sapporo, Hokkaido, Japan.

Lalor, R. J., Leoschke, W. L., and Elvehjem, C. A. (1951). Yellow fat in the mink. *J. Nutrition* **45**, 183-188.

Leoschke, W. L. (1958a). Facts about fat in the mink's diet. *Natl. Fur News* **30** (4), 22-23.

Leoschke, W. L. (1958b). Fish meal and fish flour in the mink's diet. *Natl. Fur News* **30**(6), 10-11.

Leoschke, W. L., and Elvehjem, C. A. (1954). Importance of arginine and methionine for growth and fur development of mink on purified diets. *Federation Proc.* **15**, 560.

Rimeslatten, H. (1958). Personal communication. Royal Agricultural College, Vollebekk, Norway.

Wood, A. J. (1956). Time of passage of food in mink. *Black Fox Mag. and Mod. Mink Breeder* **39**(7), 12-13.