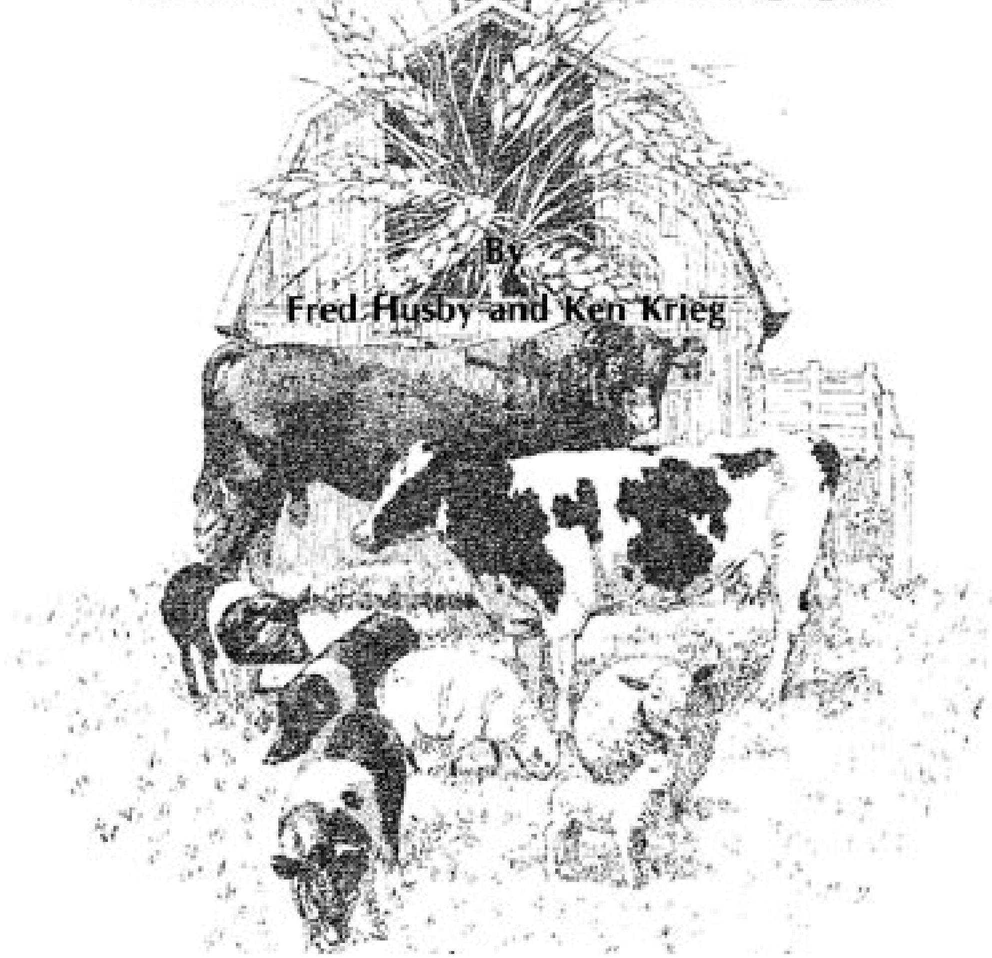
ALASKA'S FEEDS FOR ALASKA'S LIVESTOCK



By
Fred Husby and Ken Krieg

Agricultural and Forestry Experiment Station
School of Agriculture and Land Resources Management
University of Alaska Fairbanks

James V. Drew, Dean and Director

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NOTE: The material presented in this circular represents limited data on the nutrient composition of some of Alaska's feedstuffs. This publication will be revised periodically as additional information becomes available on these feeds and on new varieties of feedstuffs. This publication was updated in 1999 and published by the Alaska Cooperative Extension Service as part of its Alaska Livestock Series: Publication LPM-00745, "Nutrients for Alaska Livestock," by Milan Shipka, Extension Livestock Specialist, Cooperative Extension Service, and associate professor of animal science in the Plant, Animal and Soil Sciences Department, School of Natural Resources and Agricultural Sciences, University of Alaska Fairbanks. For online Cooperative Extension Service publications, go to: **www.uaf.edu/coop-ext/** for the home page and select "publications."

Alaska's Feeds for Alaska's Livestock

Fred Husby* and Ken Krieg**

Alaska-grown feeds have been utilized for domestic livestock since 1794, when the Russians used them at Kalsin Bay on Kodiak Island. However, it wasn't until 1898, when the Alaska Agricultural Experiment Station was founded, that scientific studies began on the value of Alaska feeds. In the past fifteen years, considerable attention has been focused on feed value by livestock owners in the state. A wide variety of feeds produced in the state are now available, both as raw products and processed complete feeds. From feeds grown in the state, feeders now have three small grains, several varieties of hay and forage crops, and fish and shellfish meals from which to choose for ration formulation.

Feed constitutes from 50 to 80 percent of the cost of producing an animal or animal product. Both the feed producer and feeder must make a profit if either is to stay in business; therefore, we must be concerned with both crop yield and nutrient content and availability. Feeds must be analyzed to determine their nutrient content and diets formulated to provide the most efficient ration at the least possible cost to maximize profits from livestock enterprises. The University of Alaska offers a feed testing program through the Agricultural and Forestry Experiment Station Laboratory in Palmer and ration balancing services through the Cooperative Extension Service. Feeds can also be tested in many laboratories outside of the state.

THE NUTRIENTS

The major nutrients are water, protein, carbohydrates, fats, minerals, and vitamins. Although energy is not a nutrient, it is a property of and is provided by carbohydrates, fats, and proteins. It is most often the limiting factor in diets for high-producing livestock. In addition to the major nutrients, we must also consider individual nutrients within most of the above categories when determining feed quality. For example, while ruminants require only crude protein, nonruminants require amino acids, the building units for protein. Calcium and phosphorus are required by all animals in significant amounts, but fifteen other minerals are also required and must be considered in a balanced diet. Mature ruminants can synthesize adequate amounts of B vitamins, but nonruminants cannot, and these must be supplied by the diet. Although a large number of feedstuffs contain all the major nutrients, no feeds contain them all in the amount and proportion needed to meet the requirements of livestock. Therefore, feed supplementation and ration balancing should be considered a routine practice.

Several factors affect the quality of feeds. Protein is influenced by the amount of nitrogen available to the growing plant. The amount of starch in the seed increases with plant maturity. Due to the presence of greater levels of indigestible fiber in plant tissue cell walls, the availability of all nutrients is reduced as a plant reaches maturity. In forages, a major portion of the nutrients are found in the leaves, thus "stemmy" hay is never as nutritious as leafy hay. Nutrient content of feeds (roughages) exposed to prolonged weathering, or that stored longer than a year, may be reduced and become insufficient to meet the animals needs. All of these factors should be considered in addition to nutrient analysis by feed producers and livestock feeders.

ALASKA'S FEEDS

Foodstuffs produced in Alaska fall into three categories: grains, forages, and protein supplements. The nutrients reported in the following tables were obtained from analyses conducted at the Palmer laboratory and amino acid analysis from commercial laboratories outside Alaska. The samples represent several varieties collected in different areas of the state over many years. Due to limited numbers, reliable comparisons between areas of the state were not possible. A majority of the hay data were obtained from a five-year study (1976–1980) conducted by J. D. McKendrick (AFES, University of Alaska) on the Kenai Peninsula and the Matanuska Valley.

* Associate Professor of Animal Science, Agricultural and Forestry Experiment Station, University of Alaska Fairbanks.

**Livestock Specialist, Cooperative Extension Service, University of Alaska Fairbanks.

Table 1. Comparison of Alaskan, U.S. and Canadian barley varieties (D.M. basis).

	Covered		Hulless	
Item	Western[1]	Alaska	U.S.[2]	Alaska[3]
Average nutrient content				
Dry matter (%)	90.0	85.4	90.0	87.6
Crude protein (%)	12.2	11.1	12.5	12.5
Ether extract (%)	1.9	2.0	2.0	2.4
Ash (%)	2.4	2.6	2.0	2.0
Crude fiber (%)	5.1	—[4]	1.6	—
Acid detergent fiber (%)	—	7.8	—	1.9
IVDMD (%)	—	76.1	—	89.2
ME (Mcal/lb)	1.4	1.2	1.5	1.4
Average mineral composition[5]				
Calcium (%)	.04	.08	—	.12
Phosphorus (%)	.35	.27	—	.31
Magnesium (%)	.14	.12	—	.13
Potassium (%)	.42	.51	—	.13
Copper (mg/kg)	8.20	51.00	—	17.00
Iron (mg/kg)	77.00	162.00	—	132.00
Manganese (mg/kg)	16.40	24.00	—	24.00
Zinc (mg/kg)	17.40	42.00	—	41.00
Cobalt (mg/kg)	.10	.20	—	—
Selenium (mg/kg)	.19	.02	—	.01
Vit. E (mg/kg)	22.50	3.30	—	—
Average amino acid composition[6]				
Alanine	.35	.48	—	.48
Arginine	.52	.58	—	.58
Aspartic acid	.56	.74	—	.74
Cystine	.21	.35	—	.34
Glutamic acid	2.75	2.87	—	3.20
Glycine	.34	.44	—	.44
Histidine	.25	.26	—	.28
Isoleucine	.46	.42	—	.46
Leucine	.77	.83	—	.89
Lysine	.40	.42	—	.40
Methionine	.15	.18	—	.22
Phenylalanine	.59	.62	—	.64
Proline	1.20	1.31	—	1.46
Serine	.46	.52	—	.56
Threonine	.38	.43	—	.44
Tyrptophan	.15	.24	—	.22
Trysosine	.35	.45	—	.44
Valine	.58	.58	—	.57

[1]U.S.-Canadian Table of Feed Composition, N.R.C., 1982. [2]Atlas of Nutritional Data on U.S. & Canadian Feeds, NAS 1971. [3]Alaska variety is Thual. [4]Figures not available. [5]Analytical mineral values not published for hulless barleys. [6]Average of 9 Alaskan covered and 2 hulless varieties, respectively.

(This table was taken, in part, from the Western Regional Swine Nutrition Project, W-166, publication, W-166, 1985, Utilization of Barley in Swine Diets, Agric. Exp. Stat. Bozeman.)

Barley

In Alaska, barley represents the most important grain produced and fed to livestock. For several years, the majority of the barley crop was produced from covered (with hulls) varieties (‘Lidal,’ ‘Weal,’ ‘Otal,’ and ‘Datal’) developed by R. Taylor with the Alaska Agricultural and Forestry Experiment Station and ‘Galt,’ a Canadian variety. Another variety, ‘Thul,’ also developed in Alaska, is a hulless mutant with a nutrient content different than the covered varieties. Therefore, the nutrient contents reported in Table 1 predominantly represent the above varieties and are compared to U.S. and Canadian experimental covered and hulless varieties of barley. All values are reported on a 100 percent dry matter basis.

The dry matter content of the Alaska varieties was lower than western barleys. Whenever barley exceeds 13 percent moisture levels, livestock feeders should be concerned about overheating, mold damage, and the cost of purchasing expensive water when the grain is being bought for a feed.

Neither covered nor hulless Alaska barleys contain more crude protein than equivalent varieties on a national average, but are equal to, or greater than, barley produced and imported from the Pacific Northwest or the Peace River area of Canada. No difference exists between Alaska and “Lower 48” barleys in either extract (fat), ash (minerals), or fiber (expressed as crude or acid detergent). However, as expected, the hulless barleys have a lower fiber content due to the lack of a hull and consequently contain a slightly increased fat content. Covered barley varieties produced in Alaska appear to have a slightly lower available energy content than those produced in the Lower 48. The available energy content of hulless barleys reported here and by other universities, however, exceeds that of covered barleys by 14 percent.

There are no differences between Alaska and U.S. barleys for the major minerals—calcium, phosphorus, magnesium, and potassium. Like cereal grains produced all over the world, Alaska barley is deficient in calcium. Phosphorus levels are sufficient for ruminants but not for nonruminants, since the level is marginal and only 50 percent is available to simple stomached animals. As in the rest of the country, magnesium and potassium levels are adequate in barley produced in Alaska. Trace minerals in cereal grains produced throughout the world are highly variable due to many factors, and without laboratory analysis, individual samples cannot be compared. Within Alaska barleys, all of the trace minerals are present in sufficient amounts except copper, manganese, zinc (which could be marginal), and selenium (which is definitely deficient). As mentioned above, copper is an example of the variability that occurs in mineral content of feeds from different locales. The data in Table 1 imply that the copper content of Alaska covered barleys may be adequate; however, the 51 mg/kg was an average of several samples with a range of 4 to greater than 100 mg/kg. With few exceptions, animals require 0.1 ppm selenium, and it can be toxic at levels of 5–40 ppm. Alaska barleys contain only one-tenth the amount of selenium required to prevent deficiency symptoms. Although vitamin E can reduce the animal's requirement for selenium, two barley samples from Delta contained only about one-seventh the amount of the vitamin found in Western barleys and not enough to alleviate a selenium deficiency problem. Alaska barleys should be supplemented with a mineral mixture containing calcium, phosphorus, salt, and trace minerals, including selenium. Care must be taken to avoid oversupplementing selenium as it is extremely toxic at levels above 5 ppm. Follow the feed tag label for recommended supplementation.

With the exception of vitamin E, no information is available on the vitamin content of the grains; however, it is doubtful that they would vary widely from varieties produced in other areas of the world. In any event, barley should be supplemented with a vitamin mixture that contains vitamins A, D, and E for all livestock, and should include riboflavin, niacin, pyridoxine, pantothenic acid, biotin, and B-12 for nonruminant diets.

Although eighteen amino acids are listed, we need only be concerned with lysine, threonine, methionine + cystine, isoleucine, and tryptophan as they are the ones limiting in the diets of nonruminants (swine, poultry, dogs, or fur-bearers) and must be added to complete diets with a protein supplement. The average levels of these critical amino acids in Alaska barleys are equal to or greater than those found in barleys produced in the Lower 48. Supplementation of the critical amino acids can be achieved easily by feeding high-quality soybean meal, canola meal + lysine, fish meal, or meat meal.

High-moisture barleys would not differ from the above comparisons when converted to a 100 percent dry matter basis. Swine feeding trials conducted at the University of Alaska Fairbanks have demonstrated that covered Alaska barley weighing 45 pounds or more per bushel had a corn replacement value of 93 percent for growing-finishing pigs. Thus, if corn were selling for $100 per ton, one could afford to pay $93 per ton for Alaska barley if it had a bushel weight of at least 45 pounds. Hulless barley with a 55 pound test weight or above appears to have a value equal to corn when fed to hogs.

Oats

Due to the small number of samples of Alaska oat varieties analyzed, no table is included; however, it can be noted that their nutrient content was similar to that reported for average U.S. oats. One must always be careful that the moisture of Alaska oats is not too high for storage.

Oats grown in this state are deficient in selenium and probably have a trace-mineral content quite similar to that noted for Alaska barleys. Although amino acid levels have not been determined for Alaska oat varieties, they would probably be slightly higher in lysine than is found in our barleys.

Fish Meals

Table 2 lists the nutrient contents of various fish and crab meals. Fish meals are considered a high-quality protein supplement and therefore demand a relatively high price throughout the world. With the exception of crude protein in crab meal, Alaska fish and shellfish meals are high in crude protein, ash, and available energy. The fat content is high in fin-fish meals, and although it is a source of energy, the fat may be a detriment, as it increases the possibility of rancidity or imparting "off" flavors to broilers and pork if too great a level is included in the diet. Although the ash content is relatively high in all these meals, it contains appreciable levels of calcium and phosphorus that can be utilized to fortify cereal grain based diets that are low in these two minerals. Shellfish meals are high in a type of fiber (chitin) that is not digested by nonruminant animals. Ruminants do, however, appear to be able to break down about 25 percent of the chitin under some feeding conditions and thus receive energy from crab meal slightly below the level furnished by barley.

As previously mentioned, fish meals are a good source of calcium and phosphorus and, with the exception of crab meal, the calcium:phosphorus ration is excelled for all classes of livestock. National Research Council Tables indicate that all fish meals contain greater levels of both minerals than that reported for meals produced in Alaska. Copper and manganese levels appear to be marginal in Alaska fish meals, and when these meals are included in diets with Alaska barley, a trace-mineral supplement should be included in the diet. With the exception of salmon meal at 2 ppm (L. B. Bruce, AFES, University of Alaska), selenium levels have not been determined in

Table 2. Nutrient content of Alaska's fish and crab meals (D.M. basis).

	Fin Fish			Shellfish
Item	Halibut	Herring	Salmon	Crab
Average nutrient content				
Dry matter (%)	91.9	96.3	93.5	94.7
Crude protein (%)	62.6	70.6	65.0	35.2
Ether extract (%)	9.3	8.6	13.9	2.6
Ash (%)	20.0	17.3	17.0	36.9
Acid detergent fiber (%)	.9	—[1]	.7	21.6
IVDMD (%)[2]	92.2	91.4	92.5	75.6
ME (Mcal/lb)[3]	1.5	1.4	1.5	1.2
Average mineral composition				
Calcium (%)	7.89	2.59	5.56	11.29
Phosphorus (%)	3.78	1.87	3.21	1.78
Magnesium (%)	.22	.23	—	.74
Potassium (%)	.41	1.21	.64	.56
Copper (mg/kg)	11.58	6.05	50.20	9.00
Iron (mg/kg)	885.23	130.90	154.00	64.00
Manganese (mg/kg)	10.33	7.84	6.60	7.00
Zinc (mg/kg)	110.20	110.50	93.90	40.00
Selenium (mg/kg)	—	—	2.00	—
Amino acid composition				
Alanine	3.23	3.30	3.06	1.83
Arginine	3.86	3.86	3.44	2.71
Aspartic acid	4.81	5.50	4.77	3.68
Cystine	.48	.46	.41	.32
Glutamic acid	6.94	8.28	6.60	5.24
Glycine	4.16	2.99	3.66	2.48
Histidine	1.34	1.40	1.30	.89
Isoleucine	2.30	2.64	2.23	1.66
Leucine	3.99	4.80	3.86	2.72
Lysine	3.98	4.87	3.93	1.70
Methionine	1.61	1.88	1.86	.86
Phenylalanine	2.20	2.49	2.16	3.50
Proline	2.74	2.38	2.36	1.91
Serine	2.86	2.75	2.52	2.12
Threonine	2.58	2.87	2.52	2.04
Tyrptophan	.59	.84	.58	.34
Trysosine	2.00	2.30	1.98	3.42
Valine	2.72	3.21	2.66	2.14

[1]Figures not available. [2]In vitro dry matter disappearance (energy digestibility). [3]Metabolizable energy calculated from IVDMD.

Table 3. Maximum Recommended levels for feeding fish and shellfish meals.[1]

Animal	King & Tanner Crab	Dungeness Crab	Shrimp	Finfish
Beef				
Cows, Maintenance	FC[2]	FC	—	—
Steers, Feedlot	10.0	10.0	—	0.5 lb/day[3]
Dairy				
Cows, Lactating	7.5	7.5	—	1-2 lb/day[3]
Heifers	30.0	30.0	—	—
Steers, Feedlot	—	—	—	3.0[4]
Sheep				
Ewes, Lactating	—	—	—	5.5[5]
Lambs, Feedlot	—	—	—	2.0[4]
Swine				
Grower-Finisher	6.0	5.0	6.0	—
Starter	—	—	—	5.0

[1]Expressed as a percent of total ration dry matter except where designated in lb/head/day. No fish flavor was imparted to either milk or meat at the levels shown. [2]Free choice. [3]Data from United Kingdom Publications. [4]Data from Cornell University. [5]Data from Iowa State University.

Alaska fish meals, but fish meals are considered a good source of selenium throughout the world.

Fish meals are a good source of the amino acids that are limiting in Alaska barley: lysine, methionine + cystine, isoleucine, threonine, and tryptophan. When compared to fin-fish meals and soybean meal, crab meal has lower levels of lysine, isoleucine, methionine, and tryptophan, but compares favorably to such lower-quality plant-protein supplements as cottonseed, linseed, and sunflower meals. Table 3 shows the maximum recommended levels for feeding Alaska fish and crab meals based on research conducted at the AFES research centers in Fairbanks, Homer, and Palmer and university publications from other locations.

Although liquified fish protein is not readily available, it may still represent the most logical protein supplement for animals in remote Alaska villages. It is another potential product from fish processing wastes that does not require the energy-intensive cooking and dehydrating of a meal. Following the cooking of fish wastes at 140º F , an acid and antioxidant are added to preserve and store the product in a high-moisture (80 percent water) state. This high-moisture product can then be mixed in diets for swine, dogs, and fur bearers. More research is needed to determine the recommended feeding rates and practices. A video cassette (VT329) demonstrating the production of liquified salmon wastes is available from IMPACT at the University of Alaska Fairbanks Elmer Rasmuson Library.

Forages

Nutrient values for hays grown in Alaska differ significantly by producer, fertilization, time of harvest, and hay species. This is true for grass hays produced in other areas of the U.S. and, therefore, no comparison is meaningful.

In approximately 50 percent of the 200 samples analyzed, available energy was deficient in meeting the requirements of a dry mature brood cow. Crude protein levels were adequate for maintenance of body weight but slightly deficient for weight gains of wintering beef calves. Some of the samples were also deficient in sodium, copper, zinc, and manganese. While the values shown in Table 4 are representative of “average” forages, be advised that any particular hay crop could vary widely from the average due to the influence of the factors discussed above.

Drying hay to an acceptable level is difficult in most areas of Alaska. This is evidenced by the dry-matter figures in Table 4. Moisture levels should be less than 15 percent to prevent hay from molding in the bale.

With the exception of oat hay, the average crude protein levels exceeded that required to maintain both a mature brood cow and a weaned calf, but may be limiting for growth. Brome and timothy were the only hays with adequate energy to maintain either a brood cow or a weaned calf. Whenever Alaska hay is fed to livestock, the potential for energy deficiency exists and supplementation should be considered.

The major mineral contents of all the hays exceeded the requirement of both sheep and cattle; however,

Table 4. Average Nutrient Analysis of Alaska's Hays[1].

Item	Brome	Timothy	Bluejoint	Mixed	Oat
Dry Matter (%)	83.1	83.7	83.8	80.8	77.1
Crude Protein (%)	11.1	9.4	10.5	11.8	8.3
Ether Extract (%)	1.6	—[2]	—	—	1.4
Ash (%)	7.8	—	—	—	8.6
ADF (%)[3]	34.6	38.9	41.0	38.3	40.8
IVDMD (%)[4]	59.5	57.9	52.7	53.4	50.5
ME, Mcal/lb[5]	.95	.92	.84	.85	.80
Calcium (%)	.33	.41	.40	.45	.36
Phosphorus (%)	.21	.20	.18	.20	.19
Magnesium (%)	.18	.15	.18	.20	.21
Potassium (%)	1.8	1.5	1.3	1.6	1.4
Copper (mg/kg)	7.0	3.0	3.0	5.0	7.0
Iron (mg/kg)	103.0	253.0	341.0	223.0	507.0
Manganese (mg/kg)	63.0	142.0	267.0	236.0	28.0
Zinc (mg/kg)	24.0	28.0	35.0	32.0	19.0
Selenium (mg/kg)	0.3	0.08	0.06	0.07	—

[1]All values are on a 100% dry matter basis. [2]Figures not available. [3]Acid detergent fiber. [4]In vitro dry matter disappearance (energy digestibility). [5]Metabolizable energy

copper was marginally deficient in all hays for cattle. Iron and manganese were sufficient, but manganese levels of both bluejoint and mixed hays were potentially toxic. Manganese levels were low in the oat hay samples. Zinc was variable and is considered low when compared to a requirement in the range of 20–50 ppm for all classes of cattle. As is the case with Alaska grain, the hay produced in this state is deficient in selenium, and it must be supplemented. A mineral mixture containing dicalcium phosphate:trace mineralized salt or bonemeal: trace mineralized salt (60:40) should be fed free choice at all times.

Summary

With the exception of higher moisture and lower energy levels, Alaska feeds compare favorably to the nutrient content reported in their Lower 48 counterparts. It should be kept in mind that the data reported in this publication represents the average of highly variable samples, and a feed analysis should be conducted on your feed before including it in a balanced ration.

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