Replacing Corn With Barley

In Turkey Rations

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Introduction

Restricted wheat acreage has meant increased barley production for Oregon. Acres of barley harvested in the state more than doubled in the last four years, jumping from 276,000 acres in 1952 to about 570,000 in 1956.

Oregon farmers need outlets for their barley production. At the same time, poultrymen and feed manufacturers need information about the relative value of corn and barley in poultry rations. Therefore, research showing the substitution value of barley for corn in turkey rations should help both barley producers and poultrymen.

Poults Raised to 8 Weeks

Growth rates for various combinations of corn and barley were first estimated. These rates are shown in figure 1.

Where the grain part (component) of the mash was all barley, turkey weights fell far below those on the mash with the all corn grain component. However, when the ration was pelleted, turkeys on barley did much better. Pelleting also increased the gains of turkeys fed the ration containing the corn component, but only by about one-third as much.[1/] Pelleting the barley ration made it almost as good as the 50-50 corn-barley combination. Similarly, the pelleted ration with the 50-50 corn-barley component gave results nearly equal to the all corn mash.

Four-pound birds can be produced with approximately 9.4 pounds of barley mash as compared to about 8.8 pounds of barley pellets (a feed saving of over 6% from pelleting). Pelleting the ration containing all corn produced about a 2% saving of feed.

If results from this experiment are typical, pelleting adds approximately 2% to the value of the corn mix, and slightly over 6% to the barley mix. Thus, if mash with corn as the grain component cost $100 per ton, the farmer could afford to pay about $102 per ton for the same mix if it were pelleted. If the mix contained only barley as the grain component, and the mash cost $100 per ton, then the same feed pelleted would be worth slightly over $106 per ton.

If the poultry ration contained both barley and corn, pelleting would add a value equivalent to 6% times the proportion of barley plus 2% times the proportion of corn. For example, pelleting a 50-50 combination of corn and barley would add about 4% to the mash value; however, these figures apply only to turkey poults up to 8 weeks of age. At older ages, pelleting did not increase the value when the grain component in the mash was corn.

1/ Reference to all-corn mash or pellets indicates the mixed feed with the 44% grain component made up of corn. Similarly, all-barley mash or pellets refers to the mixed feed containing a 44% grain component of barley. Mixtures of corn and barley also refer to the 44% grain component of the ration.

The pounds of mash or pellets required to get a poult to 4 pounds are shown in table 1. This table indicates that a corn and barley combination gives better results than does either grain alone. For example, a 50-50 mixture of corn and barley makes the mash worth about 1.5% more than the average of mash mixtures made with straight corn or straight barley.

Figure 1. Estimated turkey weights for various combinations of corn and barley grain portion of the ration.

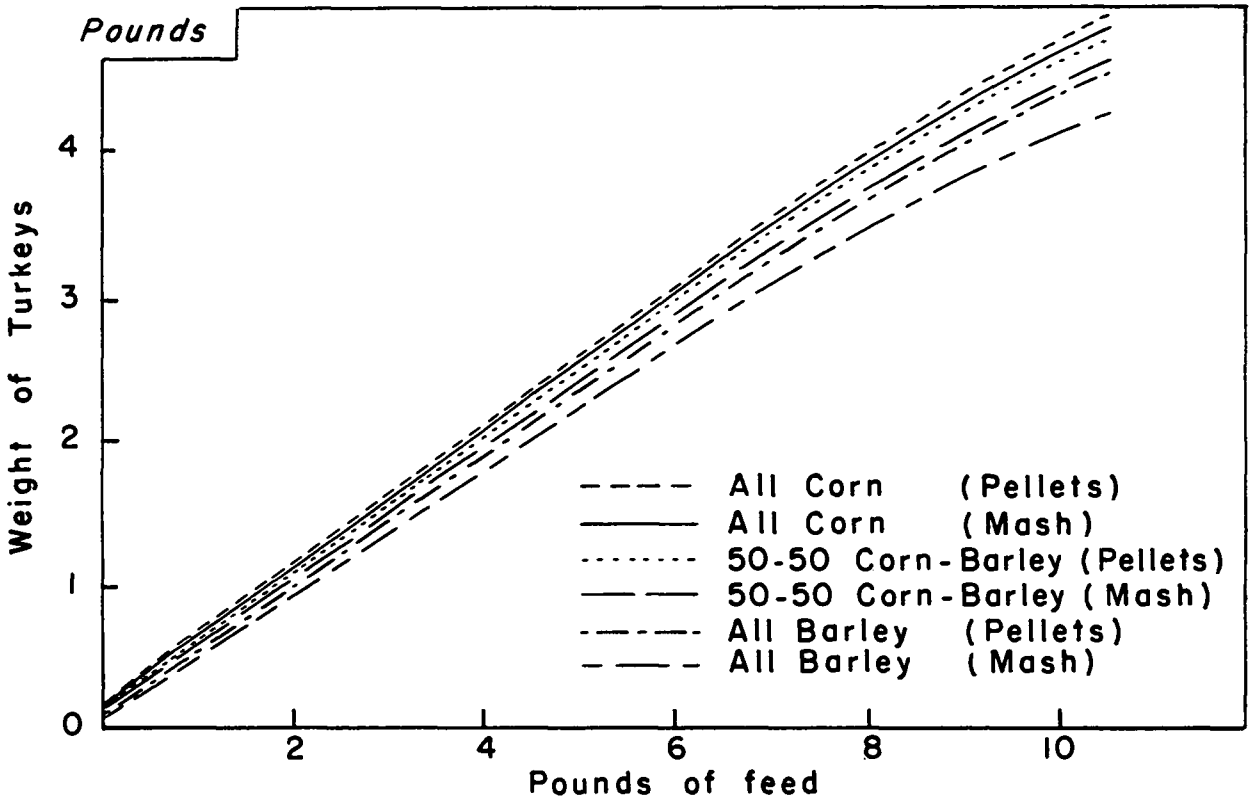

Table 1. Pounds of Mash and Pellets Required to Produce 4-Pound Turkey Poults

Grain component of ration		Pounds of ration required	
Percent	Percent	Mash	Pellets
0 Barley	100 Corn	8.187	8.022
10 Barley	90 Corn	8.264	8.067
20 Barley	80 Corn	8.349	8.118
30 Barley	70 Corn	8.441	8.176
40 Barley	60 Corn	8.542	8.240
50 Barley	50 Corn	8.651	8.312
(Danger of adverse litter conditions increases with rations of over 50% barley.)			
60 Barley	40 Corn	8.771	8.391
70 Barley	30 Corn	8.901	8.478
80 Barley	20 Corn	9.043	8.573
90 Barley	10 Corn	9.199	8.678
100 Barley	0 Corn	9.370	8.794

Value of Barley Relative to Corn

The cheapest ration for producing growth during the first two months can be determined from table 1 by figuring the cost of each ration and multiplying cost times pounds required. An easier way to locate the most profitable combination of corn and barley is provided by the substitution ratios in table 2. Divide the cost (to the poultryman) of the ration with corn as the only grain component, by the cost of the ration if it contained only barley as the grain component. This price ratio is then compared to the following substitution ratios. The barley-corn mixture with the substitution ratio nearest the price ratio should be used.

Table 2. Price Ratios When Substituting Barley for Corn to Produce 4-Pound Turkey Poults

Barley and corn in grain component				Substitution ratios	
Percent			Percent	Mash	Pellets
0	Barley	-	100 Corn	1.099	1.055
10	Barley	-	90 Corn	1.107	1.063
20	Barley	-	80 Corn	1.116	1.071
30	Barley	-	70 Corn	1.124	1.079
40	Barley	-	60 Corn	1.133	1.067
50	Barley	-	50 Corn	1.142	1.095
	(Danger of adverse litter conditions increases with rations over 50% barley.)				
60	Barley	-	40 Corn	1.151	1.103
70	Barley	-	30 Corn	1.160	1.111
80	Barley	-	20 Corn	1.170	1.120
90	Barley	-	10 Corn	1.180	1.129
100	Barley	-	0 Corn	1.191	1.138

To see how the ratios work, assume that barley is $45 a ton, corn $62 a ton, the nongrain portion of the ration (56%) $105 a ton, pelleting $2.00 a ton, and mixing, selling, etc. is estimated at $15 a ton. Under these prices, pellets made with corn as the only grain component would cost .44 x $62 for the corn plus .56 x $105 for the nongrain part of the mix, or $27.28 plus $58.80 = $86.08. Mixing, pelleting, selling, and delivery adds another $17. Total cost to the poultryman would be $86.08 plus $17 = $103.08 per ton for pellets with corn as the grain component.

Cost of pellets made with all barley as the grain component would be .44 x $45 plus .56 x $105 plus $17 or $95.60 per ton. Dividing the cost of pellets containing corn by the cost of pellets with barley gives $103.08/$95.60 = 1.078. The nearest substitution ratio for pellets in table 2 is 1.079 or the 30% barley--70% corn grain component.

What is the saving per bird in this case by using the 30-70 barley-corn mix rather than all corn? According to the figures in table 1, 8.022 pounds of pellets with 100% corn as the grain component would be required. With 30% barley, 8.176 pounds is required. Cost for 100% corn with the preceding prices would be $0.05154 x 8.022 = 41.35 cents. Price of the 30-70 blend would be .7 x $0.05154 plus .3 x $0.0478 = $0.050418 per pound. Cost of getting the 4-pound gain would be $0.050418 x 8.176 = 41.22 cents. Saving per bird would be only .13 cents; however, actual savings will depend upon the particular price situation.

Substitution ratios can be used to find the most profitable ration as prices change. Assume that barley could be obtained for $35 per ton while corn costs $60. Nongrain ingredients in the ration (56% of the total) cost $100 per ton while mixing, delivery, etc. cost another $10 a ton with pelleting at $6 a ton. Pellets made with only corn as the grain component (44% of the total) would then cost the poultryman $98.40 per ton as compared to $87.40 for all barley. Dividing the prices, the ratio $98.40/$87.40 = 1.126 is obtained. The substitution ratio nearest 1.126 is 1.129, the 90% barley--10% corn combination. (It should be remembered however, that feeding over 50% barley will sometimes cause a litter problem where birds are housed.)

Savings from using the 10-90 corn-barley mixture can easily be computed. Cost of the feed with all corn as the grain component would be $0.0492 x 8.022 = 39.47 cents. The 10-90 corn-barley mix would cost $0.04425 x 8.678 = 38.40 cents or a saving of over 1 cent per bird during the first 2-month feeding period.

The optimum amount of barley to feed varies with the price of the nongrain portion of the ration plus handling and delivery charges, as well as prices of barley and corn. The important thing to remember is that the optimum corn-barley mix is determined by the relative cost of corn mix and barley mix to the producer.

Turkeys from 8 to 24 Weeks

For older turkeys, started at 8 weeks and fed to 24 weeks of age, weight-feed relationships were also estimated. Since the birds were fed wheat free choice, determination of the most profitable combination of barley and corn is more complicated because the birds eat an increasing proportion of grain as they grow older. To overcome this difficulty, the amount of wheat the birds would eat was estimated. Examination of the experimental data and the growth curves showed that barley was more valuable relative to corn during the first part of the experiment while the birds were growing. During the last 4-6 weeks of the experiment when the birds were being finished, barley gave poorer results when compared to corn. For this reason, the feeding period is divided into two parts, (1) a growing period until the birds reach 13 pounds, and (2) a finishing period from 13 to 18 pounds.

Value of Barley During Growth Period

In table 3, the mash or pellets needed to take birds from a starting weight of about 3.86 pounds at 8 weeks of age to the 13-pound weight are presented along with the expected wheat grain consumption.

To compare the profitability of barley versus corn in table 3, costs of ingredients and feeds must be calculated. Currently, the nongrain portion of the turkey developer mash, approximately 44% of the mix, costs about $4.80 per cwt. For the remaining 56% grain component, corn is figured at $3.10 per cwt. and barley at $2.25. Allowing $0.75 per cwt. for mixing, selling, and delivery, the estimated price of mash made with all corn as the grain component would be $4.60 as compared to $4.12 for barley mash. For pelleting, $0.30 per cwt. is added. Wheat is figured at $3.85 per cwt.

At these prices, 13-pound turkeys are produced cheapest by feeding 60% barley-40% corn mash during the growing period. Cost of the 60-40 mash, plus cost of wheat, would be about $1.37 for growing the birds from 3.86 to 13 pounds.

Table 3. Predicted Feed Requirements for Turkeys to Reach 13 Pounds, Starting From 8 Weeks of Age and Fed Wheat Free Choice.

Grain component		Pounds of feed required			
		Mash	Wheat	Pellets	Wheat
Percent	Percent				
100 Barley		24.94	10.26	22.12	12.18
90 Barley -	10 Corn	24.49	9.84	21.97	11.96
80 Barley -	20 Corn	24.15	9.50	21.90	11.78
70 Barley -	30 Corn	23.90	9.22	21.89	11.64
60 Barley -	40 Corn	23.75	8.98	21.95	11.53
50 Barley -	50 Corn	23.68	8.79	22.09	11.45
40 Barley -	60 Corn	23.70	8.62	22.29	11.41
30 Barley -	70 Corn	23.81	8.49	22.59	11.39
20 Barley -	80 Corn	24.02	8.40	22.99	11.42
10 Barley -	90 Corn	24.34	8.35	23.51	11.51
	100 Corn	24.80	8.35	24.25	11.64

Getting the same gain with all corn as the grain component would cost about $1.46 and using all barley would run about $1.42. Using the 60-40 barley-corn combination would save from 5 to 9 cents per bird according to experimental results and assumed prices.

If the mash is pelleted, the 90% barley-10% corn grain component is an optimum ration under the preceding prices, costing about $1.44 to feed 3.86 pound birds to 13 pounds. Pellets are less profitable feed than mash in this case. Under the preceding prices, pelleting adds only about $2.00 per ton to the value if the grain component is 90% barley. Pelleting adds practically no value for birds over 8 weeks old unless the grain component is over 50% barley, according to results of this experiment.

Price changes will affect the optimum combination of barley and corn. For example, assume that barley can be bought at $40 a ton, corn remains $3.10 per cwt., wheat costs $3.40 per cwt., and the nongrain portion of the mash remains at $4.80 per cwt. If mixing, selling, and delivery adds $0.50 per cwt. and pelleting adds $0.20 per cwt., mash with all corn as the grain component would cost about $4.35 and a mix using barley about $3.73. Under these prices the 70% barley-30% corn is the optimum grain component. Turkeys reach 13 pounds (starting from 3.86 pounds) at a cost of about $1.25. The same gain would cost about $1.36 or $0.11 more per bird if all corn were fed, according to figures in table 3.

If the mash were pelleted, all barley should be used as the grain component under the preceding prices. However, the gain is more expensive than with the 70-30, barley-corn mash, costing about 3 cents more per bird.

Value of Barley During Finishing Period

Although at present prices more barley than corn should be fed during the growing period, the turkeys fattened better with more corn during the last part of the feeding period. In table 4, feed requirements to take the birds from 13 to 18 pounds are presented.

Assuming that mash made with corn costs the poultryman $4.60, barley mash $4.12, and wheat $3.85 per cwt., the 40% barley-60% corn grain component is the cheapest way to get the birds from 13 to 18 pounds. If pellets were to be fed, the best ration under the foregoing prices

is 50-50 corn-barley. However, feeding pellets is not as economical in this case as feeding mash since the added value from pelleting is almost nil for the 50-50 corn-barley combination for this size turkey.

Table 4. Predicted Feed Requirements for Turkeys to Reach 18 Pounds, Starting at 13 Pounds and Fed Wheat Free Choice.

Grain component		Pounds of feed required			
		Mash	Wheat	Pellets	Wheat
Percent	Percent				
100 Barley		19.08	22.34	15.86	19.56
90 Barley -	10 Corn	16.47	18.98	14.59	17.72
80 Barley -	20 Corn	15.37	16.94	13.98	16.52
70 Barley -	30 Corn	14.66	15.66	13.61	15.69
60 Barley -	40 Corn	14.26	14.79	13.39	15.15
50 Barley -	50 Corn	14.09	14.21	13.33	14.83
40 Barley -	60 Corn	14.10	13.86	13.39	14.68
30 Barley -	70 Corn	14.28	13.72	13.63	14.71
20 Barley -	80 Corn	14.63	13.80	14.02	14.96
10 Barley -	90 Corn	15.44	14.11	14.78	15.44
	100 Corn	15.44	14.81	15.76	16.38

Again, changes in price will shift the optimum barley-corn combination. The best combination can be found by multiplying prices times feed requirements in table 4. According to experimental results, an increasing percentage of corn should be fed for weights heavier than 18 pounds.

Use of Barley for Scratch Grain

Feeding wheat to turkeys is relatively expensive under present Pacific Northwest wheat prices of $3.85 or more per cwt. ($77 per ton). Consequently, turkey feeding experiments were designed to compare barley with wheat as the scratch grain. Two experimental pens were fed whole barley along with pelleted mash having barley as the grain component, and other pens were fed pelleted barley free choice as grain.

Under these circumstances, pelleted barley gave results equal to wheat during the earlier growth period, and whole barley gave gains nearly as good. Feeding barley as the scratch grain increased profits over those obtained from feeding wheat. Pelleting whole barley increased its value about $6.00 per ton or just about enough to cover pelleting costs.

After 20 weeks, consumption of whole and pelleted barley scratch grain declined markedly. At the same time, rate of gain also declined.

These results indicate that during the growth period it would be most profitable to feed barley as a scratch grain along with a pelleted developer having an all-barley grain component. This should be continued until the birds are 20 weeks of age or weigh around 15 pounds.[1] If the birds are finished to heavier weights, wheat and corn must be added to the ration to maintain consumption.

1/ In some experiments turkeys have tended to under-eat barley where it was the scratch grain and to over-eat mash, resulting in expensive gains. Where the grain component of the mash or pellet is also barley as in this experiment, under-eating of barley scratch grain would be less likely. At any rate, turkeys in the experiment did not under-eat the barley until they reached around 20 weeks of age, and approximately 15 pounds in weight.

Most Profitable Marketing Weights

With high feed costs and low turkey prices, it does not pay to feed turkeys to the heavy weights of previous years. In table 5, increased turkey weights at various amounts of feed are shown.

Assuming feed costs and turkey weights as stated in table 5, it would not pay to feed turkeys beyond the 17-pound weight. However, with cheaper feed, or turkey prices higher than 26 cents per pound, heavier weights would be more profitable.

The figures from table 4 can be used to determine the most profitable marketing weight for any birds gaining at about the same rate. Simply multiply increased turkey weights by the expected market price for each additional amount of feed; then subtract the increased feed cost for each added amount of feed, using specific costs.

Table 5. Profitability of Feeding Turkeys

(Average of Both Sexes) to Heavier Weights.

Ration fed after 8 weeks: 60-40 Corn-barley mash (Pounds)	Wheat	Predicted turkey weights (Pounds)	Increased weight (Pounds)	Value of increased weight[a]	Cost of feed required for increased weight[b]	Value of increased weight minus cost of feed
30	14.14	15.33	--	--	--	--
32	16.09	16.03	.70	$0.182	$0.163	$0.019
34	18.17	16.72	.69	0.179	0.168	0.011
36	20.38	17.40	.68	0.177	0.173	0.004
38	22.72	18.07	.67	0.174	0.178	- 0.004
40	25.18	18.71	.64	0.166	0.183	- 0.017
42	27.77	19.34	.63	0.164	0.188	- 0.024
44	30.48	19.96	.62	0.161	0.193	- 0.032

Limitations of Results

Many items can affect the relative value of barley in various combinations with corn. For example, adding fat to the ration enhances barley's value relative to corn, according to other experimental results. Similarly, soaking, or treatment with enzymes, has been shown to increase the feeding value of barley. Possible effects of such treatments are not considered by the preceding economic analysis which is based upon only two sets of experiments. Feeding under different conditions could give different results.

a/ Mash at $88.16/ton and wheat at $3.85 per cwt.

b/ Turkeys at $0.26/pound.

Source of Data

Experiments designed to determine the substitution value of barley for corn have been conducted by the Department of Poultry Husbandry. The experiments were for two age groups, (1) young poults from 0-8 weeks of age, and (2) turkeys from 8-24 weeks of age.

The Broad Breasted Bronze turkeys used for obtaining data for the 0-8 week period were hatched March 18, 1956. They were brooded in batteries for 10 days and moved to 8 x 9 foot pens equipped with electric hovers for the balance of the period.

Duplicate lots of 73 poults each were fed the 27% protein starter feeds in mash or pellet form as shown by formulas in the Appendix. Ingredients for the starter were the same for all rations and the only variation was in the grain component. Grains used in the rations consisted of all corn, 1/2 corn and 1/2 barley, or all barley. Figures for body weights and feed used were obtained at the end of the fourth and eighth weeks.

Turkeys for the experiment involving birds from 8 to 24 weeks of age were hatched June 13, 1956. This test compared corn vs. barley for growth and feed conversion. The poults were fed on an experiment concerning protein levels for the first 8 week period. At the end of this experiment poults were allotted at random from each experimental pen into 16 lots of 25 to 26 poults. The turkeys were reared in 16 x 16 foot pens of a brooder house, for the entire period.

Rations used are shown in the Appendix. The developers were formulated to contain approximately 20% protein. The grain component of the developer consisted of all corn, 1/2 corn and 1/2 barley, or all barley. Free choice of whole wheat as the grain along with the developer in mash or pellet form was fed to 6 of the duplicate lots. Two additional duplicate lots were fed the 20% all barley pellets plus free choice whole or pelleted barley. Values for body weights and feed fed were obtained at 4-week intervals.

Appendix

Table 1. Rations Used in Turkey Starter Rations, 0-8 Weeks.

	100% Corn grain component	50% Corn, 50% Barley grain component	100% Barley grain component
	Ration #4	Ration #5	Ration #6
Corn, ground	900	450	---
Barley, ground	---	450	900
Meat meal	100	100	100
Fish meal (Herring)	150	150	150
Soybean meal	675	675	675
Alfalfa (Dehy)	50	50	50
Whey	100	100	100
Shell flour	20	20	20
Bone meal	20	20	20
Salt	10	10	10
A & D Oil (2250A-300D)	5	5	5
Dry "D" 1500D	1.5	1.5	1.5
Riboflavin - syn.	3 gm.	3 gm.	3 gm.
Ca. Pento. - syn.	8 gm.	8 gm.	8 gm.
Choline chloride	7	7	7
Niacin	20 gm.	20 gm.	20 gm.
Antibiotic-Penicillin 4 gm/lb.	1.	1.	1.
Sulfa-Quinoxaline	113.5 gm.	113.5 gm.	113.5 gm.
Manganese sulfate	.5	.5	.5
	2040	2040	2040

Table 2. Rations for Trial Using Barley in Turkey Developer Rations, 8-24 Weeks.

	100% Corn grain component	50% Corn, 50% Barley grain component	100% Barley grain component
	Ration #23	Ration #24	Ration #25
Corn, ground	1120	560	---
Barley, ground	---	560	1120
Meat meal	100	100	100
Fish meal (Herring)	100	100	100
Soybean meal	300	300	300
Alfalfa meal (Dehy)	200	200	200
Whey	100	100	100
Shell flour	30	30	30
Bone meal	30	30	30
Salt	20	20	20
A & D Oil	2	2	2
Dry D	3	3	3
Manganese sulfate	.5	.5	.5
Riboflavin	3 gms.	3 gms.	3 gms.
Panto acid	6 gms.	6 gms.	6 gms.
Antibiotic - Penicillin	1	1	1
Choline - 100%	1	1	1
	2007.5	2007.5	2007.5