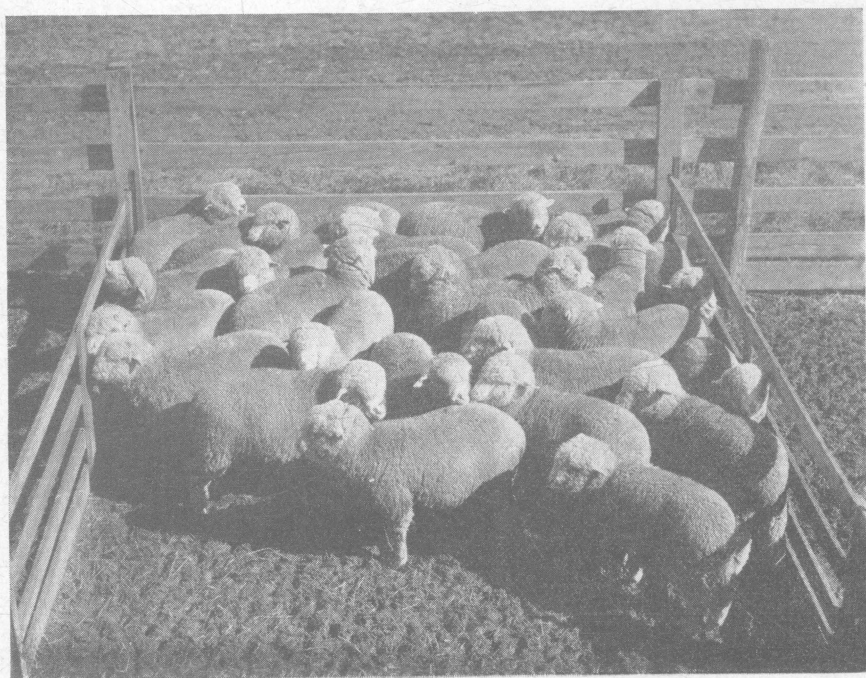


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# CORN COBS FOR LAMBS



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# CORN COBS FOR LAMBS

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Corn cobs usually contain about 32 percent fiber, about 2 percent total protein and little mineral matter. Chemically, they analyze slightly inferior to oat straw. For this reason, corn cobs have long been regarded largely as so much fibrous material of low nutritive value in lamb fattening rations.

Sometimes, when fattening lambs are being self-fed, ear corn is ground for use in the self feeder. The cob, in this case, is regarded as serving the useful purpose of "lightening" the grain ration. Most users of the self feeder, however, prefer to crack or grind shelled corn and mix it with chopped roughage of greater nutritive value than corn cobs to expedite the rate of gain.

Under hand feeding programs many experiments (1), (2), (3), (4) and vast experience have shown that feeding whole corn kernels, either as shelled corn or as ear corn or broken ear corn which the lambs shell, is the most efficient and economical way to offer corn to fattening lambs. Grinding shelled corn or ear corn has not given sufficient increased return to pay the cost of grinding. Feeding ground ear corn has usually slowed down the rate of gain made by the lambs. Even so, some feeders whose lambs seem to suffer rather high death loss from infectious entero-toxemia (so-called "apoplexy" or over-eating disease) have thought that the lighter grain ration, such as ground ear corn makes, is safer to feed and that lambs are easier to keep on full feed.

Thus, from practical knowledge, any value credited to including ground corn cobs in lamb rations seems to arise from some mechanical advantage rather than from any appreciable nutritive value in the corn cob.

Cattle feeders generally have held about the same opinion regarding corn cobs for cattle as have lamb feeders. The practical and highly successful cattle feeders in eastern Pennsylvania, however, have fed ground

ear corn to cattle for many years. Here and there could be found other cattle feeders who fed ground ear corn and stayed with the practice in spite of all teaching to the contrary. The question was whether these persistent feeders of ground ear corn had found a point in favor of including cobs that research and general practice had not revealed.

A series of feeding tests with calves and yearling steers at the Madison County Experiment Farm of the Ohio Station, comparing corn-and-cob meal with shelled corn, gave results which favored the corn-and-cob meal. On the basis of these results, Gerlaugh and associates (5) began a broader and more comprehensive series of tests at Wooster to determine the value of cobs in cattle fattening rations. The results of the first test in this series showed that 100 pounds of ground cobs replaced from 57 to 64 pounds of shelled corn in producing gains on the steers. This held true both where the normal cob content of ear corn (about 18 percent by weight) and when double the amount of cob (about 30 percent by weight) was fed.

With these results from steers, the question immediately was raised as to whether the common understanding as to the value of cobs in lamb fattening rations was correct. Hence, plans were made to initiate some lamb feeding experiments involving the use of ground corn cobs in the ration.

In contemplating these experiments several questions arose. The first question, based on the cattle feeding test, was one of grinding. Have investigators and feeders been overlooking a point as to the value of grinding corn—either shelled corn or ear corn—for lambs? Could it be that size of lambs used was a factor affecting results in earlier tests? Would larger lambs, for example, make better use of cobs than smaller lambs, or would grinding shelled corn benefit smaller feeding lambs more than those of large size? Would small lambs kept on feed for a longer feeding period tire of the ground grains, or would they actually make better use of ground shelled corn or corn-and-cob meal when used over the longer period? Is it possible that the level of feeding protein supplement in the ration might influence the utilization of the corn cobs in ground ear corn when measured grossly in terms of lamb performance, gain in weight, and carcass finish?

## EXPERIMENTAL

To investigate the subject of grinding shelled corn and ear corn for fattening lambs, three experiments were conducted. Attention was given to size of feeder lamb used and length of feeding period as factors which may be involved in utilization of ground corn or ground ear corn. Also, attention was given to the use made by lambs of corn cobs as an ingredient in ground ear corn when different levels of protein supplement were fed.

### LAMBS USED

A double-deck carload of good to choice western feeding lambs was purchased during each of three successive years. Each car was ordered to contain lambs from one producer but to show a fairly wide range in weight so that larger size and smaller size lambs of similar breeding would be available. The first car (from Oregon) and third car (from Montana) were white-faced, open-fleece, crossbred type lambs. The second car of lambs (from Montana), used in Experiment II, were crossbred type with about 40 percent of the lambs showing black or mottled faces.

After arrival at Wooster, the lambs were fed heavy mixed clover and timothy hay during a two-week acclimation, rest, and recovery-of-shrink period. During this time the lambs were ear-tagged for identity, weighed individually, and allotted into uniform groups for the start of each experiment.

### OBJECT OF EXPERIMENTS

The object of Experiments I and II was to compare shelled corn, ground shelled corn, ground ear corn, and ground ear corn with double the amount of cobs when fed to large-size and smaller-size feeding lambs. In Experiment I all lambs were fed similarly for 84 days, and the smaller size lambs were continued for 5 weeks or for a total of 119 days. In Experiment II all lots of lambs were fed for 84 days.

The object of Experiment III was to determine the effect of feeding different levels of protein supplement on the utilization of cobs as an ingredient in the grain ration. In this experiment both heavy-weight lambs and lighter-weight lambs were used and fed for 91 days.

### RATIONS USED

For all lots in all experiments, first-cutting, heavy-mixed legume-timothy hay of average to good quality was fed according to appetite in each lot. Loose salt and water were available at all times.

In Experiments I and II, Lots 1, 2, 3, and 4 made up of heavy-weight lambs, and Lots 5, 6, 7, and 8 made up of lighter-weight lambs, were fed corn as follows:

- Lots 1 and 5—Full fed shelled yellow corn
  - Lots 2 and 6—Full fed ground shelled corn
  - Lots 3 and 7—Full fed ground ear corn
  - Lots 4 and 8—Full fed ground ear corn with double the normal amount of cobs
- All lambs in Experiments I and II received 0.15 pound daily per lamb of soybean oil meal (41 percent protein)

In Experiment III, 4 lots of heavy weight and 4 lots of lighter weight lambs were fed corn and protein supplement as follows:

- Lots 1 and 5—Full fed shelled yellow corn and 0.15 pound daily per lamb of soybean meal.
- Lots 2 and 6—Full fed ground ear corn with no protein supplement added.
- Lots 3 and 7—Full fed ground ear corn and 0.15 pound daily per lamb of soybean meal.
- Lots 4 and 8—Full fed ground ear corn and 0.3 pound daily per lamb of soybean meal.

In all experiments the lambs were hand fed twice daily; the corn and protein supplement being given first, followed by feeding of the hay.

In all experiments each lot was weighed as a group on three successive days at the start and close of the experiments, and also regularly each week throughout the experiments. In addition, individual weight of each lamb was taken on the middle weigh day at the start and close, and regularly at the end of each four-week period throughout the test.

Each year, corn for all lambs on each test came from the same stock pile. This corn was analyzed for moisture content. To make comparison possible, all corn eaten and corn required per 100 pounds of gain, as well as cob, was converted to a basis of No. 2 shelled corn, carrying 15.5 percent of moisture.

To prepare the ground ear corn carrying double the normal amount of cobs, the cobs obtained in shelling an equal weight of ear corn were added to regular ear corn, and the mixture of ear corn and added cobs

was run through the hammer mill. No mechanical analysis of size of cob particles was made. However, the corn-and-cob meal can be described as ground fairly fine, with a few of the larger cob particles not exceeding three-eighths inch in size.

Shelling percentage of all ear corn was determined and was found to average 82 and 83 percent corn—from 17 to 18 percent cob. Thus the ground ear corn with double the normal amount of cobs contained about 30 percent, by weight, of cobs. To clarify the method of calculation, ear corn which would shell 82 percent grain would yield 18 pounds of cobs per hundredweight. If the 18 pounds of cobs were added to 100 pounds of ear corn, the total would be 118 pounds of ear corn and extra cobs to be ground. Actually, there are 36 pounds of cobs in the 118 pounds (the 18 pounds added and the 18 pounds in the unshelled ear corn). By dividing 36 pounds by the total of 118, the percentage cob content would be 30.5 percent.

The corn and cob eaten daily and required for each 100 pounds of gain is shown "as corn" and "as cob" in the following tables, based on the actual percentage of corn and of cob in each lot of feed prepared.

## RESULTS AND DISCUSSION

Tables I, II, and III present a summary of the data obtained in the three experiments.

### SHELLED CORN VS. GROUND SHELLED CORN FOR LAMBS

In Experiment I, both the heavy weight lambs in Lot 2 and the lighter weight lambs in Lot 6, fed ground shelled corn, gained slightly faster and required slightly less feed for each 100 pounds of gain than did the lambs in Lot 1 and Lot 5, respectively, fed shelled corn. In Experiment II, the situation was reversed; the lambs fed shelled corn (Lot 1 and Lot 5) gained a shade faster and required slightly less feed for each 100 pounds of gain than the lambs in Lots 2 and 6 fed the ground shelled corn. In Experiment I, the advantage of ground shelled corn over shelled corn was insignificant. In Experiment II, the lambs required about one-half bushel less of shelled corn than of ground shelled corn for each 100 pounds of gain.

**Thus, any net advantage seems to be in favor of feeding shelled corn over ground shelled corn.**

In these experiments where shelled corn and ground shelled corn were compared, the lambs were inclined to eat slightly more ground shelled corn per day than they ate of shelled corn. With the exception of the light weight lambs in Lot 5, Experiment II, the lambs fed ground shelled corn also ate more hay each day than did the lambs fed shelled corn. It is doubtful if this should be interpreted as an improvement in palatability of corn due to grinding. Actually, the lambs minced more when fed corn meal. Each mouthful required moistening before it could be swallowed; hence, the time spent at the feed trough had to be extended for the lambs fed the ground shelled corn. In contrast, it is well known that if lambs being hand fed shelled corn are brought to the point of dallying over their corn, because they are fed more than they will clean up promptly, they are likely to stall and go off feed. The result of spending more time at the feed trough for the ground shelled corn lambs was that they took slightly more corn each day than the lambs fed shelled corn. Just why they also ate more hay on the ground shelled corn ration, with their slightly higher corn intake, is a point this experiment does not answer.

**From the practical feeder's standpoint, there was no advantage by grinding shelled corn for lambs. The results of this phase of the tests, therefore, merely reaffirm the results obtained in earlier tests at various experiment stations, and make it more certain as a point of common knowledge, that there is no practical advantage to be gained from grinding shelled corn for lambs.**

Just why lambs eating more ground corn and hay than of shelled corn and hay gained slower is not clear. Perhaps there is something in connection with proportion of roughage to concentrates and / or in the physiology of rumen digestion which, when more completely understood, will explain this performance.

#### **CORN COBS IN THE RATION OF FATTENING LAMBS**

The performance of lambs fed corn cobs as an ingredient in the rations seems, on first analysis, to be quite irregular and inconsistent. The results seem to vary all the way from the instance of Lot 6, Experiment III (where the feeding of 79.9 pounds of cob for each 100 pounds of gain increased the total concentrates required for 100 pounds of gain



by 31.7 pounds to the instance of Lot 8, Experiment I (where the feeding of 155.2 pounds of cobs and 37.7 pounds of additional hay effected a saving of 112.1 pounds of concentrates in producing each 100 pounds of gain—concentrates meaning corn plus soybean oil meal.)

#### CORN COBS SLOW RATE OF GAIN

In all experiments where direct comparisons were possible and in all lots except Lot 3 in Experiment I, lambs fed shelled corn gained faster than lambs fed ground ear corn. Likewise, lambs fed ground shelled corn (Lots 2 and 6, Experiments I and II) gained faster than lambs fed ground ear corn (Lots 3 and 7). Further, lambs fed ground ear corn with normal cob content (Lots 3 and 7, Experiments I and II) gained faster than lambs fed ground ear corn with double the normal cob content (Lots 4 and 8). Obviously, the inclusion of corn cobs in the lamb's ration slowed down the rate of gain; the indication is that the rate of gain was slowed down nearly in direct proportion to the amount of cob included.

**If rapidity of gain is desired, shelled corn seems to promote faster gain by lambs than either ground shelled corn or ground ear corn.**

#### CORN COBS REDUCE INTAKE OF CORN

The lambs fed ground ear corn, whether with normal cob content or double cob content, ate slightly more total ground ear corn each day than comparable lambs ate of shelled corn. The actual intake of corn (as grain), however, was less for all lots eating ground ear corn, with 0.15 pound of supplement, than for the lots eating shelled corn and protein supplement. In no instance did lambs fed ground ear corn with supplement eat as much actual corn grain as they ate of shelled corn. This lower intake of grain may be the basis for the feeder's observation that lambs on ground ear corn are easier to keep on feed, and less likely to go off feed, than lambs full-fed shelled corn. With slower gains and lower corn intake, the lambs on ground ear corn are not as completely utilizing their full potential for consuming grain and making faster gains as lambs fed shelled corn; hence, the former may be easier to hold on feed and more difficult to throw off feed than the latter.

**CORN COBS IN RATION INCREASE HAY CONSUMPTION**

As was the case with lambs fed ground shelled corn, the lambs fed ground ear corn, whether with normal or double the cob content, ate as much<sup>4</sup> or more hay each day than lambs fed shelled corn. It has frequently been regarded that if lambs are fed ground ear corn, which is from 17 to 20 percent in weight (more by measure) of cob and therefore roughage, an equivalent amount of hay should be deducted from their daily allowance. These lambs did not follow along with this theory when allowed to do the deciding. If a lamb's appetite is a guide to the proportions of the various feeds needed, then the theory seems wrong. Any attempt to explain why it is wrong, on the basis of these tests, would be pure speculation. The point that perhaps more coarse roughage is needed in the rumen, to promote rumination when finely ground grain is fed, is suggested. After all, corn cobs which have been finely ground have lost some of their roughage characteristics. Again, there may be some point having to do with proportion of concentrates to roughage which the lambs attempt to bring into "balance."

In 13 out of the 14 lots fed corn cobs as an ingredient in their feed, more hay was required to produce 100 pounds of gain than when shelled corn was fed. The extra amount needed varied from 18.1 pounds up to 117 pounds per cwt. of gain.

**CORN COBS DO NOT SAVE CONCENTRATES OR HAY**

In 4 out of the 14 lots fed corn cobs as an ingredient in their feed, it took more actual corn and protein supplement as well as more hay to produce 100 pounds of gain than where the corn was fed as shelled corn.

In 10 of the 14 lots fed cobs as an ingredient in their feed, there appeared to be a saving in total concentrates (corn plus protein supplement) required per 100 pounds of gain which accompanied the inclusion of the cobs. The amount of concentrates saved was variable, and ranged from 4.1 pounds up to 112.1 pounds per cwt. of gain. In most instances, the corn replacement value of cobs was low and did not follow the pattern set by the cattle fed corn cobs (5). In each instance where the concentrate replacement value of cobs was high there seems also to be certain circumstance which applies to the individual lot showing the

high replacement value that reduces the apparent value of the cobs. One of these is that the lots (4, 7, and 8; Experiments I, and 3, 4, 7, and 8, II) showing the higher replacement value of cobs sold at from \$0.50 to \$1.00 per cwt. cheaper than the comparable shelled corn lot, and showed from 2 to 3 percent lower yield on slaughter. Interestingly, the higher the concentrate replacement value of the cobs the lower the selling price and dressed yield of the lambs. In these instances, then, cobs indicated their highest corn replacement value when the lowest quality product, as measured by rate of gain, selling price, and dressing yield, was being produced.

To analyze an instance where cobs show a high replacement value, the data furnished by the light-weight lambs of Lot 8 fed for 119 days in Experiment I show, in comparison with Lot 5, that 155.2 pounds of corn cobs and 37.7 pounds of additional hay saved 112.1 pounds of concentrates in producing each 100 pounds of gain. Under this analysis, corn cobs seem to have a 72.2 percent corn replacement value for lambs. It is, strangely, one of two instances among 14 lots fed cobs where anything like such results were obtained.

If the data furnished by Lots 5 and 8 are considered on the basis of the lamb's performance for the first 84 days (the same period as in Experiment II—data in parenthesis in Table I), then 134.4 pounds of cobs effected a savings of only 42 pounds of concentrates. Thus, during a 12-weeks feeding period, each 100 pounds of cobs fed to Lot 8 lambs replaced 31 pounds of concentrates. This is only 43 percent as high a replacement value for cobs as Table I shows for Lot 8 on the basis of 119 days on feed; the calculation disregards degree of finish or fatness. From this analysis, the inference is that perhaps over longer feeding periods lambs may make better use of cobs in the ration. Equally as important in this comparison, however, is the point of what record Lot 5 lambs made for the shelled corn they ate when compared with Lot 8 lambs, and how the two groups compared as to finish.

It is a well-established point that after fattening lambs reach a fairly high state of fatness the rate of gain slows down while the feed required to produce 100 pounds of additional gain increases. When, in Experiment I, the performance of Lot 5 lambs fed shelled corn and Lot 8 lambs fed double cob meal was studied, according to what happened during

the final 5 weeks of feeding beyond the initial 12 weeks, it became apparent that Lot 5 lambs apparently had passed the point of diminishing returns while Lot 8 lambs were holding close to their rate during the initial 84 days. Actually, the rate of gain made by Lot 5 lambs during the additional 5 weeks was one-third slower than during the first 84 days and the shelled corn required for each 100 pounds of gain had increased from the average of 388 pounds during the first 12 weeks to 911 pounds during the additional last 5 weeks—an increase of 234 percent in the pounds of corn required. Lot 8 lambs, on the other hand, had slowed only 10 percent in their rate of gain and had increased only 26 percent in the amount of corn required to produce 100 pounds of gain. Obviously, an inequitable situation for making direct comparison had been set up, due to Lot 5 lambs having passed the point of diminishing returns while Lot 8 lambs had not yet reached the same status.

It is well known that lambs full fed shelled corn can be brought to a highly desirable market finish during an 84-day feeding period. Lot 8 lambs in this test were not highly finished at the end of 119 days on feed, as shown by 1 choice, 26 good, and 3 commercial carcasses at the end of 119 days. If it may be assumed that Lot 5 lambs fed shelled corn were as well finished at the end of 84 days as Lot 8 lambs fed double cob meal were at the end of 119 days, and this seems a fair assumption, then the 155.2 pounds of cob fed Lot 8 to produce 100 pounds of gain replaced only 5.2 pounds of concentrates. Under this comparison, the corn replacement value of cobs for lambs is insignificant. A similar breakdown also can be directed against Lot 7 in Experiment I, with essentially the same results.

Aside from the two instances just analyzed, where lighter weight lambs carried for 119 days showed a rather high but apparently false corn replacement value for cobs, two other lots show a fairly high value for cobs. Under Lot 4, Table II, 136.7 pounds of cobs replaced 44.7 pounds of concentrates. This gives cobs a corn replacement value of 32 percent. To effect this saving, however, 98.2 pounds more hay were required for each 100 pounds of gain. Also, when the lambs were sold the selling price of Lot 4 was cut 25 cents per cwt. The actual net gain from feeding cobs was insignificant if not actually more costly. Again, Lot 3, Table III, shows a similar and even more favorable corn replacement value for cobs; but here, too, 72.8 pounds more hay was required,

and the lambs of Lot 3 sold under a price penalty of \$0.50 per cwt. Thus, in all instances where cobs appeared to have some value in lamb rations, a careful analysis of the data and a study of the interplay of contingent factors reduced the seeming value of cobs to an insignificant value or a negative net gain.

**Placing these alongside the instances where the results were actually unfavorable to cobs, it becomes difficult to credit any net gain in any lot to including cobs in the ration of fattening lambs.**

#### COMBINING DATA VERIFIES ANALYSIS

In addition to the foregoing, it is possible, under the completely uniform conditions of Experiment II, to throw the data from the heavy weight lambs and light weight lambs together to gain an analysis of lambs "as they come" with respect to weight—some light, some heavy, but with the carload averaging just under 70 pounds at the start.

Under this analysis the lambs of Lots 1 and 5 fed shelled corn made an average daily gain per lamb of 0.353 pound. For the lambs of Lots 3 and 7, fed ground ear corn, the average daily gain was 0.317 pound; for Lots 4 and 8, fed double-cob meal, it was 0.286 pound. Percentage-wise, the feeding of ground ear corn with normal cob content reduced the rate of gain 10.2 percent, while the feeding of the double cob meal (which was a little less on a percent basis than double cob) slowed the rate of gain 19 percent. Thus, the effect of feeding cobs on rate of gain was in almost direct proportion to the amount of cobs included in the ration.

By analyzing the combined data for concentrate replacement value of cobs, the results show that 74.27 pounds of cob fed as normal cob meal to Lots 3 and 7 saved 11.48 pounds of concentrates but required 53.7 pounds more hay. This gives 100 pounds of cobs a 15 percent concentrate replacement value; but it would be financially advantageous to feed cobs only when the extra hay required cost one-fifth as much as ground ear corn, or less, and when the end product as finished lambs is equal.

For the lots fed ground ear corn with double cob content, Lots 4 and 8, 138.7 pounds of cob saved 29.73 pounds of concentrates but it took 108.7 pounds more hay. This gives 100 pounds of cobs a 21 per cent concentrate replacement value; but again, it would be financially advantageous to feed cobs only if the extra hay costs one-fifth as much per pound as ground ear corn with double cob; and the end product would need be equal—but the end result was not equal in any of these experiments.

**Considering rate of gain, feed required, selling price, dressing yield, and carcass grade, cobs appear to have little corn replacement value. In addition, there were some losses in yield, grade, and cost which followed from causing fattening lambs to handle this extra quantity of fibrous matter, in the form of corn cobs, through their digestive system.**

#### **EFFECT OF FEEDING VARIOUS LEVELS OF PROTEIN SUPPLEMENT ON UTILIZATION OF COBS**

An analysis of the data from the various lots in Experiment III, Table III, again, as in Experiments I and II, fails to reveal any net gain from including cobs as an ingredient of ground ear corn in the ration for lambs.

Lambs in Lots 4 and 8, fed ground ear corn with 0.3 pound of soybean oil meal daily per lamb as supplement, did not gain as rapidly as lambs fed shelled corn and 0.15 pound soybean oil meal daily per lamb. The actual total daily intake of corn and protein supplement daily per lamb, however, was almost equal in both lots and for both large and small lambs. It would appear, therefore, that the cob amounted to just about so much fibrous material; the presence of which slowed down the rate of gain. With the rate of gain slowed down but with daily hay intake per lamb fairly constant, it took more hay per 100 pounds of gain where cobs were included.

It is interesting that by doubling the amount of protein supplement for the lambs fed ground ear corn (Lots 4 and 8) these lambs were brought up to a comparable dressing yield and final selling price to the shelled-corn-fed lambs of Lots 1 and 5, fed half as much supplement. It

is difficult, however, to feature a corn vs. protein supplement price relationship which would allow the doubling of the quantity of protein supplement fed to lambs getting ground ear corn to gain the same end result in selling price and dressing yield of the product as obtained with shelled corn and half as much supplement. There was no saving in total concentrates required per 100 pounds of gain effected by doubling the protein allowance.

The influence of cobs in the ration as compared with shelled corn, (Lots 1 and 5 vs. 2 and 7, respectively) when both lots are on the same 0.15 pound protein supplement basis has already been discussed. The performance of the lambs in Lots 2 and 6 fed ground ear corn without supplement, as compared with lambs fed shelled corn with supplement, is an interesting part of this test. These lambs, in Lots 2 and 6, ate more of the corn-and-cob meal daily per lamb than any other group ate of shelled corn plus supplement or of ground ear corn plus supplement. On an actual corn-intake basis, they ate almost exactly the same quantity of corn as the shelled corn-fed lambs. Actually, though, the shelled corn-fed lambs (Lots 1 and 5) consumed more total concentrates (which includes corn and soybean oil meal) each day. The lambs fed ground ear corn without supplement ate almost 0.2 pound more hay, daily per lamb, than the shelled-corn fed lambs. If the cob is regarded as roughage, then these lambs fed ground ear corn without supplement ate nearly 30 percent more roughage than the group fed shelled corn. This seems to indicate that there is a limit to the ability of lambs to consume corn as such, or it may indicate that the mechanical condition or total quantity of the grain (whether whole or ground) in relation to hay has something to do with the quantity of hay or total roughage needed.

It is interesting if not unique that the lambs fed ground ear corn without protein supplement, Lots 2 and 6, finished as well, dressed better, and sold higher than the lambs in Lots 3 and 7 fed ground ear corn with 0.15 pound of supplement daily per lamb. (Compare Lot 2 with Lot 3, and Lot 6 with Lot 7, Table III). Lot 2 and Lot 6 lambs, however, had higher feed requirements per 100 pounds of gain than did Lots 3 and 7, respectively. This may mean that the lower amount of protein allowed mainly for laying on of fat without providing for much growth of frame while under adequate protein feeding both growth and fat

deposition were promoted. This, of course, is a supposition and only through a study of the proportional relationship of fat to lean meat could the facts be ascertained. However, one wonders if some such situation may be back of those instances where nicely fattened lambs sometimes cut out with a small "eye" to the chops. These lambs were graded on the carcass basis but not on a cut-out basis and the opportunity to make this comparison is lost. The entire industry, however, is aware that well fattened lambs sometimes are disappointing when the carcass is cut. One is drawn into the foregoing speculation when feed lot performance, finish, and final grade turns out to show that lambs fed ground ear corn without supplement actually sell better and dress higher than lambs fed ground ear corn with supplement. The instance is cited here only because this unique performance of the lambs may be a lead that will ultimately explain the occurrence of the well-fattened carcass that sometimes cuts out with a small "eye."

It is undoubtedly significant to lamb feeders that in every instance where corn cobs were included as an ingredient of ground ear corn in the lamb's ration, both the selling price and the dressing yield of the lambs was less than for comparable lambs fed shelled corn. It is significant, too, that the lowest selling price and the lowest dressing yield followed from feeding double the normal cob content of ear corn.

### SUMMARY

These experiments were designed to re-analyze the subject of grinding shelled corn for lambs in view of recent results with cattle and to determine the value of corn cobs as an ingredient in ground ear corn when fed to lambs. Several factors were injected to learn whether one or more of these aspects of the lamb feeding business might bring some unique influence against the main objectives of fattening and thus qualify the generally accepted concept that grinding corn for lambs is unnecessary, or that corn cobs in the ration for lambs have low feeding value. These factors were weight of lambs fed, length of feeding period, double the normal cob content of ear corn, and the influence of level of feeding protein supplement on the utilization of corn cobs by lambs.



These experiments failed to show any advantage in rate of gain, feed required per 100 pounds of gain, selling price of lambs, or carcass yield and grade, in favor of grinding shelled corn, either for heavy weight or lighter weight lambs, fed for a normal or for an extended feeding period.

If there is any possible advantage to be gained from grinding shelled corn for lambs it may be in the single fact that lambs "bolt" their grain when eating shelled corn and "mince" at their grain when eating ground shelled corn. The result is that lambs fed shelled corn may be thrown off feed a bit more readily than lambs fed ground shelled corn, due to difference in eating habit.

No evidence was produced in these experiments to show that corn cobs have any appreciable nutritive value, or roughage replacement value, in the ration of fattening lambs.

In four instances out of 14, where cobs were fed as an ingredient of ground ear corn, direct comparison indicated a fairly high concentrate (corn and protein supplement) replacement value for the cobs. A more searching analysis, however, revealed that in two of the four instances this value arose from an inequitable basis for comparison due to the lambs in the check lot having overstayed their time in the feed lot. In the other two instances, the increased amount of hay required, the lower dressing yield, and the reduced selling price of the lambs reduced the apparent cob value to no net gain from including the cobs.

The general effect of including cobs was to increase slightly the lambs' appetite for hay, reduce the rate of gain, increase the amount of hay required for 100 pounds of gain, lower the dressing percentage, and cut the selling price of the lambs from \$0.25 to \$1.00 per cwt.

Extending the feeding period of lighter weight lambs fed cobs as an ingredient in their ration from 84 to 119 days did not result in high dressing lambs with well-finished carcasses. Just how much longer lambs fed a ration containing cobs would have to stay in the feedlot to reach the same yield and finish as obtained by feeding shelled corn for 84 to 91 days is undetermined; but the evidence indicates that it would take an additional five weeks or more. This longer period in the feedlot would increase the amount of hay needed to fatten a lamb by nearly 50 pounds per head.

Doubling the normal amount of cobs in ear corn produced the slowest gain, the lowest dressing yield, the least finish on the carcasses, and the heaviest cut in selling price on the lambs. This accentuation of the effect of including cobs in the ration adds evidence to confirm the low feeding value of cobs for lambs.

Doubling the amount of protein supplement fed with corn-and-cob meal to 0.3 pound daily per lamb caused the lambs to gain nearly as fast, sell equally well, and dress as high as lambs fed shelled corn with 0.15 pound daily per lamb of supplement. It is difficult, however, to feature a corn vs protein supplement price relationship which would permit the feeding of double the amount of supplement to gain the same end result in yield and selling price of the lambs.

Lambs fed ground ear corn and hay without supplement dressed out higher and sold for as much or more than lambs fed ground ear corn and hay plus 0.15 pound daily per lamb of protein supplement. This ration was unique in that the lambs so fed ate the highest total pounds of feed per lamb per day with the highest total fiber content.

In final summary, this review fails to bring forward any new concept concerning the value of corn cobs in lamb fattening rations. From these results there seems to be no reason to change the long-held concept: corn cobs are largely fibrous material of low feeding value in lamb feeding rations. Just why cattle utilize cobs so effectively and lambs do not is still an open question.

## REFERENCES

- (1) Coffey, W. C. *Productive Sheep Husbandry*. Lippincott, pp. 375-376, 1918.
- (2) Skinner, J. H. and F. G. King. *Fattening Western Lambs*. Ind. Agr. Exp. Sta. Buls. 273, 282, 296—1923-'25.
- (3) Patterson, A. M. and H. G. Winchester. *Lamb Feeding Investigations*. Kansas Agr. Exp. Sta. Cir. 88, 1921.
- (4) Evvard, John M., P. S. Shearer, C. C. Culbertson, and Q. W. Wallace. *Corn Preparation with Alfalfa and Silage for Fattening Lambs*. Iowa Agr. Exp. Sta. Bul. 299—1933.
- (5) Gerlaugh, Paul, Wise Burroughs, and L. E. Kunkle. *The value of corn cobs in the ration of fattening steers*. Ohio Agr. Exp. Sta. Animal Science Mimeograph No. 52.

On the following four pages are Tables I, II, and III, which give statistical data on the three experiments.

TABLE I.—Shelled Corn, vs. Ground Shelled Corn, vs. Ground Ear Corn, vs. Ground Ear Corn With Double Cob Content for Fattening Heavy Weight and Lighter Weight Feeding Lambs

Experiment I Started September 30	Heavy weight lambs				Lighter weight lambs			
	Lot 1 Shelled corn	Lot 2 Ground shelled corn	Lot 3 Ground ear corn	Lot 4 Ground ear corn + cob	Lot 5 Shelled corn	Lot 6 Ground shelled corn	Lot 7 Ground ear corn	Lot 8 Ground ear corn + cob
Number lambs in lot	30	30	30	30	30	30	30	30
Days on feed	84	84	84	84	119	119	119	119
Mortality—percent	0	10	0	3.3	10	6.7	6.7	0
Average initial weight	79.9	79.4	79.6	78.6	63.6	63.1	62.6	63.2
Average final weight	106.4	104.	106.7	101.9	98.4	98.	95.6	94.4
Average daily gain	.316	.322	.318	.276	(.313)	(.290)	(.273)	(.270)
Average ration:								
Shelled corn	1.30				1.41			
Ground shelled corn		1.34				1.39		
Ground ear corn			1.48	1.47			1.48	1.41
as corn			1.23	1.05			1.22	.99
as cob			.25	.42			.26	.41
Protein supplement	.147	.147	.147	.147	.148	.148	.148	.148
Mixed hay	1.70	1.74	1.68	1.63	1.21	1.33	1.22	1.22
Feed required 100 lb. gain:								
Shelled corn	410.5				(388.9)			
Ground shelled corn		416.4			495.6	(414.7)		
Ground ear corn			465.3	532.9		474.5	(483.4)	(473.9)
as corn			387.8	381.5			539.9	534.2
as cob			77.5	151.4			(403.0)	(339.5)
Protein supplement	46.45	45.58	46.1	53.3	(46.9)	(50.5)	(53.8)	(54.3)
Mixed hay	538.7	540.35	528.8	591.9	51.8	50.3	54.0	56.3
					(435.0)	(495.1)	(496.0)	(486.1)
					426.3	452.0	444.4	464.0

TABLE I.—Shelled Corn, vs. Ground Shelled Corn, vs. Ground Ear Corn, vs. Ground Ear Corn With Double Cob Content for Fattening Heavy Weight and Lighter Weight Feeding Lambs—Continued

Experiment 1 Started September 30	Heavy weight lambs				Lighter weight lambs			
	Lot 1 Shelled corn	Lot 2 Ground shelled corn	Lot 3 Ground ear corn	Lot 4 Ground ear corn+cob	Lot 5 Shelled corn	Lot 6 Ground shelled corn	Lot 7 Ground ear corn	Lot 8 Ground ear corn+cob
Total corn and protein supplement per 100# gain.	457.0	462.0	433.9	434.8	(435.8) 547.4	(465.2) 524.8	(467.1) 499.9	(393.8) 435.3
Extra pounds hay required in ground corn lots per 100 pounds gain		1.7	—9.9†	53.2		(60.1) 25.7	(61.0) 18.1	(51.1) 37.7
Concentrates saved by cobs			23.1	22.2			(—31.3) 47.5	(42.0) 112.1
Selling price per cwt.					\$16.00	\$16.00	\$15.50	\$15.00
Dressing yield (cold carcass)					45.78	44.74	43.30	42.95
Carcass grade—percent		(One carcass withdrawn by health inspector without lot identity and weight; thus, confused records resulted on this slaughter test. Data withheld)						
Choice					55.5	17.9	10.7	3.33
Good					44.5	82.1	64.3	86.67
Commercial							11.4	10.0
Other							3.6*	

Figures in parenthesis are those for light-weight lambs at end of first 84 days on feed.  
\*One bruised carcass. Grade for finish not recorded.

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**TABLE II.—Shelled Corn, vs. Ground Shelled Corn, vs. Ground Ear Corn, vs. Ground Ear Corn With Double Cob Content for Fattening Heavy Weight and Lighter Weight Feeder Lambs**

Experiment II Started November 9	Heavy weight lambs				Lighter weight lambs			
	Lot 1 Shelled corn	Lot 2 Ground shelled corn	Lot 3 Ground ear corn	Lot 4 Ground ear corn+cob	Lot 5 Shelled corn	Lot 6 Ground shelled corn	Lot 7 Ground ear corn	Lot 8 Ground ear corn+cob
Number lambs in lot	34	34	34	34	35	35	35	35
Days on feed	84	84	84	84	84	84	84	84
Mortality—percent	0	8.82	0	0	0	0	0	2.94
Average initial weight	74	75.3	75.7	76	64.7	65.7	65.7	65.6
Average final weight	104	104.2	101.6	101.2	94.5	93.7	93.1	89.1
Average daily gain	.352	.340	.308	.297	.355	.334	.326	.276
Average ration:								
Shelled corn	1.30				1.24			
Ground shelled corn		1.36				1.30		
Ground ear corn			1.34	1.35			1.31	1.28
as corn			1.10	.94			1.08	.89
as cob			.24	.41			.23	.39
Protein supplement	.14	.14	.14	.14	.14	.14	.14	.14
Mixed hay	1.55	1.59	1.60	1.60	1.38	1.37	1.37	1.40
Feed required 100 lb. gain:								
Shelled corn	369.0				350.3			
Ground shelled corn		398.9				388.3		
Ground ear corn			435.1	453.6			401.5	464.2
as corn			357.7	316.9			330.1	323.8
as cob			77.4	136.7			71.4	140.4
Protein supplement	40.8	42.1	46.6	48.2	40.4	42.9	43.9	51.9
Mixed hay	441.2	468.1	519.3	539.4	388.9	411.3	421.2	506.0
Total corn and protein supplement per 100# gain	409.8	441.0	404.3	365.1	390.7	431.2	374.0	375.7
Extra pounds hay required in ground corn lots per 100 pounds gain		26.9	78.1	98.2		22.4	32.3	117.1
Concentrates saved by cobs			5.5	44.7			16.7	15.0
Selling price per cwt.	\$16.00	\$16.00	\$16.00	\$15.75	\$16.00	\$16.00	\$15.75	\$15.50
Dressing yield (cold carcass)	47.6	47.7	47.1	43.4	47.3	47.2	46.1	45.8
Carcass grade * — percent								
Choice	52.9	64.5	88.2	58.8	57.1	60.0	57.1	29.4
Good	47.1	35.5	11.8	41.2	42.9	40.0	40.0	64.7
Commercial							2.9	5.9

\*U. S. Government grade.

TABLE III.—Utilization of Corn Cobs by Heavy Weight and Lighter Weight Feeding Lambs Fed Different Levels of Protein Supplement

Experiment III Started November 1	Heavy weight lambs				Lighter weight lambs			
	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7	Lot 8
	Shelled corn 15# supp	Ground ear corn No supp	Ground ear corn 15# supp	Ground ear corn 30# supp	Shelled corn 15# supp	Ground ear corn No supp	Ground ear corn 15# supp	Ground ear corn 30# supp
Number lambs in lot	33	33	33	33	33	33	33	33
Days on feed	91	91	91	91	91	91	91	91
Mortality—percent								
Average initial weight	78 7	79 9	78 6	79 8	65 1	65 5	65 3	65 4
Average final weight	110 8	108 3	109 0	109 1	100 0	98 2	95 7	97 6
Average daily gain	348	310	332	321	387	341	334	354
Average ration								
Shelled corn	1 34				1 28			
Ground ear corn		1 59	1 28	1 28		1 63	1 30	1 27
as corn		1 33	1 10	1 07		1 36	1 09	1 06
as cob		26	18	21		27	21	21
Protein supplement	147		147	29	147		147	29
Mixed hay	1 53	1 72	1 70	1 62	1 42	1 49	1 53	1 42
Feed required 100 lb gain								
Shelled corn	384 5				330 2			
Ground ear corn		514 4	386 7	399 7		479 7	390 6	360 3
as corn		428 7	330 8	333 1		399 8	325 5	300 3
as cob		85 7	55 9	66 6		79 9	65 1	60 0
Protein supplement	42 2		44 3	39 5	37 9		44 0	32 1
Mixed hay	439 2	554 7	512 0	503 8	374 8	438 3	457 9	401 9
Total corn and protein supplement per 100 pounds of gain	426 7	428 7	375 1	422 6	368 1	399 8	369 5	382 4
Extra pounds hay required in ground corn lots per 100 pounds gain		115 5	72 8	64 6		63 5	83 1	27 1
Pounds concentrates saved by cobs fed		(2 0) †	51 6	4 1		(31 7) †	(1 4) †	(14 3) †
Selling price per cwt	\$15 50	\$15 25	\$15 00	\$15 50	\$15 25	\$15 00	\$15 00	\$15 25
Dressing yield (cold carcass)	48 1	47 8	46 7	48 5	47 0	46 5	46 9	47 3
Carcass grade * — percent								
Choice	53 3	43 3	15 6	45 2	32 3	10 0	24 2	21 9
Good	46 7	56 7	81 3	54 8	64 5	90 0	75 8	78 1
Commercial			6 2		3 2			

\*U S Government grades

†Indicates pounds more required rather than saved

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