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CORN OIL CAKE MEAL FOR GROWING AND FATTENING PIGS.

JOHN M. EVVARD AND RUSSELL DUNN*

Corn oil cake meal is really a residue of the germs of corn grain which remains after most of the oil is extracted therefrom. The particular corn oil cake meal which we used in our test is a by-product from the manufacture of glucose. These four main products are made from the corn grain: Glucose, corn oil, gluten feed, and corn oil cake meal. It is with the latter that we are to deal.

The corn oil cake meal according to approximate analyses contains approximately in every 100 pounds 9 pounds of water, 22 pounds of crude protein, 47 pounds of nitrogen-free extract, 10 pounds crude fibre, 10 pounds of ether extract, and 2 pounds of ash.

In removing the oil from the separated corn germs or embryos the separation is largely physical although the germs are heated to the scorching point in the process.

To more clearly comprehend the action of this corn oil cake meal of which there is less than 2 pounds manufactured from a bushel of corn it is well to emphasize some of the main essentials of the adequate ration for young growing and fattening pigs:

First—*The protein quantity must be large enough* in order to meet all demands for growth and general metabolism.

Second—*The protein quality must be right*, which means that there must be a correct proportion existing among the various amino acids of which there are some twenty, as well as a sufficiency of the essential ones within the mixture.

Third—*A sufficiency of minerals is of considerable importance*, otherwise the bodily mechanism which is in a growing state will be severely handicapped.

Fourth—*Mineral quality should likewise be carefully attended to* so that the apportionment of the various elements within the total mineral quantity shall be adequate in every particular—which means that there shall be, specifically speaking, just enough

* With the assistance and collaboration of E. J. Strausbaugh, Superintendent; D. B. Adams, Herdsman; and H. B. Winchester, Assistant.

of each of the elements present in that particular quantity—just enough of calcium, for instance, not too much nor too little, because if there is too much that may sometimes put a burden upon the animal organism, and if there is too little the inadequacy is evident.

Fifth—*There should be present fat soluble A* in large enough quantity to meet the demands of the organism—fat soluble A such as is found in butter fat, carrots, alfalfa leaves, meat meal tankage, the lighter fractions of beef fat, and the other vitamins, and so on.

Sixth.—*Water soluble B and the other vitamins should not be neglected.* They are necessary—fortunately the water soluble B is quite widely distributed. There is some question about the anti-scorbutic being absolutely essential.

Seventh—*The fibre content should be relatively low.* Too much fibre is a detriment to young, growing pigs.

Eighth—*There should be an abundance of starch or its equivalent in sugars or similar materials* to furnish the energy and fattening requirements of the organism.

Ninth—*Toxic materials should not be contained within the ration,* in other words all of the ingredients should be healthful and not of toxic or poisonous character.

Tenth—*Other considerations general in character should be given attention*—such considerations as palatability, laxativeness, high digestibility, relatively high net production value, and the correct relationship between all of the various constituents, their relationship changing as the demands change—in other words as the animal grows and develops.

It can be readily seen that in considering the complete nutrition of an animal the problems arising therefrom are many and complex. The good ration can be made inadequate by the removal therefrom of a single nutritional essential such as fat soluble A or water soluble B, or certain amino acids, just as an automobile engine that is functioning properly can be totally incapacitated by the removal of the timing gear, or the piston rings, or the spark plugs, or the gasoline, or the oil, and so on. Sometimes just a small quantity of a certain material like fat soluble A will give results wholly out of proportion to its weight. The inflammable head of a match is very small but it can bring about wonderful changes under proper conditions. A catalyzer is very small in quantity but will cause changes which as compared to the catalyzer itself are of exceptional magnitude.

With the viewpoint in mind, therefore, of fitting a feed into its proper place, we undertook the investigation of the feeding of corn oil cake meal. In the first place we wanted to determine whether or not corn oil cake meal in itself was a complete ration. We found that it was not.

Pigs that were taken on June 29 at weaning time and fed until October 27, 1917—120 days—weighed 180 pounds at the close of the feeding period where corn, and tankage, and salt were allowed “Free-Choice” style on bluegrass pasture. Where corn oil cake meal and salt only were fed the final weight was only 96 pounds, thus showing that as compared to a good ration, even though the pigs getting the corn oil cake meal ran on bluegrass, corn oil cake meal was inefficient.

We tried adding tankage to the corn oil cake meal, letting the pigs have “Free-Choice” of these two feeds, but even at that the pigs on this aforementioned date of October 27, after 120 days of feeding, weighed only 134 pounds. Thus it will be seen that the addition of tankage to corn oil cake meal is not nearly so efficient as the addition of tankage, for instance to a corn alone ration. To drive this home we would simply cite an experiment now in progress. Corn alone pigs (salt was allowed) at nine months of age weighed approximately fifty pounds. These were fed in dry lot. Tankage added to this corn ration has made the same kind of pigs weigh better than 250 pounds at the same age. Just because tankage, therefore, is a good supplement to corn does not mean that it is just as efficient a supplement to corn oil cake meal, or to any other feed unless that feed be very, very similar to corn such as wheat for instance or barley or rye, yet even with each of these specific feeds tankage bears different relationships. Of course, by tankage I refer to the 60 per cent protein product which sometimes goes under the name of meat meal, sometimes tankage, again it is called meat meal tankage, or Digester tankage, but the point is that it is a meat and bone residue of a very high protein content, namely 60 per cent.

How about adding corn oil cake meal to the corn ration fed on bluegrass pasture? Instead of the pigs weighing 180 pounds as they should on good corn and tankage ration they weighed 114 pounds. This shows that corn oil cake meal, therefore, is not an efficient single supplement to corn when said corn is fed to hogs on bluegrass pasture in conjunction with salt at free-will.

The addition of a little linseed oil meal to the corn and corn oil cake meal ration was attended with slightly beneficial results, but

even linseed oil meal added to this combination is not to be considered as a success—it helped a little but not much.

The addition of a limited quantity of buttermilk, however, to a corn and corn oil cake meal ration was in the interests of efficiency. Where shelled corn and tankage were fed in separate feeders the weight on October 27 after 120 days of feeding was 180 pounds, but, as mentioned, where corn oil cake meal was substituted for the tankage the weight was only 114 pounds. There is a wide range between 114 and 180, sixty-six pounds, which may be remedied by the addition of proper supplemental feeds to the corn and corn oil cake meal combination. Buttermilk was successful in increasing the weight of these pigs to 164 pounds. In this case not quite five pounds of buttermilk was fed daily per pig in addition to the shelled corn and corn oil cake meal. We do not think that there is any question that had this buttermilk, or even skim-milk—its practical equal—been added in larger quantity the gains would have been favorably increased so that they would have approximated or even have excelled the corn and tankage fed group.

In order to gain a more adequate knowledge concerning the improvement of a corn and tankage ration or a corn and hominy ration by the addition of corn oil cake meal we planned to feed six groups of pigs, placing six pigs averaging about forty-eight pounds each in weight and about seventy-seven to eighty-one days in age to a group. All groups were fed "Free-Choice" style. The test was begun June 15 and ended October 17, 1917, after 124 days of feeding.

These lots were fed:

- Lot I Shelled corn self-fed plus meat meal tankage self-fed plus block salt self-fed.
- Lot II Shelled corn self-fed plus a mixture of meat meal tankage 1 part, corn oil cake meal 3 parts self-fed plus block salt self-fed.
- Lot III Shelled corn self-fed plus meat meal tankage self-fed plus corn oil meal cake self-fed plus block salt self-fed.
- Lot IV Hominy feed self-fed plus meat meal tankage self-fed plus block salt self-fed.
- Lot V Hominy feed self-fed plus a mixture of meat meal tankage 1 part, corn oil cake meal 3 parts self-fed plus block salt self-fed.
- Lot VI Hominy feed self-fed plus meat meal tankage self-fed plus corn oil cake meal self-fed plus block salt self-fed.

All of the above were fed on timothy pasture, a pasture somewhat comparable to bluegrass under our conditions — really not a good pasture from the standpoint of a lone pasture supplementing

The hominy feed which we used is that by-product from the corn meal mills; after the corn meal is removed for human consumption there remains the bran of the kernel, the germ (from which the oil has not been extracted), and the whiter, starchier portions. In reality the hard, flinty portion of the kernel has been removed and this has been milled into corn meal for human consumption; all of the rest of the kernel, therefore, goes back to the farm for live stock feed in Hominy Feed Sacks.

It will thus be noticed that in this particular product, hominy feed, there is really a concentration of germs due to the fact that the flinty portion of the kernel has been removed. We would hardly expect, therefore, to have as good results from the addition of corn oil cake meal to a hominy ration fed in conjunction with tankage as we would by adding the same feed to a corn tankage ration, providing, of course, the ingredients of the embryos or germs themselves were advisable or necessary in such combination.

Table I given herewith gives the average initial weight per pig, final weights (these at approximately 203 days), average daily gain, average daily feed, and feed required for a hundred pounds of gain.

TABLE NO. I

Lot. No.	I	II	III	IV	V	VI
Average Initial Weight per Pig	47.9	48.8	49.0	48.5	48.7	49.6
Average Final Weight per Pig (at approximately 203 days)	188.6	198.7	218.7	203.1	196.0	190.8
Average Daily Gain per Pig	1.13	1.21	1.37	1.25	1.19	1.14
Average Daily Feed per Pig.						
Corn, Shelled	4.05	3.87	4.68	...	...	...
Hominy Feed	...	...	...	4.77	4.01	4.59
Corn Oil Cake Meal	...	.82	.09	...	.62	.10
Tankage	.48	.27	.55	.38	.20	.25
Salt	.00	.00	.00	.00	.00	.00
Total	4.52	4.96	5.32	5.15	4.84	4.93
Feed Required for a 100-lb gain:						
Corn, Shelled	356.5	319.8	342.2	.....	.....	.....
Hominy Feed	.....	.....	.....	382.4	337.7	403.2
Corn Oil Cake Meal	.....	67.7	6.6	.....	51.9	8.4
Tankage	42.2	22.6	40.1	30.3	17.3	21.6
Salt	0.0	0.2	0.0	0.0	0.2	0.0
Total	398.7	410.3	388.9	412.7	407.1	433.2

Before discussing this table which takes all groups of the pigs to the same date (Oct. 17, 1917—124 days feeding) it is well to

introduce another table, namely Table II, which figures all the groups to the same weight, or approximately 189 pounds. This gives us better material for comparison. Table II, therefore, puts all groups upon a similar basis in that a definite sized pig is produced, taking them all at approximately the same size, namely forty-eight pounds at weaning time. In this table is given the average final weight, number of days required to reach the weight of approximately 189 pounds, average daily gain, and feed required for a hundred pounds of gain.

TABLE NO. II

Lot. No.	I	II	III	IV	V	VI
Average Final Weight	188.6	189.8	189.5	189.5	188.9	190.8
No. Days Required to Reach Weight	124	116	104	114	119	124
Average Daily Gain	1.13	1.22	1.35	1.24	1.18	1.14
Feed Required for a 100-lb Gain:						
Corn, Shelled	356.5	309.5	321.1	.....	.....	.....
Hominy Feed	.....	.....	.....	370.1	336.3	403.2
Corn Oil Cake Meal	.....	57.6	5.6	.....	53.1	8.4
Tankage	42.2	19.2	43.2	30.7	17.8	21.6
Salt	0.0	0.10	0.0	0.0	0.2	0.0
Total	398.7	386.4	369.9	400.8	407.3	433.2

Note that in Table II the feed required for a hundred pounds of gain in the "shelled corn groups," namely I to III, was decreased by the addition of corn oil cake meal in both instances. Where the pigs were "camouflaged" a bit by mixing the corn oil cake meal with the tankage (group II) they took 8 days less time to reach the necessary weight than where just the straight corn and tankage was used and practically twelve pounds less feed was required for a hundred pounds of gain. In Group III where these three feeds were all fed "Free-Choice" style twenty days were saved and practically twenty-nine pounds of feed.

This shows quite clearly that under the conditions of this experiment with young growing pigs corn oil cake meal when added to the corn and tankage ration fed on timothy pasture in conjunction with salt apparently supplied some deficiencies because the pigs on account of such addition gained rapidly and required less feed to make the same amount of gain.

Now why was Group II camouflaged? Remember that the pig is a physiologist and that he eats to suit himself and not his owner; therefore, it may be necessary to make certain mixtures so that the growing and fattening process will be advantageous to the owner of the pig. It is only by the proper balancing of the physiological

and economical aspects of the pig feeding game that we can come to a correct solution of our problems in practice. Both the pig and the man must be considered.

The comparison of the camouflaged Group II with Group I shows that a hundred pounds of corn oil cake meal saved eighty-one pounds of corn and forty pounds of tankage, a total of 121 pounds of feed concentrates. Counting the corn at \$1.12 a bushel and the tankage at \$100.00 a ton, current quotations in January, 1918, this 100 pounds saved \$3.62 of these feeds, or a ton was worth \$72.40, substitutionally speaking. With corn at \$1.68 and tankage at \$100.00 a ton the corn oil cake meal substituted \$4.43 worth of corn oil tankage, or a ton of it was worth \$88.60 on this basis.

Comparing Group III with Group I we find that a hundred pounds of corn oil cake meal saved 63.2 pounds of corn and 18 pounds of tankage, a total of 81.2 pounds of these feeds. With corn at the lower price mentioned, a hundred pounds was worth \$2.10; and a ton, \$43.28. With corn at the higher price, a hundred pounds was worth \$2.80 and a ton \$55.92—these figures on the substitutional basis.

Now what happens when we add corn oil cake meal to hominy feed is shown in Groups IV, V and VI. In V we added it in the same manner as to II. In this case a hundred pounds of corn oil cake meal mixed with tankage in the proportion of 3 to 1 and fed in conjunction with hominy feed as compared to hominy feed and tankage saved 82.7 pounds of corn and 24 pounds of tankage, a total of 107.6 pounds, not quite so good a showing. With corn at \$1.12 and tankage at \$100.00 a ton, a hundred pounds of corn oil cake meal was worth \$2.85 and a ton was worth \$57.08. With corn at \$1.68 and tankage at \$100.00, a hundred pounds substituted \$3.68 worth of these feeds, or a ton substituted \$73.62 worth.

Where corn oil cake meal was fed "Free-Choice" style in Group VI as compared to none being fed in Group IV there was a minus value for the corn oil cake meal. Just what the significance of this is we do not know but we hope to repeat the test and see if it will check. We are inclined to believe that this particular group for some reason was not quite so efficient even though scrupulous care was taken to divide all equally. These suspicious discrepancies happen even though all care and precaution is taken to divide the groups equally. We find inherent differences. It is up to the experimentalist to determine what these differences are, and what causes them, and to learn the remedy. So long as they

exist and so long as we do not know why they exist, then just that much longer they must exist because we do not know the necessary weapons with which to offset them.

Briefly speaking, our more favorable general deductions from the experiments we have run thus far are:

First—Corn oil cake meal added to a corn and tankage ration is quite efficient—it saves considerable corn and tankage when properly fed. The mixture of corn oil cake meal with tankage looks favorable, and under certain economic conditions should be more favorably considered than “Free-Choice” feeding.

Second—Corn oil cake meal takes the place of tankage up to about half of the daily allowance; in other words it displaces half of the daily tankage fed. On the basis of a hundred pounds of gain it really displaces somewhat more than half the tankage, this being particularly true when it is added to a corn and tankage ration, although this is not true when the meal is added to a hominy and tankage ration.

Third—Corn oil cake meal seems to fit in excellently with the corn and tankage ration; largely, we think, because it supplies certain deficiencies in said ration.

Fourth—Hominy feed, which is really corn concentrated in bran and germs and starch through the removal of the flinty portion or the gluten of the kernel, shows up quite well in comparison with corn, although our tests have not shown it to be the equal of corn.

Fifth—Hominy feed requires less tankage daily than does corn or approximately four-fifths as much. On the basis of pounds tankage to feed with a hundred pounds of corn or hominy the latter requires about $\frac{2}{3}$ as much as the former; or if twelve pounds balanced a hundred pounds of corn then about eight pounds would do for hominy feed.

Sixth—In such a nutritional complexity we find in all our rations for pigs we must expect that even with our best rations there is a certain limiting factor or factors, and the addition of this or these factors will tend to make the ration more efficient not only in increasing daily gains but in decreasing the feed required for a unit of gain. Animal Husbandmen should always be on the lookout for the “long-comings” as well as the shortcomings of rations. If a ration is deficient in certain particulars then through the use of the proper feed which supplies these deficiencies, and this in the proper quantity, the ration may be improved. It is well to keep in the front line trenches so as to catch a clear vision of the possibilities of correct combinations.

Hart, of the Wisconsin Station, deducting and reasoning from some of his livestock experiments, has this to say about the germs of corn: "it is necessary to attribute to the proteins of the embryo of this grain (corn) a high efficiency." This means that under certain conditions the proteins of Corn Oil Cake Meal are highly efficient, as for instance when we feed this feed in combination with tankage (or milk or alfalfa pasture or rape pasture) and corn. It seems to fit in nicely and save protein, that is, a pound of such combined proteins goes further.

Osborne and Mendel of the Connecticut Agricultural Experiment Station and Yale University respectively, in speaking of corn germs say: "We have found that the corn germ contains proteins which are superior in promoting growth to those found in the endosperm (other parts of the kernel including the bran). Further, they say: "When supplemented with a small amount of meat proteins Corn Germ is capable of inducing very rapid growth. It is also rich in the water soluble vitamine."

The absence of the water soluble vitamine from foods, such as polished rice, for instance, causes a disease of the nervous system, known as polyneuritis, which literally translated means a disease or inflammation (itis) of many (poly) nerves (neur). De-germinated Corn is lacking in this essential vitamine. Naturally, therefore, we believe that the substance was removed by this process in the germ. Voegtlin and Myers of the Hygienic laboratory of the U. S. Public Health Service have recently shown that pigeons fed on whole corn do not get this disease, but when the germs are removed with a pen knife and the balance of the kernel fed to those pigeons, this disease with its unfortunate symptoms of paralysis, and later, often quite soon, death, appears. The difficulties come in a couple of weeks following the change from whole corn grain to the germ free corn. They say: "the germ or embryo of the . . . corn kernel contains all of the antineuritic vitamine of the grain."

When we add Corn Oil Cake Meal to the corn-tankage ration we believe that there is improved thereby: first, the protein quality, this allowing tankage to be markedly saved; second, the vitamine content of the ration.

It is always well to allow before pigs a mineral mixture in which common salt and limestone (or air slacked lime) are the principal ingredients, also to put pigs on good leafy green pastures. Thus we tend to play safer with our pigs and more securely with our pocket books.

SOME DONT'S ARE IN ORDER

Don't try to feed Corn Oil Cake Meal as the lone feed. Tankage alone is bad, so is corn alone for young stock.

Don't use Corn Oil Cake Meal as the lone supplement to corn in dry lot. Mix it with tankage, or fish meal, or milk, skimmed or buttermilk.

Don't attempt to make Corn Oil Cake Meal take the place of corn or other basal grains as a full substitute because it is primarily a supplemental not a basal feed. It won't give good results alone, even though fed with tankage—allowing no other feed or feeds. If it is fed with tankage alongside corn or barley or other good basal feed, the results are pleasing because the gains and feed requirements are satisfactory.

Don't think that just because Corn Oil Cake Meal makes a nice creamy textured, bulky slop of good appearance the mere slopping (mixing with water) will take the place of good supplemental feed boxes. It won't. Use it with tankage or meat meal, or fish meal, or the milks when it is supplementing the ordinary feeds of the farm. Or else feed on good clover or alfalfa pastures in summer season.

Don't forget that Corn Oil Cake Meal mixed with skim or buttermilk is a splendid combination for balancing the farm grains—in the absense of milk, use tankage or fish meal product. Corn Oil Cake Meal makes the limited milk on the average farms go much further and that efficiently.

Don't fail to bear in mind that the average of three Iowa Station experiments showed that it took 90 per cent as much protein for 100 pounds gain where Corn Oil Cake Meal was mixed with tankage and fed with corn as where the tankage was fed straight with corn. This indicates that 100 pounds of corn—Corn Oil Cake Meal—and tankage mixed proteins are practically equal to 111 pounds of mixed corn and tankage proteins or the addition of Corn Oil Cake Meal makes all the proteins fed about 10 per cent more efficient. In case of brood sows alfalfa mixed with Corn Oil Cake Meal helps it out a great deal in its grain supplementing virtues.

Don't confuse Corn Oil Cake Meal with Corn Hominy Feed. They are very different. A good hominy feed is a splendid corn substitute—our tests showing it to equal in feeding value per 100 pounds about 80 to 100 pounds of good dry whole corn grain. Hominy Feed contains Corn Bran, Corn Starch and Corn Germs. Quite often the oil is extracted from the germs. It is the by-product of table corn, meal or hominy grit manufacture. It carries

less than half as much protein as the Corn Oil Cake Meal. Less tankage is required to balance Hominy Feed than corn for pigs, about $\frac{2}{3}$ as much being required. This tankage saving virtue is presumably due to the small proportion of corn germs in this feed, about two to three times as much as in corn. But a sack of Corn Oil Cake Meal carries the germs (from which much of the oil has been mechanically pressed) of practically 50 bushels of corn or 2800 pounds. Corn Oil Cake Meal is at least twenty-five times as rich in corn vitamins and corn proteins as is good hominy feed. Some hominy feeds, however, run very low in Corn Oil Germ Meal because the Corn Oil Germ Meal commands a higher price than the hominy feed per ton, hence the financial temptation to sometimes not replace all of the oil—extracted germs that naturally remain in the residues resulting from corn meal and grits manufacture. Hominy feed is a good corn substitute whereas Corn Oil Cake Meal is a good protein and vitamin supplement to corn.

Don't expect that a mixture of Linseed Oil Meal and Corn Oil Cake Meal will be taken too readily from a self-feeder, when allowed in addition to corn or other basal grain. The palatability and effectiveness of the mixture can be greatly improved by the addition of tankage in these proportions: Corn Oil Cake Meal 50 parts (5 sacks), tankage 30 parts (3 sacks), and Linseed Oil Meal 20 parts (2 sacks) by weight. The Corn Oil Cake Meal may be mixed with wheat middlings and oil meal and fed to advantage on green leafy pastures of young alfalfa, the clovers, rape and bluegrass. If pastures get sparse or scarce, or hard and dry, add tankage, or fish meal, or milk for greatest efficiency. Of course, a little skim milk or buttermilk with all of these mixtures is of special merit—and so fed a bucketful will go much further, and that pleasingly.

Don't forget that before the World War European Countries took practically all of the American yield of Corn Oil Cake Meal — shipping it over two thousand miles by rail and water to the feeding places, and why? Because they knew how to feed it, and what it was worth. Now that we in America have learned how to feed this feed to advantage, it is to our interest to be in the competitive market at all times — taking full advantage when the economic returns warrant.

Don't expect the pigs to eat Corn Oil Cake Meal to best advantage out of a self-feeder when allowed free-choice alongside of a basal grain such as corn, barley, wheat, kaffir corn, and other similar feeds, and a good protein and mineral supplement

like tankage. Better mix the Corn Oil Cake Meal with a high-grade meat product, or a fish product to insure consumption and economy. The pig's appetite is sometimes fallible.

Don't neglect or forget, nor fail to heed these simple, effective don'ts — else your Corn Oil Meal will not yield you the maximum returns that you are so diligently and persistently seeking.

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