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EXPERIMENTS WITH BOLLY REFUSE

THE ECONOMIC USES TO WHICH BOLLY REFUSE MAY BE PLACED, AND THE COMPOSITION OF BOLLY COTTON SEED AND THEIR PRODUCTS

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During the last few years the farmers in this and other Southern States, especially Texas, have been gathering at the close of the picking season the partially opened or unopened bolls of cotton and selling them to the ginners. These bolls have come to be called bollies. The ginner puts them through a cracking machine and then gins them. In this way there are three commercial products obtained, the cotton, the seed and the bolly refuse, which consists of the burr and some unginned cotton. This bolly refuse has been used for two purposes, first as a fuel, and second as a feedstuff, and during the past year or two, since feedstuffs have been so scarce, a great amount of this substance has been fed by farmers, and it was thought that we should carry out an experiment to determine its feeding value.

It is well known that the ash from cotton stalks contains a large percent of potassium and of phosphorus, and on this account is a valuable fertilizer. For this reason it was decided to make an analysis of the ash from the bolly refuse to determine its fertilizing value.

While this investigation is confined almost entirely to a study of the feeding value of bolly refuse and the fertilizing value of its ash, yet a few analyses were made of the seed from the bollies, and also refining tests were made on one or two samples of oil which had been produced from bolly seed These few analyses will be given, but it should be borne in mind that no conclusion can be drawn as to the value of bolly seed as a source of oil, or as to the value of the oil from these seed, since the number of analyses made would not justify a definite conclusion. The composition of the seed from bollies, as well as the composition and quality of the products from them, probably vary from year to year, due to a variation in the weather conditions.

Since the bolly refuse contained a large amount of fiber, as is shown by the mechanical analysis heer given, it was thought that it might be used as a raw material for the manufacture of paper, or for the manufacture of explosives. With this idea in mind, samples were sent to several papermills and several manufacturers of explosives. Reports were had from two or three papermills stating that it would be difficult to separate the cotton from the burr, and on that account the substance could not be used as a paper material. But one report was received from manufacturers of explosives, which was from the Du Pont Company, with the request that 500 pounds of the refuse be shipped to one of their plants so that they might determine whether or not it would be possible for them to use it. This company is now experimenting upon this substance, but has not given a report as to whether it is possible to use it for its purposes.

Two samples of bolly refuse were used, one from the W. H. Coyle Gin Company, and the other from the Thompson Gin Company, both of Stillwater.

DIGESTION EXPERIMENT

Two 18-month-old steers were loaned to us by Mr. W. I. Patten of Stillwater for the purpose of this experiment. They were in medium condition. The weights were taken at the beginning of the preliminary feding period and at the close of the feeding period. It seemed to be desirable to get the digestibility of the bolly refuse, both when it was fed alone, and when fed with other feedstuffs. After the preliminary feeding, bags were placed on the steers by means of a harness and the feces were collected twice a day. Ot the beginning of the collection period in the case of the feeding of the bolly refuse by itself, a liberal quantity of salt was given to each of the steers, and evidently they ate too freely of it and to such an extent that they took the scours after about three days, and the collection of the feces had to be discontinued. During the time of collection, which lasted about three days, the feces were of a normal consistency. It might at first be said that the scouring was produced by the bolly refuse ,but this is not at all likely, since nothing of the kind was observed during the preliminary feeding, nor have reports come from farmers who have used this substance as a feedstuff of its having such effect. The only conclusion then would be that it was the salt which caused it, and this is further borne out by the fact that the scouring lasted but one or two days, during which time the bolly refuse was still being fed. Much more reliance can be placed in the results of the second feeding, in which cottonseed meal and alfalfa meal were fed with the bolly refuse, since the period of collection was longer, there was no disturbance of the bowels due to salt or other causes, and since this would be the way that one would feed this substance, not by itself, but in connection with other feedstuffs.

During the rst collection period the total amount of feces were dried in the laboratory and samples taken for analysis. During the second period the feces of each half day were weighed and one-tenth was taken for analysis. The feces of the first feeding trial were dried in the laboratory by spreading them in thin layers and placing over a radiator. In the second trial the feces were dried by spreading in thin layers and placing them in an electric vacuum oven. Each half day's sample was kept in this oven for ten hours, when it had lost the greater part of its water, and it was then placed in large dishpans and placed over radiators. At the end of the collecting period the several portions from each steer were thoroughly mixed and a portion taken for analysis. A statement as to the weights of the steers, the composition of the feedstuffs and of the digestibility will now be given in tabular form.

Table No. 1

	Kind of Feed	Date	Weight of White-Faced Steer	Weight of Red-Faced Steer
At the beginning of preliminary feeding	Bolly refuse 5.3 lbs. per day	Feb. 17	375 lbs.	375 lbs.
At the end of preliminary feeding	Bolly refuse 2.64 lbs. per			
At the end of the second feeding experiment	Bolly refuse 5.3 lbs. per day day, cottonseed meal 1.3 lbs. per day, alfalfameal 2.2 lbs. per day	Feb. 27 Mar 11	383.7 lbs. 39[illegible] lbs.	379.7 lbs. 389 lbs.

It is seen from Table No. 1 that the steers were not only maintained, but actually gained in weight when the bolly refuse was fed by itself. The gain, however, was greater when the bolly refuse was fed with cottonseed and alfalfa meals. It should be noticed that the quantity of the bolly refuse fed during the second trial was just one-half of the amount fed during the first trial. At first we thought that it would be necessary to collect the part of the feed that was left over in each of these trials, but we found that this was not true, since even when nothing but the refuse was fed, everything was eaten even to all of the burrs.

Table No. 2

Showing the composition of the feedstuffs used in the digestion experiment.

	Dry Matter as Weighed Out	Ash	Protein	Fiber	Nitrogen-Free Extract	Fat
Cotton bolly refuse	88.79	5.77	9.97	41.55	40.30	2.41
Cottonseed meal	91.57	5.68	43.04	13.77	31.45	6.06
Alfalfa meal	91.93	12.16	19.52	31.39	34.70	2.23

Table No. 3

Showing period of collection, kind of feedstuffs and the composition of thte feces.

Collection Period (Days)	Steer	Feeding	1-10 Feces (air-dry gms.)	Dry Matter in Air-Dry Feces	Dry Matter Basis				
					Ash	Protein	Fiber	Nitrogen-Free Extract	Fat
1.5	Red faced	Cotton bolly refuse	3600	94.56	10.27	16.74	32.60	38.89	1.50
3	White faced	Cotton bolly refuse	4369	92.24	7.71	15.71	38.64	35.78	2.16
5	Red faced	Bolly refuse, cottonseed and alfalfa meals	6500	93.10	11.69	17.24	39.56	29.18	2.33
5	White faced	Boolly refuse, cottonseed and alfalfa meals	6050	92.75	14.51	16.60	37.89	29.07	1.93

Table No. 4

Coefficients of digestibility of cotton bolley refuse.

Steer	Feed	Collection Period (Days)	Dry Matter	Ash	Protein	Fiber	Nitrogen-Free Extract	Fat
Red-faced calf	Bolly refuse	1.5	46.75	5.23	10.60	58.22	48.62	66.86
Red-faced calf	Refuse cotton-seed and al-falfa meals	5	32.78			39.77	48.61	46.16
White faced calf	Bolly refuse	3	36.96	15.77	0.67	41.38	44.03	43.50
White faced calf	Refuse, cotton-seed and al-falfa meals	5	41.03		9.23	51.87	54.88	71.63

It is seen from Table No. 4 that the digestion coefficient of all the nutrients in cotton bolly refuse are low. The results for the two steers agree fairly well with the exception of the protein, in which not only they do not agree, but there is no uniformity of results. It has been shown by other investigators that when a feedstuff contains a large amount of indigestible matter, the digestion coefficient of protein is usually low, but in this case not only is the digestion coefficient unusually low, but in one case apparently a negative coefficient was found, and in another case a very low coefficient. It should be noticed also that with one steer the higher coefficient was found in the feeding period with the bolly refuse, and with the other steer the higher coefficient was found when the mixed feed was being used. In order to get the digestion coefficient of the nutrients in bolly refuse when it was fed with cottonseed and alfalfa meals, it was necessary to have the digestion coefficient of these meals, and they were taken from the Fifth Edition of Henry and Morrison's Feeds and Feeding. This affords a possible explatnation for the low or negative digestion coefficient of the protein of the bolly refuse when cottonseed and alfalfa meals were fed, since any decrease in the digestibility of the proteins of the cottonseed and alfalfa meals would cause a lowering of the digestibility of the proteins from the bolly refuse.

Table No. 5

Showing the percent of three constituents in the ash.

	Constituents		
Coyle Sample	P_2O_5	K_2O	CaO
Bolly refuse ash	6.42	26.14	8.69
Bolly refuse	0.33	1.34	0.44
Coyle Sample			
No. lbs. in 2,000 lbs. cotton bolly refuse	6.57	26.77	8.90
Coyle Sample			
No. lbs. in 2,000 lbs. of ash	128.40	522.80	173.80
Thompson Sample			
Bolly refuse ash	7.45	32.01	12.27
Thompson Sample			
No. lbs. in 2,000 lbs. of ash	149.00	640.20	245.40

Table No. 6

Showing the percent of cotton, cottonseed and burrs in two samples of bolly refuse.

	Cotton	Seed	Burrs
Bolly refuse from Thompson Gin Company	3.87	4.06	92.07
Bolly refuse from Coyle Gin Company	9.76	15.5	74.74

The two samples of bolly refuse of which we have made a mechanical analysis probably represent the two extremes in composition of this substance. The sample from the Thompson Gin Company, as shown above, contains 92% of burrs, 4% of seed and 3.87% of cotton. Since the feeding value of the substance will depend almost altogether on the percent of seed present, it is seen that bolly refuse of this composition would not be suitable for feedstuff. This sample was not sold to farmers as a feedstuff, but was used as a fuel under the boiler, which is probably the use to which it is best suited. It is seen that the refuse from the Coyle Gin Company contains nearly four times as much seed as that from the Thompson Gin Company, and it should be borne in mind that it was the Coyle sample that we used in our digestion experiment and, since it is probably a sample of the refuse which has the highest contents of seed, our results would put the feeding value of this substance in a most favorable light.

It would be a fairly easy matter to determine in any particular case whether or not the bolly refuse was suitable for feeding by making a mechanical analysis, such as we have made here. A certain weight of the refuse was taken, being careful to get an average sam-

ple, and this was first divided into burrs and cotton, and then the cotton was ginned by hand and each of the parts then weighed. However, it would not be necessary to go to so much trouble since an inspection of the substance would show whether or not it contained any large amount of seed.

Table No. 7

Showing the composition of cottonseed from bollies, and also the average composition of seed from well-matured cotton.

From Whom the Seed Was Obtained	Water	Ash	Protein	Fiber	Nitrogen-Free Extract	Fat
Altus Cotton Oil Mill	6.43	3.63	17.98	30.40	30.84	10.72
Snyder Cotton Oil Mill	4.90	3.46	19.65	30.00	30.36	11.63
Frederick Cotton Oil Mill	5.67	4.36	19.12	30.56	29.20	11.09
Mangum Cotton Oil Mill	5.50	4.07	18.92	34.20	26.66	10.65
Hobart Cotton Oil Mill	5.04	4.01	20.55	31.18	24.71	14.51
Chickasha Cotton Oil Mill	5.56	3.30	17.94	35.31	27.83	10.06
Independnt Cotton Oil Mill	6.20	5.00	14.06	32.85	34.00	7.89
W. H. Coyle Company	6.74	3.15	21.65	28.58	24.49	15.39
Average of 38 analyses taken from Henry and Morrisons Feeds and Feeding	9.94	4.6	19.9	22.6	24.9	19.0

Attention was called in an earlier part of this bulletin to the fact that no definite conclusions should be drawn with reference to the composition of the seed from bollies on acocunt of the fact that this composition would probably vary from year to year. It is seen, however, from Table No. 7 that the oil content is much lower; in fact, about one-half of the oil content of well-matured seed. This is what would be expected, since the oil is formed from the sugars, and the formation of the oil would probably be either cut short or retarded by the season. The high percent of fiber found in these seed is probably due to the fact that in many cases the seeds were not well formed, and it was not possible to remove the cotton as completely in the ginning as well-formed seed, so that a great part of this fiber is the unremoved cotton. One might conclude from an examination of Table No. 7 that the feeding value of these seed from the standpoint of the protein content would be equal to that of normal seed, but it should be recalled here that the non-proteins are the forerunners of the protein substances; that the proteins are formed from the non-proteins; that the non-proteins are of very much less feeding value than proteins, and on account of the immaturity of these seed it is highly probable that the protein as here determined consists to a great extent of non-proteins, and therefore would have a lower feeding value.

Table No. 8

Showing the composition of cottonseed cake from bollies, hulls from bollies, and the average analyses of these substances produced from well-matured cottonseed.

	Water	Ash	Protein	Fiber	Nitrogen-Free Extract	Fat
Cottonseed cake from Mangum Cotton Oil Company, "cold pressed"	6.96	4.71	23.59	22.46	35.31	6.97
Average "cold pressed"	7.9	4.2	26.1	24.0	30.1	7.7
Cottonseed cake from Hobart Oil Mill Company	6.86	5.22	39.93	12.59	29.96	5.44
Average—good	7.9	6.4	37.6	11.5	28.4	8.2
Hulls from bollies, Hobart Cotton Oil Mill	6.23	2.44	2.25	46.20	41.03	1.85
Hulls—average	9.7	2.7	4.6	43.8	37.3	1.9

What has just been said with regard to the facts shown in Table No. 7 would apply with almost, if not equal, force to the analyses given in Table No. 8. It is noticed that the variation of the composition of cottonseed cake from bollies, and hulls from bollies is not as great as that shown by the bolly seed. It should be noticed that in the analysis of the bolly seed, eight samples were examined, whereas in the case of the cake and hulls but two samples were analyzed, and for that reason we would not be justified in drawing any definite conclusions with reference to the cake and hulls.

Table No. 9

Showing refining loss and other properties of cottonseed oil produced from bolly seed and other data for purposes of comparison.

Sample and Source	Refining Loss	Free Fatty Acids	Specific Gravity 15° C.	Iodine Number (Wijs)	Color of Refined Oil	Odor of Refined Oil
Cottonseed oil from Hobart Cotton Oil Mill, Hobart	23.14%	2.50%	0.9255	104.99	Golden Yellow	Scarcely any odor, agreeable taste
Cottonseed oil from Mangum Cotton Oil Mill, Mangum, Oklahoma..	26.49%	3.75%	0.9260	107.40	Dark red	Disagreeable bad taste
Specifications of Interstate Cottonseed Crushers Association,, 1917						
Choice crude oil	6.00%					
Prime crude oil	9.00%					
Crude oil (according to Lanborn)		1.00%	0.930	105.3 to 107.3 (Leach)		

Table No. 9 shows that the free fatty acids in the two samples of oil were much higher than is allowed; that is, the two samples examined contained 2.5% and 3.75% each of free fatty acids, whereas crude oil, according to Lanborn, should not contain more than 1% of free fatty acids. It is seen also that the refiining loss in these two cases was unusually high; in fact, from three to four times that allowed by the Interstate Cottonseed Crushers Association. The refining loss and the fatty acids, as here given, were determined by the methods adopted by the Interstate Cottonseed Crushers Association for 1917. It is very important to bear in mind that no definite conclusion can be drawn as to the quality of oil from bolly seed from the information contained in this table, but the facts as here given are in harmony with what one would expect to find.

SUMMARY

1. Probably the most important fact brought out in this investigation is that not only bolly refuse will serve as a good roughage, but that when it contains a high percent of unginned cotton, cattle actually gain in weight when given a liberal feeding of it.

2. Contrary to what some predicted, this refuse was eaten, and there was no impairment in the health of the steers while it was fed by itself. On the contrary, they ate all that was given them and gained in weight.

3. The mechanical analyses of the two samples show a wide variation in composition of this substance, and hence we would expect that when it is ginned very closely, removing nearly all the seed, as in the Thompson sample, it would not be suitable as a feedstuff.

4. The analysis of the ash of bolly refuse shows it to be a good fertilizer.

5. Analyses of the cottonseed from bollies, of the oil cake from these seed, show, as would be expected, that the seed are of inferior quality, especially with reference to the oil content of the seed, and that the oil produced from these seed is of low grade. It should be understood, moreover, that the statement in regard to the quality of the oil is made tentatively.