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DRIED CITRUS PEEL AND PULP AS A FEED FOR LACTATING COWS

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Dried citrus peel and pulp proved a satisfactory carbonaceous feed for milk cows when used as fifty per cent of the concentrate mixture. In five separate experiments, citrus peel and pulp yielded an average of 74 therms per hundred pounds. Citrus peel and pulp was found to be a palatable feed except when used in large quantities. No noticeable effects upon the flavor and aroma of milk could be detected as the result of feeding citrus peel and pulp. Neither did the use of this feed in the dairy ration result in extreme scouring.

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DRIED CITRUS PEEL AND PULP AS A FEED FOR LACTATING COWS

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As a by-product of the citrus industry located in the lower Rio Grande Valley of Texas, there are considerable quantities of dehydrated citrus peel and pulp available as a feed for livestock. Since the dehydration plant was constructed in 1938, the production of citrus peel and pulp has averaged about 6,320 tons annually. The producers of citrus peel and pulp estimate that approximately 85% of this feedstuff is composed of the peel, rag and seed of grapefruit and about 15% composed of the refuse from oranges. Before the machinery was installed for the dehydration of this material, representatives of the industry contacted livestock men at the College relative to conducting feeding experiments with this product both to beef cattle and milk cows. Much of the citrus used in the feeding tests reported here was donated for experimental purposes to the Division of Dairy Husbandry by the Rio Grande Valley Citrus Exchange.

Probably due to the fact that the production of citrus peel and pulp is limited to three general areas of the country, our knowledge concerning its feeding value was somewhat limited. California, Florida and Texas are the only sections where citrus is produced in sufficient quantities to permit the production of a feedstuff as a by-product of the citrus industry and in sufficient quantities to warrant the installation of dehydration machinery. Workers at the California Station (6) found that dried orange pulp showed to be equivalent to beet pulp for milk production. Jones, et al., (3) at the Texas Station reported dried citrus pulp and ear corn chops with husk about equal in feeding value as to gains in liveweight when not more than 25% of the concentrates was composed of dried citrus pulp. However, the degree of finish was superior in the group fed ground ear corn. When dried citrus pulp was used as 60% of the concentrate mixture the feed was less palatable, had slightly greater laxative effect, and gains and degree of finish were not so satisfactory as with the ear corn chops. Neal, et al., (5) at the Florida Station found both grapefruit and orange refuse a satisfactory carbohydrate feed for beef cattle. They report both of these feeds to be palatable and to produce a glossy coat of hair and satisfactory gains. In some later work by the same authors (1), dried grapefruit pulp was fed to dairy cattle and yielded 1.2% digestible protein and 76% total digestible nutrients. When compared with beet pulp slightly more milk and butterfat was produced from the cows fed grapefruit pulp than from those fed beet pulp. They concluded that these two by-products are

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TABLE 1. Chemical Analysis of Feeds Used*

Feed	Crude Protein	Fat	Crude fiber	Nitrogen-free extract	Water	Ash	Units crude carotene per gram	Lime	Phosphoric acid
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent		Per cent	Per cent
Dried citrus pulp	5.50	1.71	10.21	63.48	13.23	5.87	0.35	.....	.....
Dried citrus pulp**	5.41	1.81	10.33	66.88	8.41	7.16	.....	.....	.....
Corn and cob meal	9.01	3.13	7.83	68.70	9.70	1.63	.....	0.08	0.43
Cottonseed meal	43.48	6.16	10.28	25.57	8.66	5.85	.....	0.27	2.28
Ground whole oats	8.94	5.46	11.79	58.92	11.00	3.89	.....	0.18	0.66
Wheat bran	17.80	4.14	9.41	53.70	8.63	6.32	.....	0.25	2.81
Alfalfa hay	18.58	1.74	27.27	34.20	8.27	9.94	3.90	1.80	0.66
Ground limestone	.....	.....	.....	.....	.....	.....	.....	53.65	.....

*Analysis made under the direction of G. S. Fraps, Division of Chemistry.
**Average analysis given in Texas Station Bulletin No. 620.

practically equal in feeding value when supplied as bulky carbohydrate feeds to dairy cows. They also were not able to find any characteristic flavor in the milk as a result of feeding dried grapefruit pulp which could be attributed to the feed. Morrison's Feeding Standard (4) shows that the average composition of dried grapefruit refuse, orange pulp and beet pulp are very similar. The grapefruit refuse is somewhat lower in digestible protein than any of the other feeds but is slightly higher in nitrogen free extract.

Although considerable quantities of beet pulp are fed to dairy cattle in this State, most of it is utilized in the mixed feed business. Utilizing beet pulp in this manner does not afford dairy feeders much knowledge concerning its nutritive value as a feed for milking cows. Since the available information from both the Florida and California Stations were comparisons of citrus peel and pulp with beet pulp, it was decided to conduct this investigation comparing citrus peel and pulp with corn and cob meal, a feed with which all dairymen are well acquainted as to its merits for milk production. The chemical analysis of citrus peel and pulp and corn and cob meal (without shuck) are also very similar except that the corn and cob meal is considerably higher in protein. The chemical analyses of the feeds used in the experiments are shown in Table 1.

PLAN OF INVESTIGATION

Both the dairy herds of the Experiment Station and the Dairy Department of the School of Agriculture were used to conduct five separate experiments comparing citrus peel and pulp with corn and cob meal as the chief carbohydrate feed in the concentrate ration for lactating cows. The double-reversal method of feeding was used. In this method cows were paired so that each pair was as nearly alike as possible as to size, stage of lactation, age and milk producing ability based on previous lactations. One cow from each pair was placed in group A and her mate in group B. Group A was started on the corn and cob meal and group B was started on the citrus ration. Each experiment was conducted over a 90-day period. At the end of the first 30-day period the feeds for the two groups of cows were switched so that group A received the experimental ration of citrus peel and pulp and group B was fed the ground ear corn ration. Then at the end of the 30 days the groups were switched back to the same feeds they received at the beginning of the experiment. These three 30-day periods constituted one experiment. The first 10 days of each 30-day period was considered preliminary and the results discarded and the last 20 days considered experimental. In the experiments conducted with the Experiment Station dairy herd, the cows were fed in dry lot. In the experiments conducted by the Dairy Husbandry Department, the cows were not fed in dry lot but were allowed access to pasturage and carbonaceous hay was fed to each group free choice.

Feeds

All concentrates fed to cows both at the Station dairy and Department of Dairy Husbandry were fed in the milking barn. The rate of grain feeding was in accordance with milk production, usually about one pound of grain for each two and one-half pounds milk produced per cow daily. Alfalfa hay was used as a roughage with the Experiment Station herd and was fed twice daily in a shed equipped with individual feeding mangers separate from the milking barn. Sorghum and Sudan grass hay were fed free choice to cows on experiment at the Dairy Husbandry Department. The grain mixture used at the Experiment Station is shown in Table 2 and the grain mixture used by the Department of Dairy Husbandry is shown in Table 2A.

Table 2. Experimental Concentrate Feeds in Pounds

(Experiment Station Herd)

Feeds	Corn and cob meal concentrate mixture	Citrus peel and pulp concentrate mixture
Citrus peel and pulp	0.0	50.0
Corn and cob meal	50.0	0.0
Cottonseed meal	25.0	25.0
Ground oats	10.0	10.0
Wheat bran	12.0	12.0
Oyster shell flour	2.0	2.0
Salt	1.0	1.0

Table 2A. Experimental Concentrate Feeds in Pounds

(Dairy Husbandry Department Herd)

Feeds	Corn and cob meal concentrate mixture	Citrus peel and pulp concentrate mixture
Citrus peel and pulp	0.0	50.0
Corn and cob meal	50.0	0.0
Cottonseed meal	31.0	31.0
Ground oats	8.0	8.0
Wheat bran	8.0	8.0
Oyster shell flour	2.0	2.0
Salt	1.0	1.0

Experimental Animals

In three tests conducted at the Experiment Station dairy, purebred Jersey cows were used in all experiments. In the first experiment there were seven animals in each group and the second and third experiments only six animals were used in each group. There were two experiments conducted by the Dairy Department in which both purebred Holstein and Jersey cows were used. In the first experiment ten animals were used in each group and the second experiment nine cows were used in each group. Only healthy cows were used in these experiments and cows which were not more than three or four months advanced in their lactations so that they were producing a good flow of milk.

Liveweights

Liveweights were taken for three consecutive days at the beginning and end of each 30-day period on all animals in the Experiment Station dairy herd; however, scales were not available so that no liveweights were obtained on the experimental cows from the Department of Dairy Husbandry herd. Individual averages of the 3-day weights were used as the actual weight of each cow at the beginning and end of each period to ascertain whether or not there was loss or gain in the liveweights on the different feeds during the progress of the experiment.

EXPERIMENTAL RESULTS

The value of feeds for milk cows is largely determined by their effect upon milk production. In any feeding test there will be some change in the liveweights of the animals used as experimental subjects. Such changes might or might not be the result of the feed under investigation. There will also be some difference in amount of feed consumed by the cows on the experimental ration as compared with the check ration unless feed consumption is purposely kept the same between both groups of cows. Roughage was fed according to the appetites of the cows and concentrates were fed in accordance with production. Final results of feeding experiments using the double-reversal system are indicated by differences in amounts of feed consumed, milk produced and changes in liveweights between the average of the first and third periods and the second period for each group of cows and finally the average differences are taken between the two groups. The results of milk production for the first experiment conducted at the Experiment Station are shown in Table 3. The results for feed consumption and changes in liveweights were calculated in the same manner as illustrated in Table 3 for milk production.

Milk Production

The results of milk production, feed consumption and changes in the liveweights are shown in Table 4.

Table 3. Milk Production in Pounds During First Experiment Comparing Corn and Cob Meal versus Citrus Peel and Pulp

(Experiment Station Herd)

Cow No.	First 20-day period	Second 20-day period	Third 20-day period	Average first and third period	Average first and third period minus second period
Group A	(corn)	(citrus)	(corn)	(corn)	
412	847.5	752.2	678.4	762.95	+10.75
399	563.4	563.9	532.4	547.90	—16.00
354	806.3	751.5	659.9	733.10	—18.40
401	447.7	436.1	385.1	416.40	—19.70
416	599.3	574.3	523.2	561.25	—13.05
395	562.7	505.0	427.7	495.20	— 9.80
514	716.2	625.6	556.6	636.40	+10.80
Average					— 7.91
Group B	(citrus)	(corn)	(citrus)	(citrus)	
507	781.9	785.5	662.0	721.95	—63.55
347	628.0	617.0	533.3	580.65	—36.35
365	758.6	791.5	683.8	721.20	—70.30
410	504.9	465.3	406.9	455.90	— 9.40
407	562.0	551.5	509.3	535.65	—15.85
403	586.1	545.9	457.9	522.00	—23.90
512	704.9	649.4	595.1	650.00	+ 0.60
Average					—31.25

Table 4. Corn versus Citrus

Average differences in feed consumption, milk production and changes in body weights in pounds during 20-days experimental period

	Corn and cob meal	Citrus peel and pulp	Cotton-seed meal	Wheat bran	Oats	Alfalfa hay	Weight	Milk
(Experiment Station Herd)								
Experiment 1								
Group A (started on corn)	+118.21	−127.86	−4.82	−2.31	−1.93	+5.04	+10.10	− 7.91
Group B (started on citrus)	−133.47	+117.45	−8.01	−3.84	−3.21	−3.46	+ 5.30	−31.25
Difference A—B	+251.68	−245.31	+3.19	+1.53	+1.28	+8.50	+ 4.80	+23.34
Average	+125.84	−122.66	+1.60	+0.77	+0.64	+4.25	+ 2.40	+11.67
Experiment 2								
Group A (started on corn)	+146.28	−136.90	+4.69	+2.26	+1.87	−17.75	+31.08	+40.33
Group B (started on citrus)	−139.17	+140.43	+0.63	+0.31	+0.26	−22.92	+10.34	−20.05
Difference A—B	+285.45	−277.33	+4.06	+1.95	+1.61	+ 5.17	+20.74	+60.38
Average	+142.73	−138.67	+2.03	+0.98	+0.81	+ 2.59	+10.37	+30.19
Experiment 3								
Group A (started on corn)	+119.00	−115.50	+1.75	+0.84	+0.70	−25.00	−37.97	+33.31
Group B (started on citrus)	−112.00	+118.00	+3.00	+1.44	+1.20	−43.62	−48.64	+13.30
Difference A—B	+231.00	−233.50	−1.25	−0.60	−0.50	+18.62	+10.67	+20.01
Average	+115.50	−116.75	−0.63	−0.30	−0.25	+ 9.31	+ 5.34	+10.01
(Dairy Husbandry Department Herd)								
Experiment 1								
Group A (started on corn)	+132.90	−132.00	+0.56	+0.14	+0.14	.....	.....	+26.78
Group B (started on citrus)	−129.70	+132.00	+1.43	+0.37	+0.37	.....	.....	+ 8.75
Difference A—B	+262.60	−264.00	−0.87	−0.23	−0.23	.....	.....	+18.03
Average	+131.30	−132.00	−0.44	−0.12	−0.12	.....	.....	+ 9.02
Experiment 2								
Group A (started on corn)	+124.06	−130.78	−2.52	−1.42	−1.42	.....	.....	− 8.71
Group B (started on citrus)	−154.22	+146.50	−3.02	−1.62	−1.62	.....	.....	− 0.28
Difference A—B	+278.28	−277.28	+0.50	+0.20	+0.20	.....	.....	− 8.43
Average	+139.14	−138.64	+0.25	+0.10	+0.10	.....	.....	− 4.22

In the first experiment at the Feeding and Breeding Station, group A which started on corn produced 7.91 lbs. less milk per cow in a 20-day period while on the corn than when fed the citrus ration. Group B which started on the citrus, however, produced 31.25 lbs. less milk while on the citrus ration than when fed the corn ration. In the second experiment group A starting on the corn and cob meal, produced 40.33 lbs. more milk per cow in 20 days while on the corn ration whereas group B starting on the citrus ration produced 20.05 lbs. less milk per cow during the same period of time while on the citrus ration. The results of the third experiment group A again started on the corn ration produced 33.31 lbs. more milk while fed on the corn ration and group B starting on the citrus ration produced 13.30 lbs more milk while fed citrus than when fed the corn ration. Results of milk production at the Department of Dairy Husbandry showed in the first experiment group A starting on corn produced 26.78 lbs. more milk while on the corn ration and group B starting on citrus produced 8.75 lbs. more milk per cow while fed the citrus ration. In the second experiment group A starting on the corn ration produced 8.71 lbs less milk on the corn ration and group B produced 0.28 lbs. less milk while being fed the citrus ration.

Changes in Liveweight

As previously stated only the cows in the Experiment Station dairy herd were weighed to determine the effects on liveweight as a result of feeding citrus peel and pulp to milk cows. Scales were not available at the Dairy Department to obtain liveweights for that herd. In the first experiment, the cows in group A starting on the corn gained 10.1 lbs. more in a 20-day period while fed the corn ration and the cows in group B starting on citrus gained 5.3 lbs. more in the same period while fed the citrus feed. In the second experiment cows in group A starting on corn gained 31.08 lbs. more while fed corn and the cows in group B starting on citrus gained 10.34 lbs. more when fed citrus. In the third experiment the cows in group A starting on corn lost 37.97 lbs. more when fed corn and the cows in group B starting on citrus lost 48.64 lbs. more when fed citrus.

Results of Feed Consumption

The results of feed consumption show that the feed consumed both as to concentrates and hay were somewhat similar between cows on the two rations. There was slightly more feed consumed, both concentrates and hay, by the cows on the corn ration. It was noted during the progress of the experiment that in the higher producing cows being fed considerable quantities of concentrates, the citrus ration proved slightly less palatable; however, this was only noticeable in animals being fed large quantities of concentrates. The maximum amount of concentrates fed during the progress of the various experiments was

Table 5. Equivalent of Corn and Cob Meal to Citrus Peel and Pulp

Milk and Body Weight in Pounds

	Corn and cob meal	Citrus peel and pulp	Cotton-seed meal	Wheat bran	Oats	Alfalfa hay	Weight	Milk
(Experiment Station)								
Experiment 1	+125.84	—122.66	+1.60	+0.77	+0.64	+4.25	+ 2.40	+11.67
Experiment 2	+142.73	—138.67	+2.03	+0.98	+0.81	+2.59	+10.37	+30.19
Experiment 3	+115.50	—116.75	—0.63	—0.30	—0.25	+9.31	+ 5.34	+10.01
(Dairy Husbandry Department)								
Experiment 1	+131.30	—132.00	—0.44	—0.12	—0.12	.....	.....	+ 9.02
Experiment 2	+139.14	—138.64	+0.25	+0.10	+0.10	.....	.....	— 4.22

sixteen pounds per cow daily. This meant an average daily consumption of eight pounds of citrus for the higher producing cows during their peak of production.

Table 6. Calculation of Productive Value of Citrus Peel and Pulp in Therms

(From Equations in Table 5)
Experiment Station

Productive energy	Experiment 1		Experiment 2		Experiment 3	
	Pounds	Productive value	Pounds	Productive value	Pounds	Productive value
Citrus	122.66	.....	138.67	.....	116.75	.....
Corn and cob meal × .747	+125.84	+94.00	+142.73	+106.62	+115.50	+86.28
Cottonseed meal × .720	+1.60	+1.15	+2.03	+1.46	−0.63	−0.45
Wheat bran × .563	+0.77	+0.43	+0.98	+0.55	−0.30	−0.17
Oats × .719	+0.64	+0.46	+0.81	+0.58	−0.25	−0.18
Alfalfa hay × .436	+4.25	+1.85	+2.59	+1.13	+9.31	+4.06
Milk × .30	−11.67	−3.50	−30.19	−9.06	−10.01	−3.00
Productive energy of citrus peel and pulp	.....	+94.39	.....	+101.28	.....	+86.54
Productive energy per 100 lbs. citrus peel and pulp	.....	76.95	.....	73.04	.....	74.12

Table 6A. Calculation of Productive Value of Citrus Peel and Pulp in Therms

(From Equations in Table 5)
Dairy Department

Productive energy	Experiment 1		Experiment 2	
	Pounds	Productive value	Pounds	Productive value
Citrus	132.00	.....	138.64	.....
Corn and cob meal × .747	+131.30	+98.08	+139.14	+103.94
Cottonseed meal × .720	−0.44	−0.32	+0.25	+0.18
Wheat bran × .563	−0.12	−0.07	+0.10	+0.06
Oats × .719	−0.12	−0.09	+0.10	+0.07
Milk × .30	−9.02	−2.71	+4.22	+1.27
Productive energy of citrus peel and pulp	.....	+94.89	.....	+105.52
Productive energy per 100 lbs. citrus peel and pulp	.....	71.89	.....	76.11

Productive Energy of Citrus Pulp

The value of a carbohydrate feed for milk cows is measured by determining the productive energy content. The productive energy value of a feed is measured from the results of differences in milk production, feed consumption and changes in liveweights for the various periods the cows were fed the experimental feed as compared with the check ration. Because different feedstuffs and milk each have different energy values, these items have been reduced to a common term "productive energy." In the analysis of these data, the productive energy of the feeds was calculated by the Division of Chemistry as illustrated in Texas Station bulletin 461 (2). The calculated productive energy of the feeds used in the corn and cob meal ration was multiplied by the pounds of each feed to obtain the total productive energy supplied by the corn and cob meal ration. Similar calculations were made for differences in milk production. These differences in productive energy were added to or subtracted from the productive energy contained in the corn and cob meal used. The remainder of productive energy was divided by the total pounds of citrus fed to obtain the productive value for the citrus expressed as "therms per hundred pounds" as shown in Tables 6 and 6A. As previously mentioned, the results of changes in liveweights were not included in these calculations because of such wide variations in the results of liveweight changes between the three experiments conducted by the Experiment Station. It is believed that the productive energy values calculated from the differences in milk production and feed consumption more nearly represent the true value of citrus peel and pulp for milk cows than when the changes in liveweights were included because of the extreme variations in liveweights between the three experiments.

DISCUSSION

Results of the effects of feeding citrus peel and pulp in the dairy concentrate mixture using 50% of the entire concentrate mixture as citrus pulp as compared with a similar ration containing corn and cob meal without shuck are presented for five separate experiments. It can be seen from Table 4 that in each experiment except the second experiment conducted by the Dairy Husbandry Department there was a slight difference in milk production favoring the corn ration. The average difference per cow per day when the results of production for both groups were combined was .86 lbs. per day. The same difference in milk production for the two experiments conducted by the Department of Dairy Husbandry was .12 lbs. per cow daily. Both of these average differences in milk production were in favor of the corn and cob meal ration over the citrus pulp ration. However, these differences are so small they cannot be considered as significant. This represents fairly close agreement as to the effects of citrus pulp on milk yields in dairy cows as compared with a ration of corn and cob meal.

The average differences in gains or losses in liveweights between the periods of feeding corn and cob meal as against citrus peel and pulp in the same group of cows as well as between groups for the three experiments showed an average difference in weight of .30 lbs. per cow daily in favor of the corn and cob meal. There was such variation in the results of liveweight changes between the three experiments that this difference of .30 lbs. per cow daily is not significant even though the differences representing gains in each of the three experiments were in favor of the corn and cob meal ration.

Since some investigations have indicated that citrus sometimes caused excessive scouring, all experimental animals were kept under close observation. During the progress of all of these experiments, no extreme laxative condition developed in any of the experiment animals. General thrift was also very similar between the cows fed the citrus peel and pulp as compared to those fed the corn and cob meal. It was our observation that cows fed the citrus ration did show more gloss to their hair even though the feeding periods were comparatively short. We were not able to determine any effects on the flavor and aroma of the milk as the result of feeding citrus. It can be stated that the citrus proved to be palatable even when fed as 50% of the entire concentrate mixture except in cases when fed to the higher producing cows consuming large quantities of feed. There was some refusal although slight in cows consuming 16 lbs. of concentrates daily which represents a consumption of 8 lbs. of citrus.

Corn and cob meal without shuck was used in these experiments as the check for the citrus feed because it was quite similar in chemical composition although the corn and cob meal was somewhat higher in digestible protein than was the citrus peel and pulp. No allowances were made for this difference through adjustments in the amounts of high protein feeds used in the grain mixtures because it was calculated in formulating the grain rations to be used that ample protein was available in both feeds. It was assumed that any excess protein furnished by either ration could be utilized for energy purposes. In Tables 6 and 6A giving the calculations of the productive value of citrus peel and pulp in therms as determined from the results of milk production and feed consumption shows that the two feeds are almost identical as to their productive energy values. The results as given in these Tables show the productive energy value of corn and cob meal and citrus peel and pulp to be almost exactly the same. The productive energy for corn and cob meal is 74.7 therms per hundred pounds as compared to an average for the five experiments of 74.42 therms per hundred pounds of citrus peel and pulp. This average does not include calculations based on differences in liveweight changes because they did not appear to be of significance and also because liveweight changes were not taken in the two experiments conducted by the Dairy Husbandry Department. Since slightly more milk was produced as a result of feeding the corn and cob meal as compared with the citrus peel and pulp although the

productive energy values of the two feeds as shown by these results were almost identical, the differences in production favoring corn and cob meal must have been due to the extra amount of feed consumed by the cows while being fed the corn and cob meal ration. This verifies a previous statement that the citrus pulp was not quite as palatable as the corn in the higher producing cows which consumed large quantities of concentrates. These experiments represent a rather critical test for citrus pulp because of the high percentage which was used in the concentrate mixture. Where such favorable results were obtained using the large quantities as reported in these experiments, it can safely be assumed that equally good results would be obtained if smaller amounts were used; that is, 25% of the entire grain mixture instead of 50%. In future work we plan to use smaller quantities and conduct some experiments comparing citrus peel and pulp with beet pulp; however, since the beginning of the war, we have been unable to secure citrus some of the time and have never been able to obtain beet pulp.

CONCLUSIONS

Five experiments have been conducted with lactating dairy cows comparing a concentrate ration containing 50% citrus peel and pulp with a similar concentrate ration containing 50% ground corn and cob meal without shuck.

The results of milk production and changes in liveweights show a slight difference favoring the ground corn ration.

The productive energy value of citrus peel and pulp as calculated from the results of these five experiments showed an average of 74.42 therms per hundred pounds as compared with 74.7 therms for corn and cob meal.

Citrus peel and pulp when fed in moderate quantities proved to be as palatable as corn and cob meal. In extremely hot weather citrus peel and pulp when fed in moderate quantities has a beneficial effect upon the appetite of dairy cows. It seemed that the citrus ration did have a slight effect upon the degree of glossiness in the coat of hair. We were not able to detect any noticeable effect upon the flavor and aroma of the milk produced by cows fed as much as 8 lbs. daily of citrus peel and pulp. Even when fed in large quantities, it did not produce an extreme laxative condition to the cows.

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