

ANNUAL REPORT
DECEMBER 31, 1988

Project No. 87-F1 - Tree and Crop Research
Nutritive Value of Almond Hulls for Horses
Part 1 - Digestion Trial
Part 2 - Feeding Trial

Project Leaders: Digestion Trial - Dr. Anne Rodiek
Department of Animal Science and Agricultural Education
California State University, Fresno
Fresno, CA 93740
(209) 294-2799 or 2971

Feeding Trial - Mr. Mike Lund
Animal Sciences and Industry Department
Cal Poly
San Luis Obispo, CA 93407
(805) 756-6110 or 2419

Personnel/Cooperators: Digestion Trial - Shawnalee Petty and
undergraduate students

Feeding Trial - Mr. John W. Algeo, Department Head
and Susan Perles, undergraduate
student

Objectives:

Digestive Trial - Determine the horse digestibilities of almond hulls when fed as different percentages in all-forage isonitrogenous diet.

Feeding Trial - Compare growth and performance of horses fed four rations containing differing levels of hulls as determined by the digestion trial.

Interpretive Summary: Feeding Trial

Thirty-two yearling horses of Quarter Horse breeding were randomly assigned by weight and sex to four groups. These groups were placed on four rations balanced to be isonitrogenous and isocaloric and meeting the normal growing needs for young horses. The four diets were 0% almond hulls, 15% almond hulls and 30% almond hulls, all pelleted, and 15% almond hulls, unpelleted.

Horses were fed for 120 days and weighed initially and every 28 days thereafter. Although statistical analysis of the data has not been completed, average daily weight gains between the four groups appear very similar with a range of 1.36 to 1.48 pounds per day. Other parameters evaluated were wither height, hair coat and body condition. No apparent differences were noted here either.

No apparent digestive problems were encountered and based on this trial it appears that almond hulls can be substituted for up to 30% of a normal growing ration for yearling horses.

Experimental Procedure:

Thirty-two Quarter Horse and Paint yearlings of similar genetic backgrounds were randomly assigned to four groups by weight and sex. Geldings and fillies only were used in the trial. Each of the four groups were placed in feedlot pens and randomly assigned to one of four treatment groups. These treatment groups were:

- Group 1 - 0% almond hulls - ration completely pelleted
- Group 2 - 15% almond hulls - ration completely pelleted
- Group 3 - 30% almond hulls - ration completely pelleted
- Group 4 - 15% almond hulls - ration fed unpelleted

Horses were accustomed to facilities and herdmates for 20 days and then were started on their respective ration. Feeding trial lasted for 120 days. Horses were weighed individually on a large walk on scale at onset of the trial and every 28 days thereafter until trial was terminated. Feeding was done in a group in a cement fenceline bunk with adequate space to accommodate all animals. Feed was weighed and fed at 3% of that group's average initial body weight and kept on this level throughout the trial. Feed was split into two daily feedings.

All four rations were balanced to be isocaloric and isonitrogenous to fit the recommended dietary needs of yearling horses. Table 1 shows a nutritive analysis of the almond hulls used in the rations. Table 2 shows the calculated analysis of the four rations and Table 3 shows the proximate analysis of the four rations done in the laboratory. Table 4 shows the actual make up of the four rations as fed. Trace mineralized salt blocks and fresh water were available free choice at all times.

Table 1 - Proximate Analysis of Almond Hulls

Moisture	%	11.20
Dry Matter	%	88.80
Crude Protein	%	4.48
Crude Fat	%	2.15
Ash	%	5.57
Crude Fiber	%	11.07
NFE	%	65.53

Table 2 - Calculated Analysis of Rations

	Ration Number and Percent			
	1	2	3	4
	Control All Hulls - 0	All Hulls 15%	All Hulls 15% - Unpel.	All Hulls 30%
<u>Calculated analysis:</u>	%	%	%	%
Dry matter	88.27	88.55		88.68
Crude protein	14.13	13.90		13.71
Est. net energy, mcal/cwt	50.87	50.90		52.31
TDN	61.96	62.00		63.71
Dig. energy, mcal/cwt	124.10	124.15		127.58
Crude fat	2.73	2.49		2.31
Crude fiber	17.80	17.59		16.58
Calcium	0.91	0.88		0.83
Phosphorus	0.32	0.33		0.33
Potassium	1.29	1.34		1.37

All rations pelleted except #3.

Table 3 - Proximate Analysis of Rations Fed

		Ration Number and Percent			
		1	2	3	4
		Control All Hulls - 0	All Hulls 15%	All Hulls 15% - Unpel.	All Hulls 30%
Moisture	%	10.39	10.42	11.00	10.22
Dry Matter	%	89.61	89.58	89.00	89.78
Cr. Protein	%	12.02	12.75	14.24	13.95
Crude Fat	%	2.67	2.68	3.06	7.16
Ash	%	11.19	10.16	7.79	9.19
Crude Fiber	%	16.47	15.20	15.78	12.69
Calcium	%	1.02	.87	.89	.84
Phosphorus	%	.31	.31	.37	.36
NFE	%	47.26	48.79	48.13	46.79

Table 4 - Rations as Fed

Item	Ration Number and Percent			
	1	2	3	4
	Control Al Hulls - 0	Al Hulls 15%	Al Hulls 15% - Unpel.	Al Hulls 30%
	%	%	%	%
Alfalfa hay	40.00	35.00	Same	30.00
Oat hay	20.00	17.00	as	10.30
Corn, st/lb	14.00	9.00	Ration	6.00
Oats	14.00	9.00	2	6.00
Soybean meal	6.40	9.30		12.00
Almond hulls	0	15.00		30.00
Cane Mal/Raybig 80/20	4.00	4.00		4.00
HP-2, vit. min.	0.50	0.50		0.50
Limestone	0.30	0.30		0.30
Biophos 21P	0.30	0.40		0.40
Salt	0.50	0.50		0.50
	100.00	100.00		100.00

All horses were dewormed at the onset of the trial and again about 90 days into the trial. Hoof trimming was done at this same time. One horse in group two was removed from the trial because of laminitis symptoms during the 20 day acclimation phase, and one horse was removed from group 3 due to a severe eye injury.

At the onset of the feeding trial, wither height measurements were taken and a visual score was assigned to each horse for body condition and hair coat. Body condition was rated at 1 to 5 with 1 = thin and 5 = fat. Hair coat was 1 to 5 with 1 = dull and 5 = glossy. Wither height and body and hair coat scores were again assigned at the end of the trial.

Results

Beginning and ending average weights and calculated average daily gains are shown in Table 5. Statistical analysis has not been done on any of the data as yet.

Table 5 - Weight Gains

<u>Group</u>	<u>Almond Hulls level (%)</u>	<u>Initial wt. (lbs)</u>	<u>Final wt. (lbs)</u>	<u>Gain (lbs)</u>
1	0	739	916	1.48
2	15	756	919	1.36
3	30	728	900	1.43
4	15 (unpelleted)	758	931	1.44

Initial and Final wither heights and changes, hair coat scores and body condition scores are shown on Tables 6, 7 and 8 respectively. Statistical analysis has not yet been ^{done} on this data either.

Table 6 - Wither Height Measurements

<u>Group</u>	<u>Almond Hulls level (%)</u>	<u>Avg. Initial Ht. (inches)</u>	<u>Avg. Final Ht. (inches)</u>	<u>Avg. Gain (inches)</u>
1	0	55.61	57.46	1.85
2	15	55.57	57.36	1.79
3	30	55.03	56.53	1.50
4	15 (unpelleted)	56.16	58.13	1.97

Table 7 - Hair Coat Scores

1 = Dull 5 = Glossy

<u>Group</u>	<u>Almond Hulls level (%)</u>	<u>Avg. Initial Score</u>	<u>Avg. Final Score</u>	<u>Avg. Gain</u>
1	0	3.50	3.78	+ .28
2	15	3.28	4.07	+ .79
3	30	3.37	3.87	+ .50
4	15 (unpelleted)	2.81	3.93	+ .12

Table 8 - Body Condition Scores

1 = Thin 5 = Very Fat

<u>Group</u>	<u>Almond Hulls level (%)</u>	<u>Avg. Initial Score</u>	<u>Avg. Final Score</u>	<u>Avg. Gain</u>
1	0	3.28	4.28	+ 1.00
2	15	3.28	4.07	+ .79
3	30	3.37	4.25	+ .88
4	15 (unpelleted)	3.06	3.93	+ .87

Discussion

Although statistical analysis of all the data has not been completed, differences between treatments do not appear important. Therefore it would show that almond hulls may be substituted for up to 30% of a normal growing ration for Quarter Horse/Paint yearlings without any detrimental effect. There did not appear to be any problems associated with the feeding trial such as colic, sore mouths, diarrhea or unpalatability. Boredom among the horses led to mane and tail chewing.

Further research may be of value to evaluate other levels, ration preparation or exercising of horses. Yearlings are normally kept in large paddocks for adequate exercise whereas in this study horses were confined to control feeding.

1987 ANNUAL REPORT - ALMOND BOARD OF CALIFORNIA RESEARCH PROJECTS

Section II - Tree and Crop Research

Project No. 87-F1 - Tree and Crop Research
Nutritive Value of Almond Hulls for Horses
Part 1 - Digestion Trial
Part 2 - Feeding Trial

Project Leaders: Digestion Trial - Dr. Anne Rodiek
Department of Animal Science and Agricultural Education
California State University
Fresno, CA 93740
(209) 294-2799 or 294-2971

Feeding Trial - Mr. Mike Lund
Animal Sciences and Industry Department
Cal Poly
San Luis Obispo, CA 93407
(805) 756-2698 or 756-2419

Personnel/Cooperators: Digestion Trial - Shawmalee Petty and
undergraduate students

Feeding Trial - Mr. John W. Algeo (Department Head)
and undergraduate students

Objectives: Digestion Trial - Determine the horse digestibilities of almond hulls when fed as different percentages in an all-forage isonitrogenous diet. Feeding Trial - Compare growth and performance of horses fed four rations containing differing levels of hulls as determined by the digestion trial.

Interpretive Summary: Little prior research has been done concerning the use of almond hulls for horses. Work has been done with dairy cows, beef cattle and swine but virtually none on horses. There have been numerous inquiries about the possibilities of feeding almond hulls to horses and potential problems correlated with hull levels fed.

Almond hulls contain approximately four percent crude protein and 30 percent sugar. They are highly palatable to horses and are competitively priced compared to alfalfa hay. Hulls are easier to store and handle than long hay, especially in urban areas where space is limited and waste disposal is a problem. As such, they may be a viable alternative or supplement to hay, especially for mature horses whose protein requirements are relatively low. Another possible use for almond hulls may be as an ingredient in a pelleted concentrate.

A two-part study is being conducted to determine the nutritive value of almond hulls as an alternative feed source for horses. A representative sample of the 1987 Nonpareil crop has been physically and chemically analyzed and will

1987 ANNUAL REPORT - ALMOND BOARD OF CALIFORNIA RESEARCH PROJECTS

be used in all experimental rations. Physical examination showed that the hulls contained 86.8 percent hulls, 6.1 percent shells and meats (0.7% meats) 1.7 percent twigs and 5.4 percent shell and hull fines. Chemical analysis revealed that the hulls contained 5.2 percent crude protein (CP), 46.7 percent acid detergent fiber (ADF), 5.0 percent ash and 3.6 percent fat.

The first part of the study is a digestion trial underway now. Four mature geldings (5-7 years) are being used in a four-by-four Latin Square experimental design to determine the effects of four levels of almond hulls on ration digestibilities. The four levels being fed are zero (control), 15, 30, 45 percent of the ration by weight. The four experimental diets, composed of the almond hulls, oat hay and alfalfa hay are pelleted and formulated to be isonitrogenous to provide approximately 11 percent crude protein. To date, even horses being fed rations containing 45 percent hulls are doing well. Analysis of variance will be performed on the data to determine significant treatment effects.

The follow-up feeding trial at Cal Poly is scheduled to start April 1. Tentatively the treatments will be 0 percent hulls (control), 15 percent hulls in a pelleted ration, 15 percent hulls fed whole in a non-pelleted ration, and 30 percent hulls in a pelleted ration. The hulls will be incorporated into balanced diets at the expense of the grain portion of the ration and the final percentages of hulls used will be determined on the basis of the digestion trial results. Eight yearlings will be fed each of the four experimental rations. Horses will be weighed and wither height will be measured. Additional qualitative scores will be assigned concerning hair coat, body condition, ration palatability and any feeding problems.

* * *