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Project: Nutritional Value of Almond Hulls for Dairy Cows

Objectives: (1) To determine degree of variation in chemical (nutrient) content in almond hulls from different areas and varieties. (2) To determine relationships among chemical constituents of almond hulls, ruminant digestive function, and nutritive value for ruminants.

Background: Almond hulls have been used in diets for ruminants and, particulary, dairy cattle for several years. In most instances of diet formulation, only one average nutritive value for almond hulls is used. Almond hulls are known to vary in chemical composition depending (possibly) on location, variety, year, and processing method. It has been suggested that crude fiber be used to assess nutritive value of almond hulls. Most hulls, however, are comprised of over 60% nitrogen-free extract (NFE). The chemical components which comprise NFE vary widely among plant sources and are largely determinant of nutritive value. The quantities of soluble sugars and organic acids relative to pectins and hemi-cellulose, for example, exert major influences on rumen digestion and fermentation and thus on the nutritive value of the feedstuff. In turn, the optimum form of nitrogen supplementation is affected by the chemical make-up of NFE. Very little is known of the specific chemical constituents in almond hulls and their variability with location and variety. Such information is needed to accurately assess feeding value and devise optimum methods of feeding for dairy cattle and other ruminants.

Procedures: The work described herein is designed to provide basic information needed for the design of meaningful feeding studies with lactating dairy cows.

(1) Six samples, each of Nonpareil and other varieties, will be obtained from three different locations. Chemical determinations of each sample will include: soluble sugars; organic acids; starch, pectin; hemicellulose; cellulose; lignin; total nitrogen (crude protein); and, ADF bound N. Ether extract, crude fiber, and ash will be determined as a comparison against earlier data. Digestibilities and rates of fermentation will be determined on each sample using a range of proportions of protein and non-protein nitrogen. Relationships among chemical components of almond hulls, optimum nitrogen source, and rate and extent of fermentation will be determined.

(2) Data collected in part (1) will be used to formulate diets to be fed to 3 rumen fistulated dairy cows. Diets will be cubed in conjuction with the processing and cubing studies proposed by Agric. Engineers at UCD. Almond hulls with the widest differences in composition and in vitro fermentation parameters will be used in the diets for the cows to determine if relationships observed in vitro are similar to those observed in the animal. Serial samplings with time after feeding will be utilized to determine digestion and fermentation patterns and microbial growth yields.

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ENVIRONMENTAL SCIENCES
AGRICULTURAL EXPERIMENT STATION
DEPARTMENT OF ANIMAL SCIENCE

DAVIS, CALIFORNIA 95616

January 16, 1978

Mr. Robert K. Curtis
Associate Research Director
Almond Board of California
P. O. Box 15920
Sacramento, California 95813

Dear Bob:

Enclosed is a project progress report and a table showing data on almond hull samples collected to date. Work is progressing quite well.

We were quite surprised and excited by the degree of variability in the components measured thus far. The lack of a clear-cut relationship between these components probably means that the current method of evaluating hulls (crude fiber) is just not adequate. It should get really interesting when we complete our more rigorous analyses and begin to relate these components to actual nutritional value.

If you have any comments or questions, let me know.

Sincerely,

Nathan Smith

N. E. Smith

NES/df

Enclosure

Project Progress Report (1/12/78)

Nutritional Value of Almond Hulls for Dairy Cows

N. E. Smith and R. L. Baldwin, U. of Calif., Davis

Work has been progressing on the first objective of the project which was to determine the variability in chemical composition of almond hulls. By 11/15/77, 36 samples had been received from three different areas of the state (Chico, Modesto and Fresno - Bakersfield). Varieties of hulls represented included 16 samples of non pariel, 6 of Merced, 10 of Neplus and 4 mixed. Hulls were from four different types of hullers.

Proximate analysis of the samples is completed and results are in Table 1. The results show considerable variation in the commonly determined constituents and that composition varies by area and/or hulling operation as well as by variety. For example, the range for all samples is 4.7 to 8.9% crude protein, 12.4 to 24.9% crude fiber and 1.7 to 11.5% ether extract (lipid or fat). At least three factors are of note from these findings:

1. There is tremendous variability in composition of hulls. These would appear to be considerable value in separating out the effects of variety, locality and method of processing on this variability.

2. ADF bound protein is low in almost all cases indicating that, although total protein is quite low in hulls, it is probably available for utilization by the animal. Further work is needed to determine this.

3. There appears to be no specific relationship between protein, fiber and ether extract (lipid) content of the hulls. For example, some of the samples highest in fiber are also high in lipid while others are low in lipid. Similarly, samples low in fiber are both high and low in lipid. Under the present nutritional evaluation system, all samples with high crude fiber would be given a lower value than those with lower fiber. The results support the hypothesis that factors other than crude fiber must be considered in determining nutritional value of almond hulls.

Further analysis of the samples relative to organic acid and specific carbohydrate components have been initiated and results will be forthcoming. These results, along with laboratory and animal digestion work will be utilized in developing a more accurate method of nutritionally evaluating almond hulls.

Table 1. Preliminary Determination of Chemical Composition of Almond Hulls (% of dry matter)

Huller	Hull type	Huller Type	Crude Protein	ADF Bound Protein	Crude Fiber	Ether Extract	Ash
Art Van Spronsen, Modesto							
1.	Non Pariel	RMC Shear Roll	6.0	.8	13.8	2.0	6.0
2.	"	"	6.2	.7	12.4	1.8	6.6
3.	"	"	6.1	.8	13.0	1.7	6.3
4.	"	"	5.8	.8	12.3	1.9	6.3
5.	"	"	6.0	.8	12.6	1.8	6.4
6.	"	"	5.8	.8	13.2	1.9	6.4
7.	Merced	"	5.8	.7	14.4	3.4	7.0
8.	"	"	5.7	.6	14.4	2.8	7.7
9.	"	"	5.3	.6	14.0	2.5	7.4
10.	"	"	5.3	.7	14.8	2.2	7.0
11.	"	"	4.9	.8	14.1	2.1	7.3
12.	"	"	5.6	.7	14.2	2.2	7.2
13.	Neplus	"	5.4	.7	17.7	2.5	7.6
14.	"	"	5.7	.7	19.2	2.3	7.5
15.	"	"	5.9	.7	18.3	2.4	7.7
16.	"	"	6.0	.7	17.4	2.5	7.7
17.	"	"	6.2	.7	18.0	2.8	7.9
18.	"	"	5.7	.7	18.2	2.1	7.8
Continental Nut Co., Chico							
1.	Non Pariel	RMC Ripson Mfg. Co.	8.8	1.0	15.6	12.0	5.7
2.	"	"	5.1	1.3	16.6	5.4	5.2
3.	"	"	5.0	1.3	15.5	5.3	5.2
4.	"	"	7.0	1.0	15.9	7.3	5.8
Nord Almond Services Chico							
1.	Non Pariel	Agmac	5.0	1.4	16.3	6.6	5.5
2.	"	"	4.8	1.4	15.8	7.1	5.4
3.	Neplus	"	6.7	1.3	18.3	3.9	8.3
4.	"	"	6.5	1.4	17.8	4.4	7.6
Tenneco West, Inc., Chico							
1.	Non Pariel	Miller	8.9	.7	12.1	11.5	5.2
2.	"	"	6.1	.7	14.7	5.6	6.8
3.	Neplus	"	6.7	.7	23.0	5.4	6.8
4.	"	"	5.9	.6	24.9	3.6	7.3
Superior Farms, Bakersfield							
1.	Non Pariel	?	5.8	.7	14.8	3.9	6.3
2.	Mixed	?	5.0	1.2	17.9	2.6	12.0

Calif. Almond Exch., Fresno							
1.	Non Pariel	?	4.7	.7	14.9	2.1	7.0
2.	Mixed	?	5.3	.6	15.2	2.8	6.7
Roberts Farms, Bakersfield							
1.	Mixed	?	6.9	1.0	18.1	4.5	6.7
Paso Robles							
1.	Mixed	?	6.4	.8	20.1	3.7	7.3