

Evaluation of Pineapple Juice Presscake as a Ruminant Feedstuff in Hawaii

Steven E. Olbrich, Richard O. Kellems, Anh Nguyen,
and Oliver Wayman

ABSTRACT

Wet pineapple juice presscake (solids from the juice press) was evaluated as a ruminant feedstuff. The presscake was found to have an average of 21 percent dry matter and an average pH of 3.95. The *in vitro* dry-matter digestibility was 83.8 percent, which was higher than either pineapple bran (77.4) or pineapple greenchop (62.6). Pineapple presscake could serve as a replacement or substitute for pineapple bran or pineapple greenchop. One pound of pineapple bran could be replaced by 4 pounds of pineapple presscake, and 3 pounds of pineapple greenchop could be replaced by 2 pounds of pineapple presscake.

Key Words: by-product feed, *in vitro* evaluation, pineapple, pineapple bran, pineapple greenchop, pineapple juice presscake, ruminant feedstuff, roughage

Numerous research trials have been conducted on the use of all or parts of the pineapple plant and by-products as ruminant feedstuffs. Experiments conducted by the Animal Sciences Department at the University of Hawaii have shown that pineapple plant products generally supply a moderate to relatively high level of readily available energy when used as cattle feed (Henke, 1931; Otagaki et al., 1961; Stanley and Morita, 1966; Olbrich and Wayman, 1973).

Pineapple bran is a by-product that has been used for many years as a high-energy roughage for both beef and dairy cattle. During the peak of the canning season, it is often difficult to dry all the material from which bran is produced because of the large volume and high moisture content. On a dry-matter basis, approximately 15 percent of the ingredients of pineap-

ple bran comes from the juice press. This material is referred to by several names including juice plant pulp, juice press residue, pressed pineapple core, pineapple presscake, pineapple juice presscake, Beloit presscake, and presscake. Although this wet material is generally included with the other materials that go into pineapple bran, it is the hardest to dry due to its fibrous nature and its tendency to roll into "balls." Because of this tendency, drying time to a safe level for storage is prolonged and the quantity that can be dried is reduced. This becomes particularly critical during peak canning periods when the quantity of material to be dried often exceeds dryer capacity.

Thus, if a permanent market could be developed for wet presscake, it could be excluded from the pineapple bran, and this would enable the processing of more pineapple bran at a lower fuel cost per ton. Wet presscake is currently being offered for sale by a local cannery.

The objective of this investigation, therefore, was to obtain and provide information to Hawaii dairymen and cattlemen on the relative feeding value of wet pineapple presscake.

EXPERIMENTAL PROCEDURE

Randomly chosen samples of pineapple presscake were collected during the 1977 canning season. Data from samples

Steven E. Olbrich is State and Area Dairy Specialist, Cooperative Extension Service, College of Tropical Agriculture, University of Hawaii.

Richard O. Kellems was Research Associate, Department of Animal Sciences, College of Tropical Agriculture, University of Hawaii.

Anh Nguyen was Research Analyst, Department of Animal Sciences, College of Tropical Agriculture, University of Hawaii.

Oliver Wayman is Professor, Department of Animal Sciences, and Animal Scientist, Hawaii Agricultural Experiment Station, College of Tropical Agriculture, University of Hawaii.

taken during previous seasons were also used for comparison.

Dry matter was determined on subsamples of the wet presscake by the Association of Official Analytical Chemists' (AOAC) method (1975). The remaining portions of the samples were dried in a forced-air oven at 50°C. After drying, each sample was ground through a 1-mm screen in a Thomas-Wiley Mill for laboratory analysis. Crude protein, ash, and ether extract were determined on each sample as outlined in AOAC (1975). Each sample was also analyzed for neutral detergent fiber, acid detergent fiber, lignin, cellulose, and silica (Goering and Van Soest, 1970). *In vitro* dry-matter digestibility was determined as described by Mellenberger et al. (1970). The pH was determined on random samples using a Corning (Model 7) pH meter.

RESULTS AND DISCUSSION

Average, maximum, and minimum values of pineapple presscake, showing variability for chemical analyses and *in vitro* digestibility for samples analyzed, are given in Table 1. Average values for pineapple greenchop and pineapple bran are included for comparison.

The average dry matter of the pineapple presscake was 21.0 percent, which is slightly higher than the 18.3 percent average for pineapple greenchop. The fiber levels for pineapple presscake were relatively high, nearly the same as for pineapple greenchop.

The neutral detergent fiber procedure is a method of analyzing the total fiber in a feedstuff. Neutral detergent fiber is comparable to the cell wall constituents of a plant and contains cellulose, hemicellulose, lignin, cell wall silica, and some fiber-bound protein. The portion of the sample not appearing as neutral detergent fiber is termed neutral detergent solubles or cell contents. This portion is very digestible (95+ percent), while the neutral detergent fiber is only partially available and must undergo breakdown by microbial fermentation in the rumen before it can be used by the animal as a source of energy. The values for neutral detergent fiber in pineapple presscake and pineapple greenchop are close, leading one to expect the two feedstuffs to be of similar value.

Acid detergent fiber is composed primarily of cellulose and lignin, and often silica is present. Pineapple presscake was only slightly lower in acid detergent fiber (34.3 percent) than pineapple greenchop (35.0 percent). Purified cellulose is highly digestible by rumen microorganisms and can serve as a valuable source of energy to cattle. However, because cellulose occurs in the plant cell wall, it is often associated with the compound lignin, which is a complex polymer of aromatic alcohols found in the cell walls of all woody plants. Cellulose gives plants their flexible strength, while lignin gives them their rigid structural strength. The exact chemical configuration of lignin is still unknown, and the relationship (physical and chemical) between lignin and cellulose is still unclear. It is known that lignin is essentially indigestible by the ruminant animal and the microorganisms in its digestive tract. In addition, lignin is chemically and physically bound to cellulose and actually decreases the effectiveness of microbial breakdown of the other plant cell wall components. In general, the higher the lignin content of a plant, the lower the digestibility of that plant.

Lignin values for pineapple presscake are lower than those for pineapple greenchop, which suggests that pineapple presscake should be slightly more digestible than pineapple greenchop. This is substantiated when a comparison is made between the *in vitro* digestibility of pineapple presscake and pineapple greenchop. The *in vitro* dry-matter digestibility of pineapple presscake (83.8 percent) is slightly higher than that of pineapple bran (77.4 percent) and much higher than that of pineapple greenchop (62.6 percent). Thus, on a dry-matter basis, pineapple presscake is very similar in energy to pineapple bran. As a rule of thumb, 1 pound of pineapple bran would be approximately equal to 4 pounds of pineapple presscake.

The ash content of pineapple presscake is low—only 2.6 percent on a dry basis, or 0.55 percent on a wet basis. This indicates that it is a relatively clean product with little soil contamination.

The 3.95 pH of pineapple presscake is also low, meaning that the natural acidity of the product is high. Because of this high acidity, the product has a keeping life of about 1 week before oxidation of plant organic acids occurs and microbial action starts to raise the pH, permitting spoilage to begin. This

Table 1. Chemical composition and dry-matter digestibility of pineapple presscake

| Sample | Chemical composition (percentage on dry-matter basis) | | | | | | | | | | <i>In vitro</i> dry-matter digestibility (%) |
|----------------------------------|---|-------------------------------|----------------------------|------------------------|-----------|--------|-----|------------------|------------------|-----------------|---|
| | Dry matter (%) | Neutral detergent fiber | Acid detergent fiber | Permanganate lignin | Cellulose | Silica | Ash | Crude protein | Ether extract | pH | |
| Pineapple presscake | | | | | | | | | | | |
| Average | 21.0 | 65.4 | 34.3 | 4.4 | 27.8 | 0.3 | 2.6 | 5.3 | 0.7 | 3.95 | 83.8 |
| Maximum | 25.9 | 75.1 | 39.6 | 6.2 | 32.1 | 0.4 | 3.1 | 6.3 | 1.0 | ND ¹ | 85.4 |
| Minimum | 16.7 | 50.6 | 28.4 | 3.4 | 24.2 | 0.2 | 2.0 | 4.8 | 0.5 | ND | 81.9 |
| Pineapple greenchop ² | 18.3 | 63.7 | 35.0 | 7.3 | 26.1 | 0.5 | 6.4 | 7.6 | 2.2 | 4.15 | 62.6 |
| Pineapple bran ² | 88.5 | 58.7 | 27.7 | 4.8 | 21.8 | 0.3 | 3.4 | 4.9 | 0.7 | ND | 77.4 |

¹ ND = not determined on all samples.

² Values based on samples randomly obtained during the 1975 and 1977 seasons.

high acidity also prevents the product from undergoing a natural lactic acid fermentation that aids in preservation. Therefore, long-term storage as an ensilage may not be feasible, unless this product is mixed with another less-acid product or the acidity is neutralized so that fermentation can take place.

RECOMMENDATIONS

Until further information is available, the following set of feeding suggestions should be used:

1. Do not feed more than 30 pounds of wet presscake per cow per day. (This is an amount that several dairies have already successfully fed.)
2. Use pineapple presscake as a replacement or substitute for pineapple bran or pineapple greenchop. One pound of pineapple bran can be replaced by 4 pounds of pineapple presscake; 2 pounds of pineapple presscake can be substituted for 3 pounds of pineapple greenchop.
3. If you are already feeding pineapple bran and pineapple greenchop but wish to feed additional quantities of pineapple presscake, you will need to rebalance your entire ration. Since pineapple by-products generally have low levels of crude protein with low metabolizable value, it is suggested that the protein in presscake be disregarded when balancing the ration. Also, assume that the presscake adds no calcium or phosphorus. If possible, blood samples should be taken before and after feeding to be sure calcium, phosphorus, magnesium, and copper/molybdenum are in proper ratios in the diet. This is based on the fact that blood values recently obtained on Oahu from milking cows fed relatively large amounts of locally produced feedstuffs have been abnormally high in phosphorus and low in magnesium. Also, chemical analyses of pineapple by-products have often shown them to have high molybdenum and low copper—a potentially dangerous ratio.

4. When starting to feed pineapple presscake, feed it in gradually increasing increments. Take a week to 10 days to bring the animals to full feed on the product. This is to allow the animals time to adjust to the high natural acidity of the product.
5. The keeping quality of the product may be enhanced by mixing it with equal parts by weight of pineapple greenchop. This is based on several field observations.
6. On an as-fed basis, assume the total digestible nutrients (TDN) of presscake to be approximately 15. The actual estimated TDN would be 17.6, but by using 15, a margin of safety is assured until further data are available.

LITERATURE CITED

- Association of Official Analytical Chemists. 1975. Official methods of analysis. 12th ed. Washington, D.C.
- Goering, H. K., and P. J. Van Soest. 1970. Forage fiber analyses (apparatus, reagents, procedures, and some applications). U.S. Dep. Agr., Washington, D.C., Agr. Handbook 379.
- Henke, L. A. 1931. Pineapple bran as a feed for livestock. Hawaii Agr. Exp. Sta. Circ. 2.
- Mellenberger, R. W., L. D. Satler, M. A. Millet, and A. J. Baker. 1970. An *in vitro* technique for estimating digestibility of treated and untreated wood. J. Animal Sci. 30:1005.
- Olbrich, S. E., and O. Wayman. 1973. Evaluation of pineapple centrifuge underflow as a cattle feedstuff. Hawaii Agr. Exp. Sta. Res. Rep. 222.
- Otagaki, Kenneth K., G. P. Lofgreen, Estel Cobb, and Gerald G. Dull. 1961. Net energy of pineapple bran and pineapple hay when fed to lactating dairy cows. J. Dairy Sci. 44:491.
- Stanley, R. W., and K. Morita. 1966. An evaluation of pineapple silage for dairy cattle. Hawaii Agr. Exp. Sta. Tech. Prog. Rep. 150.

DISCLAIMER

Reference to a company or product name does not imply approval or recommendation of the product by the College of Tropical Agriculture, University of Hawaii, or the United States Department of Agriculture to the exclusion of others that may be suitable.

Single copies of this publication available without charge to **Hawaii residents** from county agents. **Out-of-state** inquiries or **bulk orders** should be sent to the College of Tropical Agriculture Order Desk, Room 108 Krauss Hall, 2500 Dole Street, Honolulu, Hawaii 96822. Price per copy to bulk users, ten cents plus postage.

Hawaii Agricultural Experiment Station, College of Tropical Agriculture, University of Hawaii
William R. Furtick, Dean of the College and Director of the Experiment Station
Noel P. Kefford, Acting Associate Director of the Experiment Station
Departmental Paper 56—November 1977 (1M)