INVESTIGATIONS ON PREPARATION AND PRESSING OF BANANA PLANTS

H Prigge[1], R Kohlheb[2] & K Becker[3]

Universitat Gottingen, West Germany.

Preparation and pressing of whole banana plants was investigated. The preparation was done with a stationary chaff cutter and a hammer mill. Afterwards the material was pressed with a belt or a screw press. The efficiencies of these processes were measured by monitoring chemical composition of the products. the ratio of juice to press cake produced and the proportion of plant dry matter extruded in the juice.

Key words: Banana plants, technologica1 processing, dewatering, nutrients in the press cake.

In the search for suitable energy and protein sources as feed components for ruminants, tests were carried out with banana plants to determine their suitablility in this respect (Bo Gohl 1975; Ffoulkes et al 1978; Ohlde 1978; Rowe et al 1978) The nutrient composition can be seen as favourable,but the low dry matter content of the plants (7-10%) limits energy intake by ruminants (Ffoulkes and Preston 1978). On the other hand, on a world wide scale, 20 million tons of fresh mass (1.7 million tons of dry matter) are available from the plantations (FAO 1975).

Tests on sheep with banana plants (Musa cavendishii) from Ecuador indicated low organic matter digestibility but treatment of the vegetative parts of the plant with NaOH brought about a considerable improvement (Ohlde et al 1978)

The purpose of this work is to investigate the effect of mechanical preparation and pressing of banana plants on their use in animal nutrition.

Materials and Methods

Whole banana plants (*Musa cavendishii*) were used from the greenhouse of the Institute for Tropical and Subtropical Plant Science, University of Gottingen. This raw material was distributed and processed as outlined in Figure 1.

The first processing step was done in a stationary chaff cutter drive by an electric engine with a power of 3.8 KW at 700 rpm. The crushed material was then divided into two portions and a sample was taken for analytical purposes.

The plants to be crushed with the hammer mill were split up according to their length to ensure a uniform entry into the crushing machine. The hammer mill was adjusted to 1700 rpm with a driving power of 7.5 KW. This processing equipment was constructed and built in the Institute of Agricultural Machinery, University of Gottingen. After a thorough mixing by hand a representative sample was taken for analytical purposes.

---

[1] Institut fur Landmaschinenkunde der Universitat Gottingen, West Germany.

[2] Fa. Cilly Chemie, Heilbronn, West Germany.

[3] Institut fur Tierphysiologie und Tierernahrung der Universitat Gottingen, West Germany.

Compared with the fresh mass (7.0%), the prepared material had a dry matter content of 8.7%. With pressing/the dry matter content was increased to approximately 15-24%. The crude protein content on the other hand is lowered by an average of 1.8% in all four press variations.

The crude fibre content amounted to about 22.3% of the dry matter compared with 16.3% in the prepared material. The cake pressed with the screw extruder showed a smaller increase in crude fibre content (about 3%) than that prepared with the belt press.

Control criteria: A comparison of the efficiency of preparation methods can be made by calculating the following ratios. The proportion (by weight) of press juice to the prepared material (termed preparation intensity - PI). A value for Pl of 0.56 was determined for the material prepared with the chaff cutter, and of 0.61 for the material crushed with the hammer mill. As a second control criterion for the preparation, the ratio of the dry matter from the press juice to that from the prepared material was determined. This relation is named disintegration rate D (Kohlheb 1978). A value of D = 0.09 was obtained for the material prepared with the chaff cutter and of D = 0.16 for that prepared with the hammer mill.

The criteria for assessing the efficiency of pressing are the press grade and the extraction rate (Table 2). The press grade is the ratio of the weight of the plant juice to the weight of the prepared material. The extraction rate is determined by the relation of the absolute dry weight of the plant juice and the absolute weight of the material that was pressed.

Table 2 :
Values of press grade and extraction rate for different preparation and pressing processes

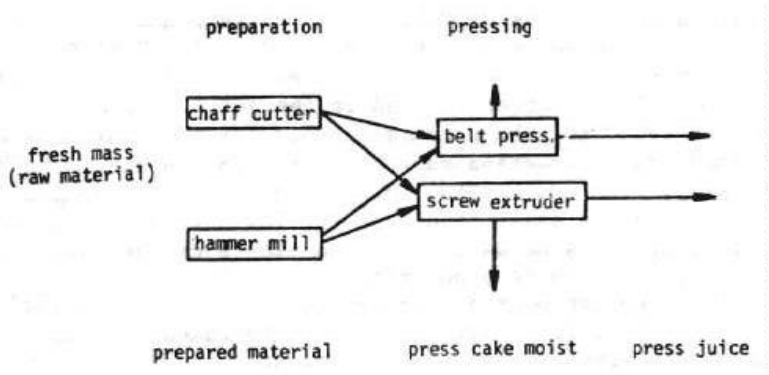
Process	Press Grade	Extraction rate
Chaff cutter/Belt press	0.47	0.12
Chaff cutter/Screw press	0.55	0.13
Hammer mill/Belt press	0.53	0.16
Hammer mill/Screw press	0.74	0.31

Discussion

For various reasons attempts are made world-wide to dehydrate green plants and to extract individual nutrient groups (Pirie 1971; Rastowski et al 1976; Edwards et al 1978; Russell et al 1978; Straub et al 1979). The economy, energy consumption, mass and quality of the end products depend on the preparation and processing of the raw material. In our case there was a slight increase in the dry matter content determined during preparation. Moreover evaporation of water could have been further increased through the enlarged surface area due to the preparation process.

In the case of preparation with the chaff cutter, 1-2cm long stalks were obtained, which according to the structure, can be suitable for ensilage as well as for drying. An effective preparation was achieved with the hammer mill: the flesh (pulp) was beaten out of the fibre and only the bare fibres of the banana plant remained. It seems therefore that a separation of fibre-rich material (about 16.3%) and fibre-poor fractions is possible besides other separating conditions.

Figure 1 .
Processes used for processing banana plants



The belt press was fed with crushed material, by hand, whereby thin layers were put in the middle of the band. The bead, was driven by an electric engine with a power of 1.1 KW and had a speed of 9.3 cm/s. The press cake was stored in a cool place.

The screw extruder ran at 100 rpm with a driving power of 5.5 KW. The material to be pressed was continuously fed into the hopper by hand. This screw extruder was constructed and built, likewise, in the Institute of Agricultural Machinery, University of Gottingen. The yielded press cake was again stored cool for further processing.

Results

Nutrient analysis: Table 1 shows the composition of the dry matter,

Table 1:
Chemical composition of processed banana plants

Sample	%DM	% DM				
		Crude protein	Ether extract	Crude fibre	NFE	Ash
Prepared material						
Chaff cutter	8.6	13.22	4.16	15.63	48.75	18.24
Hammer mill	8.9	14.53	3.91	17.03	46.98	17.55
Press cake						
Chaff) belt press	18.95	11.41	3.40	24.68	46.13	14.38
cutter) screw press	23.71	11.79	3.79	19.74	51.55	12.95
Hammer) belt press	14.93	12.69	3.64	22.98	47.38	13.31
mill) screw press	20.01	12.16	3.56	21.99	50.51	11.78

The significance of the lower crude fibre content of the press cake achieved with the screw extruder (press) will be shown by the results of the organic matter digestibility which are to be published later.

The preparation intensities of 0.56 (chaff cutter) and 0.61 (hammermill) are distinctly higher than results with grass or alfalfa (Kohlheb 1978). The relatively low dry matter content of the fresh material (about 7%) favours this value. In terms of dry matter removed in the juice (disintegration rate) a higher value was found for the hammenmill than for the chaff cutter.

The press grade and extraction rate give information about the effectiveness of the pressing. The extraction, in this case, is a mechanical separation. The high press grades are a result of the low dry matter contents of the prepared material. This means that banana plants can be easily pressed and are suitable for press juice production.

Pressing with screw extruder is more productive if the material is prepared with the hammermill. However care must be taken so that fibres do not remain too long in the prepared material otherwise they twist around the rotating conical end of the screw and choke the press.

The determined press grades lie above the comparable values with grass or alfalfa (Kohlheb 1978). The extraction rate of 0.12, 0.13 and 0.16 correspond with the values for grass mixtures and alfalfa, The very high rate of 0.31 for the screw press in connection with the hammer mill is not achieved by any equipment described in the literature (Cornell 1973, Wilkins 1976, Davis 1973, Hollo et al 1969, Utvik and Lunder 1975).

The achieved press effects of banana plants are unusually high. Dry matter contents in the press cake correspond with those of dried green grass and other green forage plants. The increased dry matter should facilitate the ensiling of banana plants by reducing production of effluent.

Until now, the high water content of banana plants has prevented a satisfactory supply of energy to ruminants (Ffoulkes and Preston 1978). With the mechanical dehydration described above the biomass from banana plants could be added to animal feed in greater amounts. Further investigation is needed to ascertain whether the digestibility of the organic matter from the press cake can be raised by treatment with chemicals (NaOH, NH_3) or by ensiling. Further results on these problems will follow.

References

Bo Gohl 1975 Tropical feeds. Feeds information summaries and nutrition values FAO Rome

Connell J 1973 The prospects for green crop fractionation Span Vol 1# No 3

Connell J & Mansfield G A 1975 Green crop fractionation NIRD/ADAS Development Programme

Davis M N G 1973 An introduction to dewatering Grass 7:62-79

Edwards R H, de Fremery D, Mackey B E & Kohler G 0 1978 Factors affecting juice extraction and yield of leaf protein concentrate from ground alfalfa Transactions of the ASAE p 55-62

FAO 1975 Tropical feeds Feeds information summaries and nutrition values FAO Rome

Ffoulkes D & Preston T R 1978 The banana plant as cattle feed: digestibility ant voluntary intake of different proportions of leaf and pseudostems Tropical Animal Production 3:114-117

Ffoulkes D. Espejo S, Marie D, Delpeche M & Preston T R 1978 The banana plant as cattle feed: Composition and biomass production Tropical Animal Production 3: 45-50

Hollo J, Koch L & Koch B 1969 Quelques aspects de ['employ des proteines de feuille dans l. augmentation de la production des matieres nutritives . Budapest Universite technique Institut de technologie chimique agricole Voeding 30e jaargang, 9
Kohlheb R 1979 Gewinnung von Nahcstoffkonzentraten aus grunen Pflanzen Diss. sc. agr. Gottingen
Ohlde F 1978 Ein Beitrag zur Frage der Verwendbarkeit von Bananenpflanzen als Futter fur Wiederkauer Diplomarbeit Gottingen
Ohlde F, Becker K & Pfaffer E 1978 Untersuchungen uber die Eignung von Bnnanenpflanzen fur die Wiederkauerfutterung Der Tropenlandwirt Okt.:99-111
Pirie N W 1971 Leaf protein: its agronomy, preparation, quality and use IBP Handbook No. 20
Rastowski ski A, Kinds H P P, van Nielen L, Nieowenhuis A & Slotboom J G 1976 Leaf protein extraction Publikatie 276 A IBVL Wageningen
Rowe J & & Preston T R 1978 The banana plant as cattle feed: growth of animals given different proportions of banana tops and sugar cane with molasses ad libitum Tropical Animal Production 3:193
Russell J R, Hurst J P, Jorgensen N A & Barrington G P 1978 Wet plant fractionation
Straub R J, Tung J Y, Koegal R G & Bruhn H D 1979 Drum drying of plant juice protein concentrates Transactions of the ASAE p 484-493
Utvik O A & Lunder J 1975 The stord twin - screw press Grass 15
Wilkins R J 1976 Scientific and technical progress in forage crop dehydration. Proceedings 12th International Grasslands Congress

Received 22 March 1980