INTRODUCTION OF FLOUR FROM *DIOSCOREA DUMETORUM* IN A RURAL AREA

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We taught 25 village volunteers a simple method to produce flour from *Dioscorea dumetorum* tubers by drying precooked slices and grinding them in a diesel-powered mill. Enriched porridge and fufu prepared during a demonstration session were tasted, the latter with local sauces. The volunteers were then asked to feed their households flour, and, each week, we recorded the number of times the flour was eaten. After 12 weeks, results showed that all but three households ate the flour regularly. They thought it was good and, if available, could substitute for other flours used locally, especially for infant feeding. The flour processing was possible at the village level, and they recommended changes in some of the steps.

The study of the nutritional potentials of tropical roots and tubers continues to attract many researchers because these crops are major staples of the developing world. Criteria have been laid down for crop-improvement research, and these include potential yield, cost of production, the food and feed value of the crop, and the way the crop can be processed or otherwise used. The nutritional qualities of crops have not been accorded a high priority in the decision-making, and this might explain why *D. dumetorum* has not been as widely studied as other species. It grows readily on various soils, the yield being 3–7 times that of other widely grown yam species (Treche and Guion 1980), and both planting and harvesting can be mechanized. Nutritionally, it is superior to the commonly consumed yams, having high protein and mineral content (Baquar and Oke 1976, 1977; Treche and Guion 1979). Szylit et al. (1977), Bewa (1978), Treche and Guion (1980) have all shown that the starch grains are smaller, more soluble, and more digestible than those of other yam species. Unfortunately, the postharvest losses are large because, if the tubers are not cooked within a few days after harvest, they harden and are good only for planting. This hardening phenomenon has been described by Treche and Delpeuche (1982).

The Centre for Nutrition, Cameroon, has been carrying out comparative studies of the physicochemical and nutritional properties of several species and varieties of yams grown in the country, in collaboration with the agricultural research institute. From the results, *D. dumetorum* was selected not only for its nutritional qualities but because it has been neglected in attempts to process yam into more durable forms such as dried slices and flour. Yam flour from *D. rotundata* in the forms of "elubo" or "amala" . . . despite its colour . . . is being enjoyed as food in parts of western Nigeria. Other countries have produced yam flour from their yams (Jarmai and Montford 1968; Martin and Ruberte 1975b; Ciacco and D'Appolonia 1978). S. Treche and others (unpublished) have adapted one of the known methods to make flours from *D. dumetorum* and *D. rotundata*. Following tests for physicochemical and nutritional properties and acceptability among the centre personnel, we decided to try out the flour in a community. Our objectives were to determine whether a rural community would process the flour and eat it.

MATERIALS AND METHODS

Dioscorea dumetorum (Jakiri variety) setts were supplied by the Institute of Agricultural Research (IAR), Bambui. Village participants used their own farmland for planting and constructed stands by their houses for the special trays we provided.

The study was carried out in four villages in Mvolye 5–7 km from our centre. It was in three

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phases: planting, January–March 1982; processing, November 1982–January 1983; and consumption, February–May 1983. The whole exercise was explained to 25 volunteers and a questionnaire was completed, detailing their yam planting and eating habits. On each farm, we chose a suitable site and demonstrated how to plant the setts in beds because the participants were more accustomed to planting on mounds.

When the participants had completed the land preparations, we supplied them with enough setts to plant their areas. We closely supervised planting, staking, and clearing. The yams were harvested over 4 weeks in 4–5 batches. Following each harvest, the yams were weighed and divided into three parts: one for drying in the village, the second for processing in the laboratory, and the third left to the planter to eat fresh and store for seeds. On the following morning, the yams were peeled, cut into 0.5-cm slices, boiled for 45 minutes, and spread thinly on the trays. The trays had to be taken in at night and whenever it rained for there was no one to protect them from thieves and animals. It took about 3–4 days for each batch to be well dried. We took samples for laboratory analysis, and the rest was packed in plastic bags. The dried yam slices were ground, sifted, and weighed at the centre. Each participant was given what he or she had dried, the good flour for human consumption and the chaff and poor samples for animal feed. The detailed analysis of the planting and transformation phases have been described in greater detail elsewhere (S. Treche et al. unpublished).

The consumption phase was preceded by a cookery–eating demonstration. Yam porridge was prepared with boiling water and sugar. Subsamples were enriched with either milk, egg, or groundnut paste. Cooking time was about 2–3 minutes. We cooked the yam fufu (foofoo mesol as the local women called it) by stirring the yam flour in a little boiling water and adding more water until preferred consistency was obtained (3–6 minutes). It was eaten with soups (Kelengkeleng, groundnut stew, and cassava leaf or Kpem) cooked by the participants. Everybody ate — children and adults including the researchers. We noted verbal and facial expressions of appreciation or disapproval.

The participants were asked to cook the flour at home and feed it to their families as often as they wanted and to try other local recipes. Two questionnaires were completed during this period, one to determine their attitudes toward the planting and processing and the other their consumption pattern.

Results and Discussion

The villages in Mvolye are within our community health project where medical students do field postings and researchers study the nutritional status of the community. Perhaps we were working with an enlightened and receptive group. They, also being on the outskirts of the city of Yaounde, may not be representative of a village. Nevertheless, yam flour is foreign to them. Their staples are cassava, plantains, cocoyams, and rice in descending order, and they eat lots of vegetables and palm oil. Food is cooked once a day in the mid-afternoon and is eaten as the main meal. Children eat leftovers during the rest of the day. The people are subsistence farmers, and they grow the first three staples and groundnuts. *Dioscorea dumetorum* and *D. rotundata* are grown but on a very small scale, about 10–50 setts; only two women grew more, mainly for sale.

In previous laboratory study, flours made from raw and precooked yam were dried both in an oven and in the sun. Palatability tests (S. Treche et al. unpublished) had shown that the oven- and sun-dried, precooked flours were preferable, and, as the process was intended for a village technology, the sun-drying method was more practical.

Before completing our first questionnaire, we had thought that the flour could become an adequate weaning food to substitute for porridge from cassava starch. To our surprise, yam — especially *D. dumetorum* — is taboo for children. The belief is that children will either be dumb or stammer if they eat yam before speech is established, i.e., about age 2 years. Imported infant foods are used, and the contents are not questioned. We went ahead with our project because we noticed that the belief was not shared by all and those who did believe were not too convinced.

The participants included 2 men, 2 teenaged girls, and 21 mothers, ages ranging between 18 and 72 years. Of these, 12 were younger than 35 years and 13 older; 4 had postprimary education, 17 had primary education, and 4 never had been to school. They were all farmers, but two were also secretaries and one a retired inspector of schools. Of the total, 20 planted yams regularly (*D. rotundata* and *D. dumetorum*), but none of them knew of any process to conserve *D. dumetorum*.

No participant planted *D. dumetorum* alone; of the 16 who planted both species, 12 planted equal quantities. The reasons given were:

Table 1. Yam setts distributed and yield per village.

Village	Setts			Yield (t/ha)
	Distributed (%)	Planted (%)	Weight (kg)	
Ahala	96.1	97.8	1.41	20.3
Nsimeyong I	78.0	—[a]	2.44	28.6
Nsimeyong II	80.0	89.2	1.31	14.1
Nsimeyong III	89.5	86.5	1.35	18.2

[a]Not determined.

Table 2. Frequency of flour consumption per week in the commmunity.

Week	February	March	April	May
1	0	11	13	16
2	7	11	15	11
3	7	7	16	7
4	6	19	10	0

- Yam setts were not readily available;
- Yam planting was too arduous and their soil was hard;
- *D. dumetorum* ("Isol") yielded more than *D. rotundata* ("Kkodo"), but, because the former could not be stored, only a few setts were planted; and
- For those who sold yams, *D. rotundata* fetched more money.

The *D. dumetorum* tubers are harvested as needed for food and cooked immediately, and *D. rotundata* tubers are all harvested at once and stored in a cool, shaded area. The participants consider the latter as food because it is available for longer periods than the former, which is considered a snack. They think *D. dumetorum* is good food but perhaps not as good as *D. rotundata*. The yields in our study were acceptable (Table 1), and the differences noted between villages might have been a reflection of variations in the sizes of the setts supplied as well as in the previous crops planted on the sites. The amount of flour obtained was 10.83% of the fresh weight of the tubers. The unacceptable dried samples were ground and mixed with chaff for animal feed. The dry-matter content was 86.7 g/100 g in the village flour compared with 90.2 g/100 g for the centre flour. The protein content was slightly higher in the village flour (7.19/100 g) than in the centre flour (6.9 g/100 g) and in the indigestible glucides (village, 3.23 g/100 g; centre, 2.67 g/100 g). These differences may reflect onset of hardening, with increase in cell wall content because of slow and uncontrolled drying.

In general, the participants felt that they could produce the flour at the village but would prefer to boil the tubers whole or in large pieces and then peel the thin skin before slicing. If possible, appliances should be made available. The drying was too dependent on the weather, and the trays had to be carried indoors to protect them from thieves and animals.

There were 137 people, of both sexes with ages ranging from 1 month to 78 years, in the 25 households, of which 3 never ate the flour (1 missed the demonstration and 2 would not eat it). In the remaining households, the flour was eaten once or twice a week as porridge (mainly by children) and fufu. Flour consumption increased from February to April and dropped in May (20, 48, 54, and 44 times, respectively, Table 2). The sweetened, enriched porridge (with groundnut paste, egg, or milk) and fufu were eaten 102 and 191 times, respectively. Kelengkeleng (*Corchorue alitarius*) was the most popular soup (50 times), followed by groundnut stew (44 times), cassava leaf (36 times), and okra (24 times). As the flour stock began to run out, it was reserved for children. It replaced some of their staples and was economical because small quantities were sufficient for meal preparation, with the flour swelling up considerably when mixed with liquid. Two disadvantages noted were a slightly bitter taste, which could be masked with sugar or soup, and a poor binding capacity, which could be improved with cassava starch. Some of the participants felt that, with time, they could get accustomed to the taste and texture.

During the 12 weeks, the flour was also used in Ekomba (yam flour, groundnut paste, and salt) and Koki (yam flour, palm oil, pepper, and salt) steamed in plantain leaves.

This pilot study shows that *D. dumetorum* flour can be processed in a rural community with simple trays and a grinding mill.

This study was made possible by the collaboration of the researchers in IAR, the village participants, and members of the nutrition centre.

IDRC-221e

TROPICAL ROOT CROPS:
PRODUCTION AND USES IN AFRICA

EDITORS: E.R. TERRY, E.V. DOKU, O.B. ARENE, AND N.M. MAHUNGU

PROCEEDINGS OF THE SECOND TRIENNIAL SYMPOSIUM OF THE INTERNATIONAL SOCIETY FOR TROPICAL ROOT CROPS — AFRICA BRANCH HELD IN DOUALA, CAMEROON, 14 – 19 AUGUST 1983