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An easy technique for rapid determination of dry-matter content in cassava roots (*Manihot esculenta* Crantz)*

Francisco Franco Feitosa Teles

CNPq—R. Agapito dos Santos, 376/101-60 000-Fortaleza-CE, Brazil

Valéria Euclydes de L. Borges & José Cals Gaspar Jr

Department of Food Technology UFC/CNPq—R. Agapito dos Santos, 376/101-60 000-Fortaleza-CE, Brazil

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A new technique is developed for cassava (*Manihot esculenta* Crantz) root dry-matter estimation. It is based on the use of a common microwave oven and a top-load balance. The methodology is simple, quick and accurate. The results are comparable to the ones obtained by the AOAC methodology.

INTRODUCTION

Since 1972 it has been known (Teles & Scholz, 1972) that there is a correlation between cassava (*Manihot esculenta* Crantz) root dry-matter and starch content. This correlation is understandable since more than 90% of the cassava root dry-matter is composed of starch and starch components, such as amylose, amylopectin and soluble carbohydrates.

Identical correlation was also observed in tubers, especially potatoes (Howard, 1974; Smith, 1975; Borgstrom, 1976; Vakis, 1978).

For both cassava and potatoes, when the processing plants are bought from the farmer, the price of the roots and tubers are established depending upon their dry matter content, i.e. higher prices for higher content (Bettelheim & Sterling, 1985).

In the potato industry, the problem with dry-matter determination is minimized since there is a good correlation between dry matter and specific gravity of the tubers (Zaag, 1976; Kramer, 1977; Vakis, 1978). In cassava, however, the correlation is very poor because of the root format and empty spaces inside the roots, but there is an acceptable correlation between dry matter content and real density of the roots. (Teles & Scholz, 1972). But, the determination of real density of cassava roots is an operation not easily performed using industrial facilities, and it, obviously, would cause a severe delay in paying the farmers. It is therefore necessary to speed up the dry-matter content determination in the cassava industries.

Microwaves have been used for total solids determination since 1972 (Borzani & Prada, 1971). However, some difficulties were encountered when cassava roots were tested.

The determination of cassava tuber dry-matter, if carried out according to AOAC (1975), Battisti (1979) or Silva (1981) is an operation which is both laborious and time-consuming. In order to avoid those difficulties and improve the accuracy of the dry-matter determination on fresh cassava roots, the present study was undertaken.

MATERIALS AND METHODS

The three biggest roots of the same cassava plant (variety 'Pão do Chile', 20 months old, commercially cultivated in the state of Minas Gerais, Brazil) were harvested and immediately brought to the laboratory of the Department of Chemistry at the Universidade Federal de Viçosa-MG.

The roots were washed under tap water, dried with a cotton towel, and sliced into 10-mm high rings. The roots' proximal and distal endings were discarded. The rings were cut into small cubes, approximately 1 cm^3 each, and homogenized by hand mixing.

Approximately 20·0-g samples were transferred to clean, dry and tared glass Petri dishes. The operation was done as quickly as possible and the dishes immediately covered to prevent moisture loss during handling. A Mettler top-load balance (Fortaleza, Brazil) with 0·01 g precision was used.

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Table 1. Percent moisture content of cassava roots as determined by a microwave oven set at medium power, at different time intervals

Minutes / Sample	3	6	9	12	15	18	21	24	27	30	33
1	10·93	25·22	36·87	47·27	53·21	57·25	58·41	59·14	59·51	59·72	59·72
2	12·80	27·37	37·57	45·69	50·63	55·21	57·97	59·21	60·20	60·57	60·83
3	12·07	23·71	35·87	45·09	51·30	54·35	56·63	58·39	58·96	59·37	59·84
4	11·44	23·13	33·53	41·12	47·09	53·18	55·77	57·49	58·32	59·10	59·26
5	7·46	21·81	33·01	40·46	48·30	53·26	56·06	57·82	58·69	59·42	59·76
Average	10·94	22·25	35·37	43·93	50·11	54·65	57·11	58·41	59·14	59·64	59·88
SD	1·849	4·910	1·805	2·666	2·177	1·500	1·175	1·175*	0·688*	0·658	0·515*

*Averages not statistically different from the AOAC results, by the t-test ($P < 0·05$).

Table 2. Percent moisture content of cassava roots as determined by a microwave oven set at high power, at different time intervals

Minutes / Sample	3	6	9	12	15	18	21	24
1	12·48	31·32	45·80	52·61	56·82	59·07	59·87	60·28
2	14·73	28·07	40·69	50·29	56·65	59·52	61·16	61·16
3	14·38	30·27	42·87	50·82	56·25	59·75	60·54	60·90
4	13·97	33·42	44·28	51·66	56·39	59·40	60·61	61·01
5	16·21	33·21	46·03	53·29	60·04	60·54	61·29	61·64
Average	14·35	31·26	43·93	51·73	57·23	59·66	60·69	60·99
SD	1·346	5·590	2·216	1·236	1·586*	0·551*	0·566*	0·490*

*Averages not statistically different from the AOAC results, by the t-test ($P < 0·05$).

Sets of 11 samples were taken to a Panasonic (S. Paulo, Brazil) microwave oven (2450 MHz, 500 W, rotative plate) set at 'medium' position, and samples were taken every 3 min (33 min total). During drying, the Petri dish covers were put under the bottom of each dish to preserve the analytical order and precision. The operation was repeated five times (replications) in a total of 55 samples. The samples were covered and weighed immediately after being taken from the oven, and kept covered.

Another set of five batteries of only 8 samples each (40 samples total) were taken, and the microwave oven was set now to the 'high' position, and operated as described above at 3-min intervals (24 min total).

Another set of give samples was analysed according to the method recommended by AOAC (1975) and modified by Silva (1981)—hot oven, 48 h at 75°C followed by 1 h at 100°C.

Table 3. Percent moisture content of cassava roots as determined according to the method recommended by the AOAC (1975)

Sample No.	Percent moisture
1	57·50
2	57·65
3	58·14
4	58·19
5	58·64
Average	58·024
SD	0·408

RESULTS AND DISCUSSION

The results expressed in percent moisture are shown in Table 1 (medium power), Table 2 (high power) and Table 3 (AOAC, 1975).

Before analyzing the results statistically, a few observations should be made, such as: even in the high position, samples dried for only 9 min were still moist, being very difficult to grind; at 12 min one cube was still soft, and after 18 min the samples seemed slightly burnt, which, of course, would render difficult further analyses such as digestible and/or soluble carbohydrate determinations, etc.

The t-test at 5% probability was chosen for comparison of the results. There was no difference between the results obtained when the samples were dried at medium power, after 21 min, or after 15 min when dried at high power.

When comparing these results with the ones obtained by the AOAC recommended method, there was also no difference. Considering this, the new methodology is much easier and more rapid than the one recommended by the AOAC (1975).

The use of a reliable top-load balance greatly accelerates the analysis, firstly because it is much easier to

operate than the classical analytical balance, and second, because there is no need for temperature stabilization time in a silica gel desiccator, since the Petri dishes do not get so hot in the microwave oven as in a conventional heat-convection oven.

The results agree with those in the literature (Charley, 1970; Gray, 1972; Teles & Scholz, 1972; Eipeson & Paulus, 1973).

Based on the above discussion, the methodology proposed in this work could advantageously be used in the cassava industry or in the laboratory as a 'first action' method.

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