

QUALITY EVALUATION OF YAQONA (*PIPER METHYSTICUM*) IN FIJI

by

RAM N. DUVE AND JAGENDRA PRASAD
Research Division, Department of Agriculture, Fiji.

SUMMARY

A comparative study of the chemical constituents of powdered and unpowdered dried roots and basal stems of *Piper methysticum* (Fijian: Yaqona) has revealed adulteration of the powdered materials. In comparison to the unpowdered roots and basal stems the powdered forms had much lower amounts of 7 major 8-pyrones, the principal active constituents of *Piper methysticum*. The comparative study was carried out on 31 samples of dried basal stems, 37 samples of powdered basal stems, 35 samples of roots and 25 samples of powdered roots of *Piper methysticum* collected from regular outlets throughout Fiji. This study concludes that there is a need to formulate minimum standards of powdered *Piper methysticum* in terms of its major active constituents.

INTRODUCTION

The beverage prepared by straining dried powdered roots (Fijian: Waka) and basal stems (Fijian: Lawena) of *Piper methysticum* (Fijian: Yaqona) with water, commonly through a muslin or similar cloth, and traditionally through especially prepared plant strands such as those of *Hibiscus tiliaceus* Linn. (Fijian: Vaudina), is the national drink of Fiji. The yaqona beverage has an important place in all traditional Fijian ceremonies and is widely used as a token of good-will and respect amongst the South Pacific peoples. The "intoxicating" effect of yaqona beverage is due to the presence of 7 major and 8 trace pyrones (Duve, 1976; Gaty, 1956; Hansel, 1968, 1980; Keller and Klohs, 1963; Mers *et al.*, 1962; Steinmetz, 1960) which possess local anaesthetic (Meyer and May, 1964), antimycotic (Hansel *et al.*, 1966), sleep producing (Klohs *et al.*, 1959; Meyer, 1962), anticonvulsive (Meyer, 1964; Meyer and Kretzschmar, 1965; Meyer and Meyer-Burg, 1964), and spasmolytic (Meyer, 1965) properties.

The annual cultivation of yaqona in 1978 was 2,463 ha (Rothfield and Kumar, 1980). Using gross income figures/ha of \$11,180 from yaqona (Pittaway, 1980) it can be seen that the potential

value of yaqona cultivation in 1978 was worth some \$27 million.

In the preparation of the yaqona beverage it is customary to pound the dried roots and/or basal stems just prior to straining. However, with the increase in the demand of yaqona for social consumption it is now common to find dried yaqona being marketed in the powdered form.

The powdered form of yaqona, however, can be easily adulterated with powdered wood etc. This paper deals with a preliminary survey which the authors carried out to establish the extent of adulteration in powdered yaqona compared to the unpowdered forms.

EXPERIMENTAL

SAMPLES

Approximately 0.25kg of each of dried roots, basal stems and their powdered counterparts were bought from regular outlets throughout Fiji in 1980-1981 period and ground to pass through sieve No. 25. The prepared samples were stored in glass bottles fitted with metallic screw caps. The distribution of samples collected is shown in Table 1.

METHODS

Moisture content of the samples was determined by drying 5 g at 100°C for 5 hours while protein content was determined by macro Kjeldhal method using approximately 2 g sample. Fibre determination was performed on a 2 g sample defatted with chloroform direct on a filter funnel. Ash content of the samples was determined by ashing approximately 5 g sample overnight at 500-600°C. For the determination of ash constituents each ash was dissolved in boiling hydrochloric acid (25ml, 1 + 2.5), filtered and the filtrate made up to 100 ml in a volumetric flask. The resulting solution was analysed for calcium, magnesium, aluminium, iron, zinc, manganese, and copper by Atomic Absorption Spectrophotometry while sodium and potassium contents of the filtrate were determined by Flame Photometry. Chloroform extract and the quantification of the major active constituents were determined by the recently developed method of Duve (1981). Carbohydrate content was calculated by difference.

RESULTS AND DISCUSSION

SAMPLES

Most of the samples collected were from the

produce markets; however, some samples were collected from shops. From Table 1 it is clear that the roots and basal stem samples were available in all districts. However, this was not true of the powdered samples since, for example, districts such as Nadi and Lautoka in the Western Division have strong preference for powdered roots while districts such as Nausori and Suva in the Central Division have strong preference for powdered basal stems. These factors did not have any bearing on the aim of the investigation which was to compare the quality of unpowdered yaqona with their powdered counterparts throughout Fiji.

CONSTITUENTS

Tables 2, 3, and 4 summarize results of the survey in terms of general, ash, and chloroform extract constituents, respectively of powdered and the unpowdered yaqona in Fiji. This survey involved chemical comparison of the powdered basal stems and roots of yaqona with their unpowdered forms; factors such as age and variety of the parent plants have not been considered as they could not be established with certainty. Hence the large C.V.% for most of the constituents was expected. These constituents of yaqona are discussed below under separate headings.

TABLE 1. DISTRIBUTION OF COLLECTED YAQONA SAMPLES FROM FIJI, 1980-1981

Districts	Number of Samples			
	Roots	Basal stems	Powdered roots	Powdered basal stems
Suva	6	6	—	12
Lautoka	4	4	7	1
Nadi	4	2	6	—
Ba	3	3	3	3
Labasa	3	3	3	3
Nausori	3	3	1	5
Sigatoka	2	—	1	1
Tavua	2	2	2	2
Ra	2	2	2	2
Navua	2	2	—	4
Tailevu	2	2	—	4
Taveuni	2	2	—	—
Total	35	31	25	37

TABLE 2. GENERAL CONSTITUENTS OF DRIED YAQONA FROM FIJI, 1980-1981

Sample		Moisture	Carbohydrates	Fibre	Chloroform extract	Ash	Protein
Basal stems (31 samples)	Average	14.60	74.11	10.66	7.07	5.83	2.33
	C.V. %	12.67	5.47	24.30	13.94	22.90	30.55
	Range	10.91- 17.91	65.09- 80.55	6.93- 17.05	5.54- 9.23	4.23- 9.67	1.03- 4.25
Powdered basal stems (37 samples)	Average	14.10	68.84	17.58	5.62	5.56	2.40
	C.V. %	10.00	7.85	33.09	26.45	18.45	28.11
	Range	10.92- 16.81	48.26- 77.75	7.52- 23.30	2.90- 9.43	4.51- 8.73	1.72- 3.51
Roots (35 samples)	Average	13.66	64.26	13.09	12.09	6.99	3.57
	C.V. %	12.52	6.17	29.86	28.54	14.81	24.50
	Range	11.17- 19.60	56.43- 75.62	9.77- 26.12	7.22- 15.05	4.75- 9.19	2.35- 4.66
Powdered roots (25 samples)	Average	12.81	64.77	15.09	9.16	7.42	3.56
	C.V. %	7.24	4.93	22.72	21.18	15.51	12.69
	Range	11.26- 15.36	56.80- 71.03	10.57- 21.80	5.78- 12.56	5.93- 11.53	2.50- 4.55

The average and range figures are percentages based upon samples dried at 100°C for 5 hours.

TABLE 3. CONSTITUENTS OF ASH OF DRIED YAQONA FROM FIJI, 1980-1981

Sample		Major (%)			Minor (%)			Trace (ug/g)		
		K	Ca	Mg	Na	Al	Fe	Zn	Mn	Cu
Basal stems (31 samples)	Average	2.016	0.455	0.105	0.0362	0.0205	0.0170	60.66	12.04	13.08
	C.V. %	25.66	20.21	25.59	56.82	56.67	61.98	26.44	53.03	24.61
	Range	1.45- 3.53	0.296- 0.66	0.07- 0.154	0.01- 0.068	0.006- 0.040	0.007- 0.031	28.0- 91.4	4.63- 24.86	8.0- 18.69
Powdered basal stems (37 samples)	Average	1.905	0.412	0.158	0.063	0.041	0.0355	57.6	12.135	13.73
	C.V. %	17.63	19.41	25.19	38.63	120.51	93.96	27.30	71.03	61.20
	Range	1.44- 2.72	0.33- 0.64	0.098- 0.225	0.0115- 0.1075	0.01- 0.266	0.01- 0.08	24.29- 96.90	5.27- 37.10	8.02- 58.13
Roots (35 samples)	Average	2.00	0.201	0.179	0.060	0.150	0.106	55.35	51.77	16.95
	C.V. %	18.96	20.11	29.60	70.75	64.67	51.22	40.43	48.73	27.61
	Range	0.683- 2.83	0.253- 0.68	0.07- 0.285	0.01- 0.219	0.01- 0.31	0.01- 0.27	17.62- 107.80	5.87- 14.27	6.82- 24.39
Powdered roots (25 samples)	Average	2.186	0.519	0.243	0.0574	0.117	0.098	60.63	38.86	15.67
	C.V. %	21.31	9.77	24.34	37.15	57.42	41.83	19.49	41.50	24.98
	Range	1.22- 2.88	0.47- 0.59	0.13- 0.237	0.022- 0.108	0.02- 0.264	0.03- 0.179	34.71- 81.83	16.25- 74.01	10.25- 23.80

The average and range figures are based upon samples dried at 100°C for 5 hours.

TABLE 4. AMOUNTS OF MAJOR ACTIVE δ - PYRONES PRESENT IN YAQONA FROM FIJI, 1980-1981

Sample	Physiologically active major δ pyrones										Total major δ -pyrones	Chloroform extract	Other constituents by difference **	
	Kawain	Dihydro-kawain	Methysticin	Yangonin	Dihydro-methysticin	Dehydro-kawain	Tetrahydro-yangonin							
Basal stems (31 samples)	Average	1.052	1.356	1.087	0.718	0.946	0.291	0.196			5.65 (79.91)*	7.07	1.42	(20.09)*
	C. V. %	19.24	28.42	18.75	18.92	28.67	25.41	26.67			20.66	13.94		
	Range	0.73-1.46	0.55-2.36	0.75-1.44	0.43-1.00	0.58-1.65	0.21-0.48	0.10-0.30			4.31-8.24	5.54-9.23		
Powdered basal stems (37 samples)	Average	0.811	1.073	0.86	0.581	0.73	0.219	0.151			4.42 (78.65)*	5.62	1.20	(21.35)*
	C. V. %	23.14	33.01	28.05	29.45	39.78	27.64	40.13			22.65	26.45		
	Range	0.50-1.31	0.68-1.97	0.41-1.36	0.26-0.96	0.32-1.62	0.13-0.35	0.07-0.26			2.79-7.54	2.90-9.43		
Roots (15 samples)	Average	2.21	1.78	2.386	1.75	1.20	0.71	0.30			10.34 (85.53)*	12.09	1.15	(14.47)*
	C. V. %	28.58	19.04	22.48	28.53	16.44	26.86	22.58			18.46	28.54		
	Range	1.11-2.99	1.07-2.57	0.99-3.51	0.70-2.47	0.74-1.59	0.28-1.05	0.16-0.44			7.04-13.02	7.22-15.05		
Powdered roots (25 samples)	Average	1.40	1.58	1.47	1.17	1.095	0.45	0.20			7.37 (80.46)*	9.16	1.79	(19.54)*
	C. V. %	34.40	20.12	35.11	43.80	18.15	37.00	23.88			26.82	21.18		
	Range	0.83-2.49	0.78-2.11	0.62-3.00	0.44-2.59	0.84-1.39	0.19-0.68	0.12-0.32			4.35-10.21	5.78-12.56		

The average and range figures are percentages based upon samples dried at 100°C for 5 hours.

* Figures in brackets are expressed as percentage of total chloroform extract.

** Made up of polar tarry material, non-polar unknown compounds, δ trace δ -pyrones and unknown (Duve, 1981).

GENERAL CONSTITUENTS

In the survey a number of general constituent figures (Table 2) of yaqona are of academic interest only and have been included for the reason that there does not appear to be any previous report of this kind of survey. In general the moisture, ash, protein and carbohydrate contents of the powdered as well as unpowdered yaqona were similar. However, when compared to the unpowdered basal stems the powdered basal stems had much higher fibre contents and also gave lower chloroform extracts. The powdered and unpowdered roots were similarly related. In addition the roots had higher protein and ash contents when compared with basal stems.

ASH CONSTITUENTS

The ashes obtained by igniting dried yaqona at 500-600°C were also analysed for their metallic composition (Table 3). There was nothing unusual about the constituents of the ash; all the major, minor and trace constituents were present in the ash.

ACTIVE CONSTITUENTS

The 7 major and 8 trace active constituents of

yaqona are quantitatively extracted by chloroform (Duve, 1981) (Fig. 1, p.6). Approximately 80% of the chloroform extract is made up of the 7 major pyrones of *Piper methysticum* (Table 4) and it can therefore be argued that the chloroform extract figures could be used as a guide to predicting extent of adulteration in powdered yaqona. From Tables 4 and 5 it is clear that powdered forms of yaqona sold in markets of Fiji are inferior in terms of both the active constituent concentrations as well as cost to the consumer of purchasing a unit of these constituents. Using average figures of Table 5 it can be seen that compared to unpowdered basal stems the powdered form is approximately 21.80% deficient in major active constituents; not only this, it also costs the consumer 54.9% more to purchase a gramme of active constituents in the powdered basal stems. Similarly, when compared to the unpowdered roots the powdered roots are on an average 28.7% deficient in major active constituents and it costs the consumer 40.2% more to purchase a gramme of active constituents in the powdered roots. These figures and others in Tables 4 and 5 indicate clearly that powdered yaqona is being adulterated.

In Table 6 we have further shown that the ratios of the major active constituents in basal stems, roots and their powdered forms is similar.

TABLE 5. COST OF PURCHASING ACTIVE CONSTITUENTS OF YAQONA FROM FIJI, 1980-1981

Samples		Cost of sample (cents/100g)	Chloroform extract in 100g sample(g)	Major γ -pyrones in 100g sample (g)	Cost of chloroform extract/(cents/g)	Cost of major constituents (cents/g)
Basal stems (31 samples)	Average	46.2	7.07	5.65	6.83	8.18
Powdered basal stems (37 samples)	Average	56.0	5.62	4.42	9.96	12.67
Roots (35 samples)	Average	64.6	12.09	10.34	5.34	6.25
Powdered roots (25 samples)	Average	64.6	9.16	7.37	7.04	8.76

FIGURE 1 STRUCTURAL FORMULAE FOR THE MAJOR (1-7) AND TRACE (8-15) ACTIVE CONSTITUENTS OF YAGONA (*PIPER METHYSTICUM*).

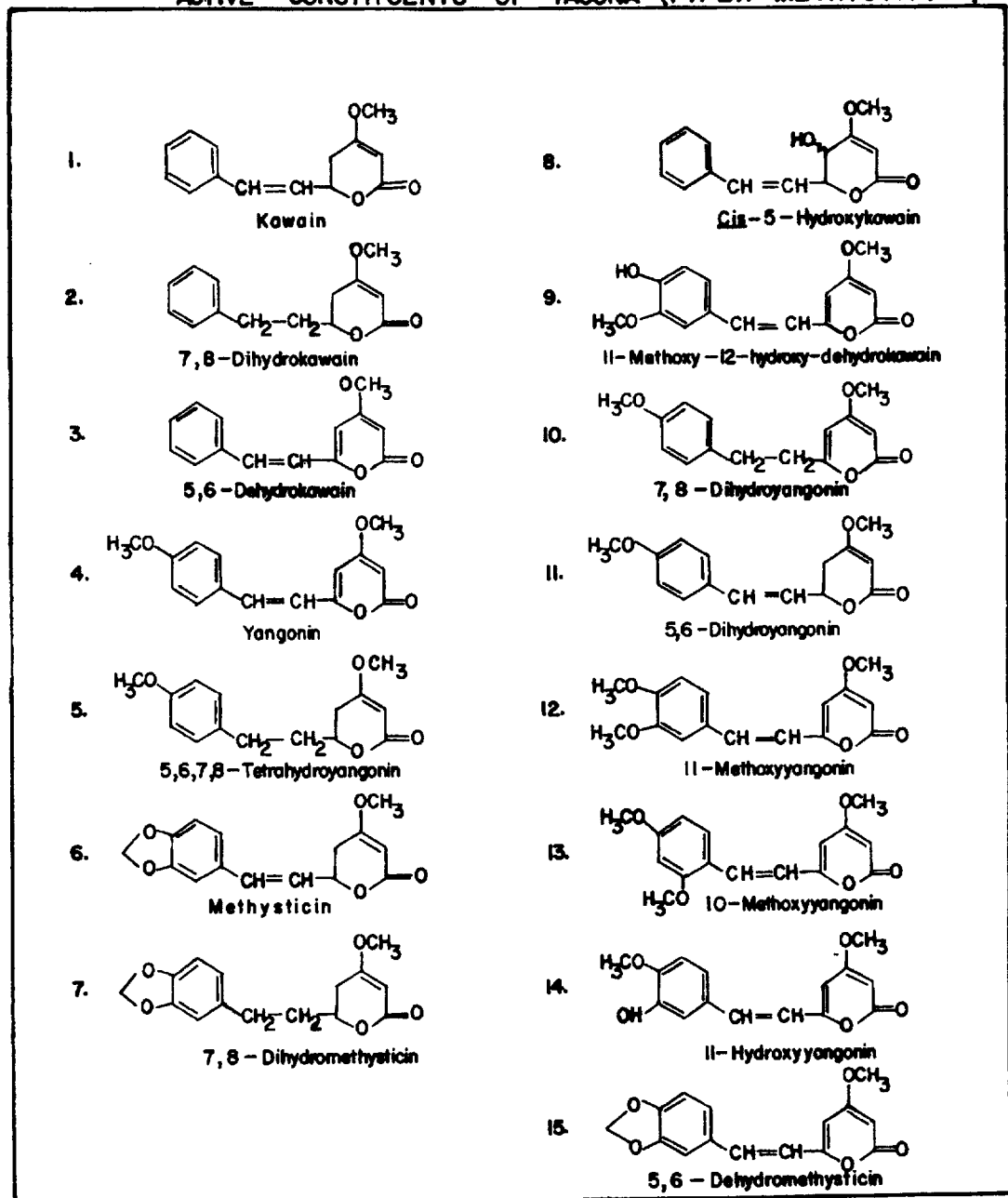


TABLE 6. AVERAGE RATIOS OF MAJOR δ -PYRONES IN THE CHLOROFORM EXTRACT OF YAQONA FROM FIJI, 1980-1981.

Samples	No. of samples	Kawain	Dihydrokawain	Methysticin	Yangonin	Dihydromethysticin	Dehydrokawain	Tetrahydro-yangonin
Basal stems	31	1.00	1.089	1.033	0.683	0.90	0.277	0.186
Powdered basal stems	37	1.00	1.323	1.060	0.716	0.90	0.271	0.186
Roots	35	1.00	0.805	1.080	0.792	0.54	0.321	0.136
Powdered roots	25	1.00	1.128	1.050	0.836	0.78	0.321	0.147

Hence determination of the total chloroform extract which contains all the major active constituents can give a good indication of the extent of adulteration of powdered yaqona.

A further evidence of the adulteration of powdered yaqona is reflected in the higher fibrous matter content of the powdered forms of yaqona when compared to the unpowdered forms (Table 3).

It is evident in this paper that there is a need to formulate minimum standards for powdered yaqona in terms of active constituents. However, other factors such as variation in active constituents of *Piper methysticum* with age, variety, rainfall patterns, soil types etc. need to be studied before chemical standards of *Piper methysticum* can be formulated.

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