Studies on the composition of some Ghanaian ginger samples

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SUMMARY

Five different ginger samples of local origin were analysed to determine their suitability for the export market. On the whole, the samples met the British standard and the American market specifications. In a few instances where samples fell below the specifications, it is believed that proper agronomic and post harvest handling methods could easily correct the deficiency.

Received 12 Feb 76; revised 21 Sep 76.

RÉSUMÉ

DEI-TUTU, J. & RISCH, E.: *Etudes sur quelques lots de gingembre Ghanéen.*

Cinq lots différents de gingembre d'origine locale ont été analysés pour déterminer s'ils étaient acceptables en vue du commerce d'exportation. Dans l'ensemble, ces lots ont satisfait les conditions standard britanniques et celles exigées par le marché américain. Dans quelques cas, les lots net satisfaisaient pas les conditions requises. L'auteur pense qu'en utilisant des méthodes convenables d'agronomie et de manipulation après la récolte, on pourrait aisément remédier à ces déficiences.

Introduction

The underground stem or rhizome of the ginger plant, *Zingiber officinale* Roscoe, is traditionally used in Ghana only in small quantities as medicine for stomach trouble, as internal stimulant, and also as remedy for dyspepsia, cold, headache, toothache, and gout. Small quantities are also used in food preparation. There is, however, a good demand for ginger in Europe, America and the Arab countries (UNCTAD/GATT, 1970). Industrially, ginger is used in the manufacture of such items as ginger beer, ginger-ale, ginger-bread, ginger oil, ginger essence, ginger chocolates, pastries and biscuits. It is also used to some extent in pharmaceuticals and perfumery products (Patel, 1972). Ginger oleoresin, a substance which has the pungent properties of ginger as well as containing essential oil, is obtained from the ground rhizome by extraction with volatile solvents. It is used for flavouring beverages and for similar purposes as the spice itself. The essential oil, which lacks pungency, is derived from the rhizome by steam distillation. The oil is used for flavouring foods and soft drinks, and to a small extent, as a modifier in perfumes and toilet waters of the spicy types (Tropical Products Institute, 1964).

Until lately ginger has been cultivated in Ghana in small quantities for local use only. Cultivation has normally been in the backyard garden or small portions of food farms (Osei-Kwakye, 1970) and consequently there are no reliable statistical data on ginger production in the country. However, as a result of interest generated in the crop by the Ministry of Agriculture and some financial institutions, there was a sharp increase in the amount of fresh ginger produced in the 1973/74 growing season. It was estimated by the Ministry of Agriculture that the total production in that period alone was in the neighbourhood of 40 000 t. Even though this figure might appear to be exaggerated, the fact remained that more ginger was produced than the economy could absorb.

The Ministry of Economic Planning consequently set up a task force to advise on how to dispose of the surplus crop. These events have clearly indicated that Ghana has reached a stage

where she can fully participate in the ginger trade.

The chief commercial ginger varieties already on the world market are 'African ginger' exported mainly by Sierra Leone and Nigeria and Jamaican, Fijian, Indian, Chinese and Japanese gingers. Among these, the Jamaican ginger is rated as the best on account of its delicate odour, flavour and clean peeled condition in which it is exported (Tropical Products Institute, 1964). The Tropical Products Institute (1964) reports that the ginger from the main exporting countries differ in respect of methods of preparation, appearance, pungency, flavour, but for many purposes ginger from different sources are interchangeable.

The term African ginger can be misleading since the ginger from different parts of Africa may not have identical characteristics. The Tropical Products Institute (1964) has described the Sierra Leonean ginger as containing more essential oil than other types and is, therefore, used for the extraction of oleoresin and for the distillation of ginger oil. The Nigerian ginger was described as resembling the Jamaican type but is of lower quality. Merory (1960) has described the African ginger as lacking the fine aroma of Jamaican ginger but having an intensely pungent odour. Locally, it is commonly said that the Ghanaian ginger is highly fibrous. The impression created by these statements is that the Ghanaian ginger is not suitable for marketing overseas. Consequently, the Ministry of Agriculture has attempted to introduce the exotic varieties like the Jamaican and Fijian types into the country. In fact it is not even known whether the Ghanaian ginger is similar to the Sierra Leonean or the Nigerian or any other type described in the literature. Since very little is known about the local crop, this work was carried out to establish some basic facts on the composition of the ginger varieties found in Ghana.

It is hoped that such information will be useful to the exporter, the agriculturist and the manufacturer who might decide to set up a processing plant to extract ginger for local use or for export.

Materials and methods

Five 50 kg batches of fresh ginger showing no signs of spoilage were used. One batch was bought at Nkawieh near Kumasi and was designated Nkawieh sample. The other four batches were purchased from the Makola market in Accra at various times and were designated market samples I, II, III and IV respectively.

Sample preparation

In the laboratory, the 'hands' of the rhizomes were broken up so that all adhering soil could be removed by washing under running tap water. The washed pieces were peeled manually using stainless steel knives and the peeled pieces were washed again and were mechanically cut into 0·3 cm thick slices. The slices were then loaded on stainless steel trays at the rate of about 9·76 kgm^{-2} and were inserted into an Apex Cross-flow dehydrator with the temperature setting at 60 °C and dehydrated for 8 h to moisture content of about 10 per cent. The dry ginger was milled in a Christy and Norris Laboratory mill to pass through a 20-mesh sieve. The ground ginger was packed in polyethylene bags and stored in a desiccator for further use.

Analysis

The analyses were carried out for moisture, total ash, water soluble ash, acid insoluble ash, water-soluble extract, alcohol-soluble extract, volatile oil content, alkalinity of soluble ash, acetone extract, starch content, lime, per cent crude fibre, per cent crude protein by using AOAC (1970) methods.

The essential or volatile oil was obtained by continuous distillation for 8 h of 1 kg of freshly dried and ground ginger suspended in water. Condensation of the distillates was facilitated by circulating water at melting ice temperature through the condenser.

The volatile oil was recovered from the water by extraction with diethyl ether. The ether extract was dried over anhydrous sodium sulphate and the ether was evaporated off on a water bath leaving the essential oil. In all determinations, four separate trials were conducted and an average value was calculated from the result.

Results and discussion

The results of the various analyses are presented in Table 1. Apart from water which constitutes

TABLE 1

Composition of Ginger Samples Grown in Ghana

Constituent	*Percentage of constituents in samples*					
	Nkawieh	*Market I*	*Market II*	*Market III*	*Market IV*	*Mean*
Moisture (fresh) (1)	85	—	87	—	82·3	84·8
Moisture (dehydrated)	9·7	7·5	10·1	11·0	11·1	9·9
Total ash	3·0	2·6	3·4	4·2	3·5	3·3
Water soluble ash	1·8	1·9	2·2	3·5	1·7	2·2
Acid-insoluble ash	0·80	1·17	0·55	0·70	0·55	0·56
Water soluble extract	10·1	8·4	10·1	12·0	12·9	10·7
Alcohol-soluble extract	17·0	10·2	7·0	7·1	8·1	9·9
Volatile oil	1·7	2·1	2·9	3·0	1·5	2·2
Alkalinity of ash	14·1	—	17·1	—	13·3	14·8
Acetone extract	15·6	8·2	5·7	—	6·3	8·9
Starch content	26·7	48·8	57·3	49·8	54·4	47·4
Crude fibre	4·1	3·6	3·4	3·4	3·4	3·6
Crude protein (N × 6·25)	4·9	8·6	8·1	—	8·4	7·5
Lime content	0·13	0·08	0·08	0·20	0·06	0·11

All values except for (1) are expressed on dry weight basis. Alkalinity of ash is expressed as millilitres of 1*N* HCl per 100 g of ginger

nearly 90 per cent of the fresh material, starch is the major constituent of ginger (Table 1). Except the Nkawieh sample which showed a low starch content of 26·7 per cent which is an indication of immaturity of the rhizome, the other four samples showed very high levels on dry weight basis (48·8–57·5 per cent) and this easily met the American market specification for starch which is a minimum of 42 per cent.

Two very important constituents of ginger are oleoresin and volatile or essential oil.

According to the British Pharmaceutical Codex (1963), the pungency of ginger is due to the oleoresin or gingerol, a yellowish oily substance which consists of a mixture of terpenes, ketones (chiefly zingerone) and saturated aliphatic aldehydes (principally n-heptaldehyde). The odour is due to volatile oil of which the sesquiterpene zingiberine is the principal constituent in addition to other terpenes and terpene alcohols. The level of volatile oil found in the experiments was 1·7–3·0 per cent. These levels compared well with published results (Pearson, 1970; Natarajan *et al.*, 1972). The level of oleoresin or alcohol soluble extract was high (7–17 per cent) compared with the British standard which is 5·1 per cent minimum. The American Standard does not specify the level for oleoresin or the alcohol-soluble extract.

The importance of crude fibre is generally related to the difficulties and waste encountered during the grinding or milling of high fibre content gingers. Pearson (1970) notes that crude fibre for which a maximum level is prescribed in the US is useful for assessing the degree to which the rhizomes have been scrapped. The British Pharmacopoeia (1963) and the British Standard (BS4593: 1970) do not set a limit for crude fibre. All the samples analysed, however, easily met the crude fibre limit prescribed by the US standard. The complaint that Ghana ginger is too fibrous does not, therefore, appear to be well founded. The presence of exhausted or spent ginger, which is a byproduct of ginger-beer manufacture is indicated if the cold water and alcohol extracts are low. In addition, the water soluble ash of spent ginger represents only about 25 per cent of the total ash instead of the usual 40–50 per cent for genuine ginger (Pearson, 1970). In Ghana, the ginger is not extracted in any way and fears about exporting spent ginger in that sense will not be real. However, the practice of leaving the crop in the soil over periods up to 2 years or allowing the harvested crop to sprout or respire excessively can affect the levels of these extracts.

The results in Table 1 show that two samples, Market III and IV easily met the cold water extract standards for British and the US standards.

TABLE 2

British and American Standards for Dry Ginger

Constituent	*Specification (per cent)*	
	British (BS4593: 1970)	*American*
Moisture (by mass)	12 (max)	—
Total ash (on dry basis):		
(i) unbleached	8 (max)	7 (max)
(ii) bleached	12 (max)	—
Water-soluble ash	1·9 (min)	2 (min)
Acid insoluble ash	2·3 (max)	2 (max)
Alcohol-soluble extract	5·1 (min)	—
Cold water-soluble extract	11·4 (min)	12 (min)
Starch content	—	42 (min)
Calcium (as CaO)	—	1·0 (max)
(i) unbleached	1·1 (max)	—
(ii) bleached	2·5 (max)	—
Crude fibre	—	8 (max)
Volatile oil (on dry basis)	100 ml/100 g (min)	—

Source: TPI Report No. G 95 (1975)

Two other samples, Nkawieh and Market II, just fell short of the standard while one sample, Market I decidedly fell below the standards. These results indicate the need to determine the correct stage of maturity at which the ginger should be harvested. In practice, local farmers hold the crop in the soil and only harvest if the market is available. They should rather be encouraged to harvest at the correct time of 9–11 months after planting, then wash and peel or slice or scrape the rhizome before finally sun-drying the crop in order to arrest any further change in quality. The American and British specifications for water-soluble ash are 2·0 per cent and 1·9 per cent minimum respectively, while values found for the local samples ranged from 1·7 to 3·5 per cent (Tables 1 and 2).

The level of acid-insoluble ash indicates the level of sandy matter. A high level would indicate a high level of silicious matter. In these experiments, it was quite easy to attain a high level of cleanliness but this may not be so easy when it comes to handling large quantities of ginger at the farm level especially if the ginger is not peeled. It would appear, therefore, that a strict produce inspection would have to be enforced for an export market. It has already been stated that one of the merits of the Jamaican ginger is the clean peeled form in which it enters the world market and though the Nigerian ginger resembles the Jamaican type it is considered to be of lower quality probably because it is not peeled.

There was no difficulty with total ash content of any of the samples analysed. While the maximum limits were 8·0 per cent and 7·0 per cent for the BS and the US market, the highest level obtained in the present investigation was 4·2 per cent.

Similarly, the lime (CaO) content was also found to be within specification for all the five samples analysed. The per cent crude protein was found to range from 4·9 to 8·6 per cent. This value was lower than those reported by Natarajan *et al.* (1972) for 26 Indian ginger varieties which had crude protein contents ranging from 10·3 to 15 per cent. On the other hand, the acetone and alcohol extracts showed higher levels for the Ghanaian samples. These values ranged from 5·7 to 15·6 per cent for acetone extract and 7·0 to 17·0 per cent for the alcohol soluble extract for the local varieties (Table 1). Similar values for the Indian varieties were 3·9–9·3 per cent and 3·6–9·3 per cent respectively.

Conclusion

Results of the analyses show the variable maturity of the Ghanaian market gingers. With standardized harvesting time and processing procedures, Ghanaian ginger would satisfy international standards and could be of marketable export quality.

The impression that Ghanaian ginger is too fibrous is not borne out by the analytical results since all the samples fell within the specification for crude fibre.

For the local ginger to enjoy any reputation abroad, there should be a strict crop inspection and high standard of hygiene because chemical composition *per se* may not be enough.

The result of alcohol and acetone extractions indicate a high level of oleoresin in Ghanaian gingers. Although volatile oil content values obtained by steam distillation did not reach the high concentrations found in Sierra Leonean

ginger, they approximated closely the values for other gingers reported in the literature.

Further work is necessary to follow the rate of build up of the chemical constituents so as to determine the optimum time to harvest after planting.

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