The Effects of Peeling, Splitting and Drying on Ginger Quality and Oil/oleoresin Content

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ABSTRACT

Farmers in Nigeria are handling and processing their ginger using primitive practices inherited from ancient traditions resulting in poorly and unhygienically processed ginger. This is because there is little information on ginger handling and processing. There is the need to improve the traditional methods of processing and drying for better quality and appearance of the dried ginger. In a series of experiments conducted in 2003, four processing treatments: whole-unpeeled, split-unpeeled, whole-peeled and split-peeled and four drying methods: sun, solar, natural air and fire-heat drying were investigated on their effects on the appearance, aroma/flavour, pungency and the ginger oil/oleoresin yield of dried ginger. Whole-unpeeled samples sufficiently dried by fire-heat drying, giving a smoky-burnt aroma and a pronounced pungent smell. The analysis of the ginger oil/oleoresin contents in the four treatment samples shows that the highest yield of 2.0% was from the whole-unpeeled samples dried by fire-heat drying. The use of fire-heat drying to dry whole-unpeeled ginger not only will reduce quality deterioration, but help to alleviate farmers from the high labour-intensive operations of peeling, slicing and sun drying.

Keywords: Ginger, evaluation, treatment, drying, oil/oleoresin.

1. INTRODUCTION

Ginger (Fig. 1) is an herbaceous perennial plant known as Zingiber officinale, which belongs to the order, Scitamineae and the family, Zingiberaceae. It is a tropical herb extensively grown for its pungently aromatic underground stem or rhizome which is an important export crop valued for its powder, oil and oleoresin (NEPC, 1999).

Figure 1. Ginger plant on the field

The rhizome is used as spice in culinary, beverage, confectionary, pharmaceutical and perfumery industries (Njoku, et al., 1995). Dry ginger contains 1-3% essential oil, 5-10% oleoresin, 50-55% starch and 7-12% moisture, with protein, fibre, fat and ash as its other constituents (Ebewele and Jimoh, 1981). Although a perennial plant, ginger is cultivated as an annual crop and propagated vegetatively by the cuttings of the fresh rhizomes (Sutherland, 1981).

Nigeria is among the major producers and exporters of ginger in the world with Southern Kaduna area of Kaduna State, Nigeria, as the main producing zone with over 95% of the country's total annual production (Musa, 1991). The two popular varieties produced in the country are the 'Tafin-Giwa', a yellowish variety with plump rhizomes and 'Yatsun-Biri, a black or dark variety with small compact rhizomes (Fumen et al. 2003; Erinle, 1988). The yellow variety is richer in flavour, of better colour and appearance and also better and more suitable for ginger powder production. Nigerian ginger is highly valued in international market for its aroma, pungency, high oil and oleoresin content (Njoku, et al., 1995).

Primary processing of freshly harvested ginger entails sorting, washing, soaking, splitting or peeling (Fig. 2) and drying (Fig. 3) it to a moisture content of 7-12% (Ebewele and Jimoh, 1981). The processing of the Nigerian ginger has not been standardized with the result that microbiological, organoleptic and chemical properties of the products often fall short of importers' specifications. Consequently, Nigerian ginger receives low rating in international markets and hence loss in foreign exchange earnings. The traditional drying methods used by farmers to dry ginger are varied, haphazard and risky, resulting in mould growth, loss of some volatile oil by evaporation and destruction of some heat-sensitive pungent properties (Ebewele and Jimoh, 1981).

Figure 2. Splitting or peeling of ginger

Figure 3. Drying of ginger

At present, the bulk of Nigerian ginger is marketed internationally in split-dried form, where the importing countries further process it into industrial products mainly ginger powder, essential oils, oleoresin and ginger ale concentrates. The amount of foreign exchange earned by exporting dry ginger is however very insignificant when compared with the amount spent on importing processed ginger products thereby substantiating the need for industrial processing of the Nigerian ginger within Nigeria (Meadows, 1988).

There is little or no research on ginger handling and processing hence no known research information on ginger production and processing for the Nigerian farmers. Farmers are therefore handling and processing their ginger using primitive practices inherited from ancient traditions resulting in poorly and unhygienically processed ginger (Maigida and Kudi, 2000). It is therefore expedient to make room for improvement on the traditional processing and drying methods so as to improve the appearance, oil/oleoresin and quality of the dried ginger. This paper presents the results of a study conducted to examine the effects peeling, splitting and drying on dried ginger oil/oleoresin yield.

2. LITERATURE REVIEW

Ginger splitting and sun drying are the most widely accepted processing treatments and drying practices in Nigeria (Fume et al., 2003). However, ginger peeling is only done in small quantities meant for culinary purposes. According to reports, ginger peeling is tedious, time-consuming and most often, the peeled-dried ginger does not attract a significant price difference over the split-dried ginger, hence most farmers prefer to process their ginger into split-dried form (Ebewele and Jimoh, 1981; KSADPMEU, 1984).

Fumen et al. (2003) and Maigida and Kudi, (2000) also reported that farmers continue to process their ginger into split-dried form because that is the form demanded by the local ginger market. Other reasons for the wider acceptability of the split-dried ginger over the peeled-dried form may also be attributed to the fact that the flavour components of ginger are concentrated just below the peel, hence great losses are encountered in the peeling process (Ashurst et.al., 1973). While splitting process has been found to conserve about 15-20% ginger material, which is lost during peeling process it also facilitates fast and thorough drying of ginger (Meadows, 1988; Akomas and Oti, 1988). Ginger splitting also minimizes loss of volatile oil components; hence split-dried ginger is most suitable for industrial distillation and extraction of volatile oil and oleoresin (Ebewele and Jimoh, 1981).

Whole-unpeeled dried ginger was not very common in the area. The very small quantities noticed were said to result from dehydration of the rhizomes during prolonged storage of' 'seed ginger' or from fields left unharvested during the cold-windy harmattan period or when the dry season prolongs beyond expectation (Nnodu and Okwuowulu, 1988). For the split-peeled dried ginger, insignificant quantities are prepared mainly for kitchen use.

The removal of the peel (cork skin) and the splitting are said to reduce fiber content of the spice and minimize roughage in food, and to facilitate faster drying of the spice. Ginger in this form is used for spicing local diets such as 'Kunu-tsamiya', 'fatte', daffa-duka' (jollof rice), 'gusgus', 'fura de nono' (Hausa Nigerian language), soups, pepper soup, etc. It is also used for preparing ginger powder, which is usually blended with some other spices as 'yaji'-(Hausa language); a local curry powder for spicing various local diets (Nnodu and Okwuowulu, 1988).

3. MATERIALS AND METHODS

To evaluate the effects of peeling, splitting and drying methods on sensory and nutritive properties of dried ginger, several analyses were conducted following methods from the Association of Official Analytical Chemists (AOAC, 1980). A 36.0 kg bulk sample of freshly harvested ginger (Tafin Giwa) was obtained from Fai district in Jaba Local Government area of Kaduna State, Nigeria.

The bulk ginger sample was divided into four main samples of 9.0 kg each tagged: whole-unpeeled (WU), split-unpeeled (SU), whole-peeled (WP) and split-peeled (SP). The four main samples were each divided into three sub-samples and each sub-sample was further subjected to different processing (chemical) treatments: unsoaked, soaked or bleached.

Each sub-sample was further divided into four sub-sub-samples and each sub-sub-sample was subjected to different drying methods: sun, solar, natural air and fire-heat drying. Thus, a 4 x 3 x 4 factorial experimental design was adopted for the experiment, each repeated three times. The results were analyzed as a split-split plot design (Steel and Torrie, 1980)

4. RESULTS AND DISCUSSION

Table 1 shows a summary of the data obtained on dried ginger oil/oleoresin content. Table 2 shows the results of the analysis of variance of essential/oleoresin content for dried ginger while Table 3 shows the interaction effects of physical processing treatment and the combined effects. The results showed that the effects of physical processing treatments (P), drying methods (D) and the combined effect of these processing factors (P&D) on essential oil/oleoresin content of dried ginger were significant at $p<0.05$.

Table 1. Summary of ginger oil/oleoresin data obtained on the four main samples.

Experimental Number	Experimental Factor			Replication Mean			Total Mean
	P	U	D	R1	RII	RIII	
1	WU	U	D	4.7	4.7	4.9	4.8
2	WU	S	D	4.6	4.7	4.8	4.7
3	WU	B	D	4.6	4.6	4.9	4.7
4	SU	U	D	5.8	6.2	6.1	6.0
5	SU	S	D	6.2	6.1	6.0	6.1
6	SU	B	D	6.2	5.9	6.1	9.1
7	WP	U	D	4.5	4.4	4.6	4.5
8	WP	S	D	4.5	4.3	4.1	4.3
9	WP	B	D	4.5	4.4	4.0	4.3
10	SP	U	D	2.8	2.8	2.6	2.8
11	SP	S	D	2.7	2.7	2.6	2.7
12	SP	B	D	2.9	2.6	2.7	2.7
Total Mean				4.5	4.4	4.5	4.5

Table 2: Analysis of variance of essential oil/oleoresin content of dried ginger

Source of variation	Degrees of freedom (DF)	Sum of Squares (SS)	Mean Squares (MS)	Computed F
Main-plot analysis				
Replication	2	0.09	0.04	0.27
Physical treat. (P)	3	205.22	68.41*	456.07*
Error	6	0.90	0.15	
Sub-plot analysis:				
Chemical treat (C)	2	0.11	0.05	0.71ns
C x P	6	0.25	0.04	0.57ns
Error (C)	16	1.11	0.07	
Sub-sub-plot analysis:				
Drying treat. (D)	3	96.48	32.16	402.00*
P x D.	9	73.09	8.12	101.50*
C x D.	6	0.32	0.05	0.62ns
P x C x D	18	1.21	0.12	1.5ns
Error (D)	72	5.66	0.08	
Total	143	384.45	2.69	

a, CV(P) = 8.6%, CV (C) = 5.9%, CV (D) = 6.3%

b, * = Significant at 5% level, ns = not significant

Table 3: Mean difference between P X D interaction means on ginger oil/oleoresin content.

S/No.	Treatment Interaction	Interaction Mean (%)	Mean difference range		
			R2	R3	R4
1.	SUD1	1.5	0.5*	0.7*	0.8*
2	WPD1	1.0	0.2ns	0.3ns	

3.	WUD1	0.8	0.1ns		
4.	SPD1	0.7			
5.	SUD2	1.6	0.2ns	0.5*	0.9*
6.	WPD2	1.4	0.3ns	0.7*	
7.	WUD2	1.1	0.4ns		
8.	SPD2	0.7			
9.	SUD3	1.2	0.4ns	0.4ns	0.6*
10.	WPD3	0.8	0.0ns	0.2ns	
11.	WUD3	0.8	0.2ns		
12.	SPD3	0.6			
13.	WUD4	2.0	0.3ns	0.9*	1.2*
14.	SUD4	1.7	0.6*	0.9*	
15.	WPD4	1.1	0.3ns		
16.	SPD4	0.8			
17.	WUD4	2.0	0.9*	1.2*	1.2*
18.	WUD2	1.1	0.3ns	0.3ns	
19.	WUD1	0.8	0.0ns		
20.	WUD3	0.8			
21.	SUD4	1.7	0.1ns	0.2ns	0.5*
22.	SUD2	1.6	0.1ns	0.4ns	
23.	SUD1	1.5	0.3ns		
24.	SUD3	1.2			
25.	WPD2	1.4	0.3ns	0.4ns	0.6*
26.	WPD4	1.1	0.1ns	0.3ns	
27.	WPD1	1.0	0.2ns		
28.	WPD3	0.8			
29.	SPD4	0.8	0.1ns	0.1ns	0.2ns
30.	SPD2	0.7	0.0ns	0.1ns	
31.	SPD1	0.7	0.1ns		
32.	SPD3	0.6			

* = Significant at 5% level
ns = not significant

Comparing the interaction means of the physical processing treatments (P) and the drying methods (D), the whole-unpeeled samples dried by fire-heat drying gave the highest mean percentage yield of (2.0%) ginger oil/oleoresin extracts, followed by SUD_4 (1.7%), SUD_2 (1.6%) and SUD_1 (1.5) while all WP and SP samples gave very low percentage yields. The low yield of ginger oil/oleoresin from the whole-unpeeled samples dried by fire-heat may be attributed to the pungent cork skin which was coated (whole-unpeeled) and effective during the drying process through the high temperature associated with the fire-heat drying.

Ebewele and Jimoh (1981) and Ukpabi (1995) reported that drying ginger with heated air up to 80^{o}C has no adverse effect on ginger oil/oleoresin content. The yields in SUd_4, SUD_2 and SUD_1

samples also show the conservative effect of the pungent cork skin in the split-dried ginger (Akomas & Oti, 1988) and the effect of proper drying of the spice by fire-heat, solar and sun drying.

Very low yields of the extracts from whole-unpeeled samples dried by sun, solar and natural air drying, may be as a result of prolonged drying period which resulted in poor drying effect on the samples, thus, affecting the yield or ginger oil/oleoresin. While the poor yield associated with the WP and SP samples may be as a result of total removal of the cork skins.

5. SUMMARY AND CONCLUSION

Ginger splitting and sun drying have remained the major primary processing operations for ginger farmers in Southern Kaduna area of Kaduna State, Nigeria. Although with small farm sizes coupled with abundant available labour, these operations have continued to depend on weather, drying spaces available in family compounds and labour to split, spread, turn and packing the product, from time to time until it is sufficiently dried. However, where the production is large, labour is limited and weather is unfavourable, the use of fossil fuel to energize the drying air would be more suitable.

Coated (whole-unpeeled) ginger rhizomes were sufficiently dried by fire-heat drying, producing the highest yield of ginger oil/oleoresin (2.0%). The use of fire-heat drying for drying whole-unpeeled ginger has the advantage of effecting proper and timely drying, and conserving the volatile oil components of the spice. The smoky-burnt smell of the products and their burnt-brown appearance may be minimized, or eliminated, if adequate control of the heating temperature and sooty flame during the drying process is done.

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