



Assessment of Current Practices Involved in Handling and Storage of Ginger Products in Kaduna State, Nigeria

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Abstract: This research assesses the current practices in handling and storing ginger produced in Kaduna State of Nigeria. Nigeria is a leading producer of ginger after India, with Southern Kaduna being the major heart of ginger production in Nigeria. Two major varieties of ginger (Yellow and black ginger) are cultivated based on their improved properties compared to other varieties. Two hundred well-structured questionnaires were shared in (8) local government areas: Jema'a, Kachia, Chikum, Kagarko, Kajuru, Sanga, Lere, and Zangon Kataf Local Governments Areas. Information obtained suggests that drying ginger before storage is the best storage method. This is confirmed as 36% of the respondents said they always dry their ginger before storage to ensure its safety during handling and storage. The results also show that ginger can have a shelf life of about 4-6 months. Results also show that demand is the major problem farmers and marketers face during ginger's handling and storage process.

Keywords: Ginger, Handling, Storage, Assessment, Problems

INTRODUCTION

Ginger (*Zingiber officinale*) is a commercial crop cultivated mainly for its aromatic rhizomes used for medicinal and spicing purposes (Jagdish, 2019). Two varieties are widely cultivated in Nigeria: yellow ginger and black ginger. Yellow ginger has been very popular due to its high-yielding capacity and pungency (Kure, 2007). Worldwide, about 4,081,374 tons of ginger are produced annually, with India being the major producer, producing about 1,788,000 tons of ginger produced annually on 164,000 ha of land. This is followed by Nigeria, which produces an estimated 691,239 tons of ginger annually on 84,156 ha of land. China ranks third with a total production estimate of 581,137 tons per year. Other major producing countries are Nepal; Indonesia, Thailand, Cameroon, Bangladesh, Japan, and the Philippines. Details are available in Table-1.

Table-1 World Ginger Production 2019 Estimates (FAOSTAT, 2020)

Rank	Country	Production (Tons)	Area (Ha)	Yield (ton/Ha)
1	India	1,788,000	164,000	10.90
2	Nigeria	691,239	84,156	8.21
3	China	581,137	55,059	10.55
4	Nepal	297,512	22,132	13.44
5	Indonesia	174,380	8,077	21.29
6	Thailand	166,923	10,118	16.4
7	Cameroon	83,434	8,145	10.24
8	Bangladesh	80,234	9,610	8.34
9	Japan	45,506	1,729	26.31
10	Philippines	26,929	3,924	6.86

Ginger is produced in several parts of Nigeria, particularly in the Guinea Savanna Zone (Southern part of Kaduna State) and to a small extent in Keffi and Akwanga Local Government Areas of Nasarawa State (Dauda and Waziri, 2006). The southern part of Kaduna State is the traditional home of ginger in Nigeria. Its production was boosted to generate internal revenue for the people and improved foreign exchange earnings for countries. However, ginger yields in Nigeria are comparatively very low, ascribed to various factors such as poor agronomic practices, unimproved varieties, and laborious harvesting and processing operations (Titilayo, 2014). Ginger oil has good antibacterial and antifungal properties and prevents food-borne diseases when used in food preparation. Ginger is also reported to prevent rancidity, thereby increasing the shelf life of lipid-containing foods. The phytochemicals in ginger oil also possess free radical scavenging, antioxidant and anti-per oxidative effects. These properties are attributed to the plethora of biologically active compounds in the fresh, well-dried ginger oils. ginger's antioxidant and lipid peroxidation inhibition properties prevent oxidative damage, indicating the benefits of ginger in preventing microbial food spoilage, free radical-induced damage, and rancidity (Shrinath 2017). Local processing of ginger involves cleaning fresh ginger, then slicing the fresh ginger tubers into parallel parts and sun drying. Drying completes in approximately two weeks, depending on the prevailing weather conditions.

This operation is usually carried out between November and January, while further sorting and cleaning (by the intermediaries) continue up to April (Ahmed, 2018). Dried ginger halves are stored and transported in gunny bags for local and distant markets (Gautam and Acharya, 2009). In the Ethiopian context, clean sisal sacks can be used as alternate packing materials for dried ginger (Zakir et al., 2018). Dried ginger storage can last several months with proper postharvest handling and storage procedures (Zaki et al., 2018). The optimal temperature and humidity for storing and transporting fresh ginger are 12°C and 70 -75% RH. In these conditions, fresh rhizomes will remain marketable for a maximum period of 3 months. Otherwise, surface mould grows at relative humidity above 90%, and sprouting is stimulated at temperatures above 16 °C. However, ginger production is met with several issues during Nigeria's cultivation, transportation, and storage. Usually, loss in weight is recorded during storage. Mould growth is another challenge, especially due to improper drying. Economically, farmers and marketers of ginger are faced with price fluctuations of the products. This can be attributed to the lack of an ideal market for ginger. On the other hand, an insect's attack during storage causes several losses (Ahmed, 2018). Therefore, this research focuses on assessing the current practices in handling and storing ginger production in the Kaduna State of Nigeria. Findings will provide local farmers with information necessary for improvement in current practices. To maintain the quality and improve the shelf life of the food substances various processing, preservation, and storage techniques have been developed such as drying, freezing, salting, vegetables (Manisha et al., 2017; Natarajan et al., 2022) keeping in mind the low shelf-life of fresh ginger and inadequate facility for their modern storage leading to distress sale, value addition could be a viable alternative which will fetch remunerative price to the growers. The major problem with ginger is to prolong the shelf-life good marketability. The preservation of ginger is imperative especially when it is transport or consumed over a longer period (Camacho and Brescia, 2009). Prolonging the post-harvest life of vegetable commodities is one of the primary concerns of farmers and traders. In the countryside, the objective in storage is not to keep the product for a long time but to lessen the perishability so that the usefulness of this product is maximized and a larger profit can be derived, if these crops are to be marketed. Until this treatment is all known and applied, it is unsafe to say that any particular storage method is exactly are correct for all rhizomes or tubers Ninive et al. (2021).

MATERIALS AND METHODS

2.1 Study Area

This study was conducted in Kaduna State, in Northwestern Nigeria, which lies between latitude 10 degrees centi 38'58" N and 10 degrees centi 25'36" north of the equator to longitude 7- degree centi 22'14" E and 7 degrees centi 32'00" east of the Greenwich Meridian (Yusuf, 2015). The state has a total land area of approximately 46,053 km² with a total population of 6,113,503 (2006 census). The state economy largely depends on agriculture, especially groundnut and cotton production (KSBS, 2020). The study area, just like all the areas in the middle belt of Nigeria, has the tropical savanna type of climate as classified by Koppen and found within the Guinea Savanna region of the country. It is characterized by wet and dry seasons. Rainfall occurs between April to October, with a peak in August. The mean annual rainfall is about 1800 mm; the mean monthly temperature is 25 °C, while the relative humidity is about 62%. The aerographic effects of the Jos - Plateau and the Kagoro Hills positively influence the climate of the study area, influencing rainfall, temperature, and relative humidity. Ferruginous tropical soil is related to the climate: vegetation, lithology, and topography dominate (Ishaya and Abaje, 2008). Clayey and sandy soils are also found along some rivers' banks.

The relief of the area is relatively flat and undulating, with the lowest relief in the South and South with a height of 180 m rising steadily North and North - Eastward to about 450 m along the Northern edge of the study area and reaching 600 m in the extreme North-East (Ishaya and Abaje, 2008). The major occupation of the inhabitants of the Local Government is farming. Most farmers practice small-scale Agriculture with farm sizes ranging from 0.1-3 ha (Danladi *et al.*, 2017).

2.2 Sampling Techniques and Sample Sizes

Random sampling and purposive sampling techniques were used to obtain information from one hundred (200) respondents in the study area in two stages. The first stage involved a purposive selection of five (8) local government areas: Jema'a; Kachia, Chikum, Kagarko, Kajuru, Sanga, Lere and Zangon Kataf Local Government Areas. These Local Government Areas were purposively selected because they are the major ginger-producing areas of the state. In each Local Government visit, the list of farmers producing the crop was administered to the area's two hundred randomly selected respondents. At the same time, the secondary source involved the use of relevant research reports in textbook journals and the internet. The data was collected in January 2021 for the previous harvest of the 2020 season. The questionnaire was designed with simple questions, comprehensive enough that it covered all the research objectives.

2.3 Method of Data Collection

Primary data were obtained via the use of well-structured questionnaires. A total of one hundred (100) survey questionnaires were randomly administered among households, and one hundred (100) survey questionnaires were retrieved for analysis.

RESULTS AND DISCUSSION

3. 1 Socio-economic Characteristics

From Table-2, the highest category (39%) of ginger farmers falls within the 30 – 39 years range. It could be seen that most farmers are between 30 - 39years old, and the mean age is 35. Youth aged 20-29 and adults 58 years and above are less involved in ginger production in the study area. This agrees with the study of Udoh and Nyienakuma (2008) on socio-economic characteristics and adoption trends of artisanal fishers in Akwa-Ibom State, who showed that farmers within the active age groups would be able to withstand stress and put more time into various farming operations. This will result in increased output. Age is very important in agricultural production because it determines the physical strength of the farmer; young people tend to withstand stress and put more time into various farming operations, which will likely increase output (Danladi *et al.*, 2017). Table 2 shows that only 24% of the respondents were females, while the remaining 76% were males. It can be deduced that most farmers are males, implying that fewer females participate in the storage and handling of ginger. This may be because women major more in processing, while storage and handling of ginger, on the other hand, requires a lot of energy and effort, which most men can handle. This is in line with the findings of Baiyegunhi & Fraser (2009), who found that the domination of males in ginger production is due to the high demands of time and effort required to work in such an enterprise. Agriculture is a very energy-consuming occupation that can only be done by able men, which may be the reason for the age distribution of the farmers (Danladi *et al.*, 2017). The majority (45%) of ginger farmers are married. The single ones among the farmers are only 37%.

Those divorced (8%) are higher than widows (4%) and widowers (6%) because they have to struggle more to feed themselves, seeing that they are alone and have no support from their in-laws or, at worst, from their families and friends. The supply of agricultural family labour can explain the significance of marital status on agricultural production. Family labour is expected to be more available where the household heads are married since women and children can participate in crop production, processing, and marketing. About 20% of ginger farmers had primary education, 32% had secondary school level education, and 48% went to tertiary institutions, the highest percentage of the farmers interviewed. This indicates that all (100%) of the total population of farmers had one form of formal education or the other. Illiteracy is believed to have negative implications for the efficient use of productive resources and the adoption of farm innovation. However, [Banta \(2011\)](#) reported that the educational background of a farmer is an important determinant of his adoption behaviour and managerial ability. According to [Muhammed et al. \(1999\)](#), a farmer's level of education is expected to influence adoption, agricultural innovations, and decisions on various aspects of farming. [Danladi et al., \(2017\)](#) said that the level of education affects the type of decisions farmers take in agricultural production and determines the level of opportunities available to improve livelihood strategies and managerial capacity in agricultural production.

Table-2 Socio-economic Characteristics of Ginger Farmers

Category	Frequency	Percentage
Age (years)		
20 – 29	4	4
30 – 39	39	39
40 – 49	21	21
50–59	31	31
60+	5	5
Total	100	100
Gender		
Female	24	24
Male	76	76
Total	100	100
Marital status		
Married	45	45
Single	37	37
Divorced	8	8
Widower	6	6
Widow	4	4
Total	100	100
Educational Level		
Primary level	20	20
Secondary level	32	32
Tertiary level	48	48
Total	100	100

3. 2 Variety of Ginger Stored

Table-3 shows the distribution in the study area. A total of 61% of the Tafin Giwa variety of ginger is stored by farmers, while 39% represents the Yatsun Biri variety of ginger. Therefore, the Tafin Giwa variety is preferable to farmers. The yellow ginger variety, locally called "Tafin Giwa", with a bold yellow rhizome flesh, is stout with short internodes. The black ginger variety is locally called "Yatsun Biri", with a dull-grey rhizome. The yellow variety is more popular than the black one due to its high-yielding capacity and pungency (Kure, 2007; Ahmed, 2018). Table-4 also shows the distribution in the study area; for the Demand', the Tafin giwa variety had 3.27%, representing two people in the population, while the Yatsun Biri variety had 0 population, representing 0%. Due to low cost, 12 people, representing 19.67% of the population, preferred Tafin Giwa, and eight people, representing 20.5%, chose the Yatsun Biri variety. For the marketability preference, three persons, representing 4.91% of the population, preferred the Tafin Giwa variety, and only one person, representing just 2.6% of the population, chose the Yatsun Biri variety, out of 13 persons representing 13% of the population concerning the planting material preference, six persons representing 9.83% preferred the Tafin Giwa variety, and seven persons representing 17.9% chose the Yatsun Biri variety. For the profitability preference, a total of 32%, 19 persons representing 31.14% of the population, preferred the Tafin Giwa variety, and 13 persons, representing 33.3%, chose the Yatsun Biri variety. For storage, the Tafin Giwa variety had 0%, meaning none in the population preferred it. In comparison, the Yatsun Biri variety had one person from the population, representing 2.6% of the population with a preference for storability of 2 persons representing 5.2% of the population for the taste preference, 13 persons representing 21.31% preferred the Tafin Giwa variety. Seven persons, representing 17.9% of the population, chose the Yatsun Biri variety. In contrast, for 'utilization', six people, representing 9.83% of the population, preferred Tafin Giwa and two persons, representing 5.2%, chose Yatsun Biri variety in a total of 8 respondents. Therefore, a total of 100 respondents, which represented 100% of the population, summed various reasons (Demand, low cost, marketability, planter, profitability, storability, taste, and utilization) the reason for storage preference for a ginger variety, 61 respondents which represent 90.11% of the total population preferred the Tafin Giwa variety and a total of 39 respondents which represented 99.9% of the total population chose the Yatsun Biri variety. Therefore, with the statistics above, the Tafin Giwa variety is preferred.

Table-3 Variety of Ginger stored, Reason for Storage Preference

Variety Stored	Frequency	Percentage		
Tafin Giwa	61	61		
Yatsun Biri	39	39		
Total	100	100		
Reason for Storage Preference	Tafin Giwa		Yatsun Biri	
	Frequency	Percentage	Frequency	Percentage
Demand	2	3.28	0	0
low cost	12	19.67	8	20.51
Marketability	3	4.92	1	2.56
planting material	6	9.84	7	17.95
Profitability	19	31.15	13	33.33
Storability	0	0	1	2.56
Taste	13	21.31	7	17.95
Utilization	6	9.84	2	5.13
Total	61	100.00	39	100.00

3.3 Storage Type

Table-4 shows the distribution of storage methods in the study area, 77% preferred storage of dried ginger, while 23% preferred fresh ginger. Therefore, storage of dried ginger has proven to be the most effective and preferred method of ginger storage. According to Fumen *et al.*, (2003), processing ginger in split dry form is preferred by farmers because it is in high Demand in the local ginger market. From Table 4, the distributions in the storage method foreigner show that only 1% of the population prefers the storage of ginger by covering it with soil, 22% of the population preferred storing ginger on the farm, while 7% preferred storing ginger at home, 35% of the population preferred storing ginger in an improved ginger barn, 6% preferred storing ginger on shelves, 9% preferred storing ginger in a store, 20% of the population preferred storing ginger in an aware house.

Table-4 Percentage Distribution of Storage Type, Distribution of Methods of Storage

Storage Type	Frequency	Percentage
Dried	77	77
Fresh	23	23
Total	100	100
Method of storage		
Covered with Soil	1	1
Farm	22	22
Home	7	7
Improved ginger barn	35	35
Shelve	6	6
Store	9	9
Warehouse	20	20
Total	100	100

3.4 Method of Transporting

Table-5 shows a mode of transportation used in conveying ginger; 13% of the population prefers transporting ginger products through bags, while 12% prefers using a motorcycle to transport their ginger products. 8% chose the use of a head pan in transporting their ginger, 51% of the population preferred the use of a truck, and 16% preferred the use of a wheelbarrow in transporting their ginger product. Therefore, from the statistics and interpretation above, farmers' most common and preferred method of transportation for ginger is the use of the truck.

Table-5 Method of Transporting of Ginger, Problems Encounter during Handling

Method of transporting Ginger	Frequency	Percentage
Bags	13	13
Bike	12	12
Head pan	8	8
Truck	51	51
Wheelbarrow	16	16
Total	100	100

3.5 Handling challenges

Table-6 shows the various challenges the farmers and marketers face in ginger, 13% cited colouration as the problem they usually encounter. 4% indicated facilities as the challenge encountered, 21% of the population indicated insects as the challenge encountered during storage, 5% of the population indicated knife cutting as a major challenge encountered during ginger handling, especially when cutting the rhizomes for drying, 12% of the population indicated that labour was the major challenge during the farming season of ginger, 11% indicated that weight loss was the major problem they always faced during storage, 25% indicated market demand as the major challenge encountered during ginger marketing, 3% said separating root from ginger rhizome was the major challenge during harvest, 6% mentioned transportation means and cost as the challenge, especially when moving the freshly harvested ginger from the farm to the storehouse/marketplace. Therefore, the most common count of problems encountered during the handling of ginger is the market demand, which represented 25% of the population. The result obtained regarding demand being the major challenge in storage is similarly reported by Ahmed (2018). "Market glut" is a microeconomics concept that describes a situation in which there is an excess supply of products or commodities against the demand for them under a perfectly competitive market. According to respondents, this situation often happens, especially when the price of ginger rises; it entices ginger farmers to increase ginger production in the subsequent growing season, which in most cases results in overproduction concerning its market demand (Ahmed, 2018).

Table-6 Problems encountered during handling

Parameter	Frequency	Percentage
Colouration	13	13
Facilities	4	4
Insects	21	21
Knife cuts	5	5
Labour	12	12
Loss of weight	11	11
Market Demand	25	25
Separation of root from ginger rhizome	3	3
Transportation	6	6
Total	100	100

3.6 Safety Measures in Ginger Storage

Table-7 shows the various safety measures used by farmers and marketers of ginger take during the storage of the product, 12% are not taking any safety measures to ensure the safe storage of produce, 10% applied insecticides during storage, 1% cover the produce with dry grasses in addition to applying insecticides. 8% said they realize that keeping the environment clean helps protect the product from deterioration. 8% covered their produce with dry grass during storage. This method is mainly used when handling fresh ginger, 7% cut and dry fresh ginger produce to ensure safety during storage, 36% indicated drying to be one of the best measures to take before storing ginger produce, 1% said that free ventilation also helps to preserve ginger during storage, 5% indicated that placing in pits and covering with dry grasses is used to ensure safety during storage, 1% indicated that placing on wooden planks ensures safety during storage, 11% of the population indicated that sillage ensures safety during storage.

Therefore, the most common and accepted safety measure in ginger storage is drying, representing 36% of the population.

Table-7 Safety Measures in Ginger Storage

Measures	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Nil	12	12.0	12.0	12.0
Application of insecticide	10	10.0	10.0	22.0
Application of insecticide and cover with dry grass	1	1.0	1.0	23.0
Clean Environment	8	8.0	8.0	31.0
Cover with dry grass	8	8.0	8.0	39.0
Cut and dry	7	7.0	7.0	46.0
Drying	36	36.0	36.0	82.0
Free Ventilation	1	1.0	1.0	83.0
In pits and covered with dry grass	5	5.0	5.0	88.0
Placed on a wooden plank	1	1.0	1.0	89.0
Silage	11	11.0	11.0	100.0
Total	100	100.0	100.0	

3. 7 Storage Duration

Table-8 shows the various storage duration of ginger, as mentioned by various respondents. 23% preferred storing ginger for about 1- 4 weeks, 11% of the population said ginger could be kept for about 1-3months, 32% of the population said ginger could be stored for about 4-6 months, 28% of the population said ginger could be kept for 6-9months, while 6% said ginger could be kept for 1-2 years. From the distribution above and interpretation, 4-6 months is ginger's best storage duration. The storage period at times goes from a minimum of 4 months to a maximum of 6 months, that is usually from October to March ([Ahmed 2018](#)).

Table-8 Duration of Storage

Duration of storage	Total	Percentage
1-4 weeks	23	23
1-3 months	11	11
4-6months	32	32
6-9months	28	28
1-2years	6	6
Total	100	100

CONTRIBUTION TO KNOWLEDGE

This research assesses the current practices in handling and storing ginger produced in Kaduna State of Nigeria. The results also show that ginger can have a shelf life of about 4-6 months. This was observed by the response of 32% of farmers and marketers interviewed who said ginger could be kept best for 4-6 months. Simple and user-friendly ginger processing technologies, especially the ginger slicing technique, should be explored to improve the quality of ginger and reduce drudgery.

CONCLUSION

The finding proves that drying ginger before storage is the best storage method. This is confirmed by 36% of the respondents, who always dry their ginger before storage to ensure its safety during handling and storage. The results also show that ginger can have a shelf life of about 4-6 months. This was observed by the response of 32% of farmers and marketers interviewed who said ginger could be kept best for 4-6 months. From the findings, ginger handling and storage have been successfully managed in this area, and all methods used during handling and storage have proven effective. Therefore, it could be concluded that demand is the major problem farmers and marketers face during handling and storage.

To achieve the goal of increased ginger handling and storage in Nigeria, the following recommendations are postulated:

1. The extension agents should organize short training for farmers on the control measures to be adopted for Ginger during storage.
2. More research should be done to extend ginger's shelf life.
3. To obviate the services of the mediators, the farmers, producers, and traders should each form cooperative groups for ginger production. This will enable them to combine their resources for efficient production and marketing.
4. Simple and user-friendly ginger processing technologies, especially the ginger slicing technique, should be explored to improve the quality of ginger and reduce drudgery.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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