

## Review of Dried Fruits and Vegetables Consumed In Northern Nigeria

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### Abstract

Fresh fruits and vegetables are important foods both from economic and nutritional point of view. Fruits and vegetable of all types are valuable part of our diet, however, many vegetables are highly seasonal in nature, they are available in abundance at a particular season and sometimes result in market glut, while at off-season they become very scarce and expensive. Large quantities of these vegetables are lost during or shortly after harvest due to their perishable nature. Drying of vegetables as a means of reducing post-harvest losses and improve storability has been practiced for many centuries. As compared to fresh vegetables which can be kept for few days, dry products can be stored for months or even years without substantial loss of nutrients. This paper reviews some commonly dried fruits and vegetables consumed in northern Nigeria, which includes; Tomato, Okra, Baobab leaves, Sweet potato, Cassava, Moringa, Sorrel and Jute. A comprehensive review of preservation methods, price variation with season, storage and duration of these fruits and vegetables is presented and recommendations are made for further studies.

**Keywords:** Fruits, Vegetables, Market glut, Post-harvest losses, Drying, Storage

### Introduction

Fruits and vegetables play an important role in maintaining general good health owing to the presence of mineral elements and vitamins (Adegunwa ET al.2011). Vegetables either fresh or processed are preserved by various methods, which include drying, canning, air-cooling and refrigerated storage. The choice of preservation method employed is normally dependent on availability of resources and facilities. Drying is a major way of removing moisture from agricultural products to minimize post-harvest losses (Isiaka 2009). It is used for producing dried fruits and vegetables that can be consumed directly or used as ingredients for the preparation of soups, stews and many other products (Abano et al. 2012). However, the method employed in drying vegetables is of great importance as it determines the extent of nutrient loss, textural change, change in color and change in taste of the products (Aravindh and Sreekumar 2015). These quality attributes influences the acceptability of the dried products in the market. Open sun drying, hot air drying, freeze drying, microwave drying, spray drying, drum drying, infrared radiation drying, hybrid drying, dehydrator drying, oven drying among others are methods employed in dehydrating vegetables (Isiaka 2009, Visavale 2012, and Aravindh and Sreekumar 2015). Open sun drying one of the oldest and most popular method used for drying food products in northern Nigeria, is done by exposing the food material to direct sunlight. The sun provides the heat for moisture evaporation while the wind removes the evaporated water. Due to uncontrollable conditions and exposure of products to dust and other atmospheric particles, these method results in low quality dried products, as such products from open sun drying are seen in the market having dark and not easily acceptable colours especially in dried tomatoes, which might be as a result of long exposure of the products to ultraviolet radiations from the sun (Vipin et al. 2014).

Drying of fruits and vegetables increases the shelf life of the perishable products by removing excess moisture hence increasing the availability of the products for a long period after harvest. When done properly, drying produces dried products of good quality and hence can be sold at better prices in the

market, thereby increasing the economy of the farmers and a nation at large (Aravindh and Sreekumar 2015). Fruits and vegetables are usually in abundance during or shortly after harvest, however vegetables of all types have their seasons of harvest as such the period of the year when they are in abundance differs. This paper aims at giving comprehensive information on harvest periods, preservation methods, prices at off and on season and storage conditions of the commonly dried and consumed vegetables will help engineers in developing suitable solar dryers and also assist in proper economic planning.

## **2.0 Methodology**

Questionnaires were employed to source for information from the locals within Zaria metropolis. Zaria is an example of a typical Northern Nigeria settlement. It is located on 11.11 latitude and 7.72 longitude and its situated at elevation 644 meters above sea level. Zaria has a population of about 975,153 making it the 2<sup>nd</sup> largest city in Kaduna state. (World Atlas 2019). Sixty (60) structured Questionnaires were developed and administered to farmers and marketers. Needed information were obtained from farmers and marketers through oral interviews and filling the questionnaire by the researcher on the current practices used in drying and marketing of fruits and vegetables. Thirty (30) questionnaires meant for the farmers were administered at two(2) farming area in the following manner; fifteen (15) at Bomo village and fifteen (15) at Shika Village, while the thirty (30) questionnaires for the marketers were administered at four(4) major markets in this order; five (5) at Giwa central market, five (5) at Samaru market, ten (10) at Sabon Gari central market and ten (10) at Zaria City central market. Information was obtained from farmers and marketers by asking relevant questions contained in the questionnaire. The farmers and marketers were able to answer the questions both individually and in groups.

## **3.0 Results and Discussions**

### **3.1 Types of fruits and vegetables dried.**

According to the farmers, there are predominantly eight vegetables commonly sold in their dried state. These are Tomato, Okra, Sweet potato, Cassava, Moringa, Baobab leaves, Sorrel and Jute, of which Tomato, Okra and Baobab leaves are the most purchased. In a similar study conducted by (Mohammed et al. 2019), tomato, pepper, onion, spinach, cucumber and cabbage were identified as the most widely consumed vegetables in Bauchi State which is a North Eastern State of Nigeria. The information gathered also showed that 80% of the marketers obtain the products fresh from farmers while the rest obtain theirs in dried state either from the farmers or professional dryers. Lack of adequate preservation techniques necessitates most of the farmers to sell off the products fresh to any marketer willing to buy often at a giveaway price Rai (2018) also identified perishability, seasonality, bulkiness and geographical specialization of productions as the major factors influencing the marketing of fresh fruits and vegetables. This ultimately reduces the gain of the farmer. Plates 1a is a pictorial view of dried cassava in for sale in the market. Among several other uses, dried cassava is used for making cassava flour “garri” and “Fufu”. Plate 1b is dried sweet potatoes, used as sweetener in some local drinks like “kunu”. Plate 1c is dried tomatoes, when rehydrated dried tomato can be used for making stew just like fresh tomatoes. Plate 1d is a sample of dried red sorrel fruit. It is used in making a special sorrel drink known locally as “zobo drink”. Plate 1e is dried white sorrel fruit; it is used for making soup by the locals. Plate 1f is dried baobab leaves; it is used in making a special soup known as “Meyan Kuka” in Hausa language. Interestingly dried fruits vegetables are very important from gut-health perspective; in that they contribute fiber and sorbitol cure for constipation and bowel health in humans (Michele et al. 2019).



**Fig 1a. Dried cassava**



**Fig. 1b. Dried sweet potato**



**Fig. 1c Dried tomato**



**Fig. 1d. Dried Red Sorrel**



**Fig. 1e. Dried white sorrel**



**Fig. 1f. Dried baobab leaves**



**Fig.1g. Dried moringa leaves**



**Fig. 1h. Dried okra**



**Fig. 1i. Dried jute leaves**

Plate 1g is dried moringa leaves; this is a very important leaf according to the marketers. It is highly medicinal used in treating many illnesses. Moringa leaves are also used in making soups and some special local food. According to research, moringa leaves are rich in vitamins, minerals and other essential phytochemicals. Extract from the leaves are also used to treat malnutrition, augment breast milk in mothers. (Lakshmi priya et al. 2016). It is also used as an anticancer, antioxidant, antidiabetic, anti-inflammatory and antimicrobial agent. Plate 1h is dried okra. It is used by the local to make dried okra soup. Dried okra offers many nutritional benefits; this includes serving up beneficial amount of folic acid and vitamin C (agro web 2019). Dried okra is also rich in dietary fiber, vitamin A, calcium and protein and carbohydrate which help the brain and nervous system function properly. Plate 1i is dried jute leaf known as “Ewedu” or “Ayoyo”. It is used for making special draw soup. The leaves contain flavonoids, triterpenes, saponins, capsularin steroids, glucosides and many other secondary metabolites (Ali 2016).

### 3.2 Peak season of fruits and vegetables

Table 1 presents the season of the year when fruits and vegetables are in abundance.

*Table 1 Peak Season of fruits and vegetables*

S/NO	Crop	Peak season
1	Baobab leaves	August- November
2	Moringa leaves	August- November
3	Sorrel	August- November
4	Tomato	March- April, December- January
5	Okra	June- August
6	Sweet potato	November-December
7	Cassava	October- December

Table 1 show the various seasons of the year when each of the vegetables are available in abundance. All fruits and vegetables are abundant during rainy season or immediately after rainy season, except tomato that has two (2) distinct seasons of abundance that is March to April and December to January. This is because tomato is usually grown by irrigation in addition to the normal rainy season farming. At their peak harvest periods these vegetables usually cause market glut, as such farmers usually sell them very cheap to prevent losses as the vegetables are highly perishable in their fresh state. A similar study carried out by Hossain et al. (2017) identify transportation dummy, labour dummy and market demand dummy as factors that have negative and significant effect on post-harvest losses. Hossain et al.( 2017) in their study, recommended that an appropriate training programmer on different postharvest activities, storage facilities should be established and also transportation and communication systems should be developed constructing of different feeder roads in order to reduce existing postharvest losses of major fruits and vegetables.

### 3.3 Preservation Method

It was observed by the researcher that fruits and vegetables are mainly preserved by open sun drying. This is usually seen beside highways and major roads usually in northern part of Nigeria. When asked, the farmers explained that drying of the fruits and vegetables is carried out by first slicing the fresh product either into two halves or into smaller pieces and spread under the sun to dry as presented in Plate 2. Products, such as tomatoes and other high moisture content fruits and vegetables take 6 to 10 days to dry. Leafy vegetables like baobab are dried by first detaching the leaves from the stem and spread in the shed. When spread in the sun it takes one (1) day to dry but when spread in the shed it takes 10 to 15 days to dry. 85% of the farmers that were interviewed stated that leafy vegetables to be consumed domestically by themselves are dried in the shed as it gives better quality dried leaves. However, this preservation method confers poor quality on the transformed products in terms of less nutritional values, bad appearance, poor hygiene, colour and taste (Radegunda et al. 2019). In the same vein, sun drying has been known to reduce the quality of some essential nutrients.



**Fig. 2 Open sun drying of sliced Okra by marketers**

### 3.4 Storage method and duration

The marketers interviewed said that dried products are stored in porous leather bags as shown in Plate 3a. Storage duration depends on the type of products. Basically leafy vegetables like Baobab leaves, moringa leaves and jute leaves can only be stored up to a maximum period of 6 months. Products like tomato, okra, potato, sorrel and cassava can be stored for as long as 24 months. They also stated that 2 tablets of Bextoxin (Aluminium Phosphide) is added in 1 bag of the dried products if the product is to be stored for a period of more than 6 months. Research carried out in Tanzania by (Luxsika and Sakamon 2018) indicates that storage stability of a dried food is closely related to packaging and storage conditions (e.g oxygen concentration, humidity, light and temperature). Quality changes of dried products during storage are mostly caused by an increase in water activity due to moisture adsorption.



Fig. 3a. Dried cassava stored in sack



Fig. 3b. Bextoxin tablets for fumigation

From the questionnaire the prices as they vary within the season of 2016/2017 when the interview was carried out are presented in table 2.

Table 2. On and off season prices of selected fruits and vegetables within Zaria

Crop	Condition	Unit Of Measurement	Price Per Unit (₦)	
			On Season	Off Season
Tomato	Fresh	Baskets (40kg)	400-500	15,000-20,000
	Dry	Tier	150	500
Okra	Fresh	Bag	600	2000
	Dry	Tier	150	500
Sweet Potato	Fresh	Bag	3000	7000
	Dry	Tier	80	200
Cassava	Fresh	Bag	3000	7000
	Dry	Tier	100	220
Moringa	Fresh	*	*	*
	Dry	Tier	80	150
Baobab leaves	Fresh	*	*	*
	Dry	Tier	240	250
Sorrel	Fresh	*	*	*
	Dry	Tier	300	600
Jute	Fresh	*	*	*
	Dry	Tier	300	600

\* This products according to the marketers are not usually sold fresh.

### 3.6 Limitations

#### A. Limitations in drying

From physical observation of typical dried products been sold in the market as shown in plates 4a, 4b and 4c dried fruits and vegetables sold in the market are dark, and the green vegetables are brownish in colour. This

could be due to long exposure of products to solar radiation in the process of open sun drying, dust particles present in the moving wind or probably debris in the drying area. Some of the farmers interviewed said standard on-farm drying systems discourage them from drying the fresh vegetables themselves.



**Fig. 4a Dried tomato in the market**



**Fig. 4b Dried okra in the market**



**Fig. 4c. Dried baobab leaves in the market**

### **B. Limitations in Storage**

From the results obtained in the questionnaire and physical observations, longer storage resulted in change of colour, taste and mould growth as can be seen in plate 5. This could have been as a result of re-wetting from atmospheric moisture, heat, rodent infestation, or as a result of products not properly protected from environmental effects during storage.



**Fig. 5 Dried tomatoes in the market after 3 months of storage**

## Conclusion

Various dried vegetables commonly consumed in their dried state in northern Nigeria have been reviewed in this paper. From the review it was established that eight fruits and vegetables are dried and consumed, these are cassava, tomato, sweet potato, okra, baobab leaves, moringa leaves, jute and sorrel. These fruits and vegetables are usually in abundance during or just a while after rainy season. At their periods of abundance they are usually sold at giveaway prices. The same fruits and vegetables become extremely expensive when they are not available in abundance. It was also established that farmers and marketers face some series of challenges in preserving these fruits and vegetables. The information in this article is geared at providing engineers and economist to plan on how to provide these locals with efficient on-farm solar dryers thereby improving the economy of the famers and the nation at large.

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