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Curry Production (Murraya Koenigii), Preservation, Utilization, Entomology and Phytopathological Evaluation in the Niger Delta

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ABSTRACT Curry seeds obtained from agricultural extension agents were planted first in the nursery and later transplanted into the field. Agronomic practices for efficient production of curry leaves such as proper watering, weeding, manuring and pruning were done. Associated insect/ pests and diseases were also evaluated. The mature curry leaves were subjected to proximate, mineral and vitamins analyses. The mature curry leaves were slightly fried and air dried in the rainy season and sundried during the dry season and crushed into powder and preserved in an air tight bottle for six months. The curry seeds showed 100% germination and grew luxuriantly which prompted their being harvested after six months of planting. It was also observed that curry leaves possessed appreciable nutrient qualities which distinguished it as a potent vegetable with both culinary and medicinal attributes. Curry leaf plants played host to several diseases and insect pests. Such diseases include mosaic virus, bacterial blight and powdery mildew. The insect/ pests include spiders, scale insects, aphids and mollusc which varied in their percentage incidence and relative abundance during the dry and rainy seasons. Palatability assessment revealed that curry leaves can better be preserved by slightly frying and air dried in the rainy season and by sun drying during the dry season without much quality loss for about six months. No moulds were found on the preserved curry leaves throughout the duration of study. This work has shown that curry could be effectively propagated mainly by seed with several diseases and pests associated with the crop on the field. The best methods of preservation of the leaves were through air drying of slightly fried leaves during the rainy season and sun drying during the dry season. Analysis also revealed that curry leaves were rich in essential nutrients characteristics of most tropical vegetables.

Keywords: curry, production, preservation, utilization, insect pests, diseases

Introduction

Curry leaf tree *(Murraya koenigii* L) belongs to the family *Rutaceae*. It is native to India and grows in the United States Department of Agriculture Plant hardiness zones (NPGS/GRIN"www.ars-grm.gov). Curry leaf trees are grown mainly for their leaves which are used to flavour many Indian dishes. Although originated from India, its production has spread all over the tropical and subtropical regions of the world. Curry is an important vegetable in the Niger Delta regions as every house hold grows it in gardens around their homes. The importance of vegetables in human diets cannot be over emphasized as vegetables are the cheapest and the most readily available sources of important proteins, vitamins, minerals and essential amino acids (Okafor, 1983). Many of the local vegetable materials including the curry leaf plant are under-exploited because of inadequate scientific knowledge of the nutritional potentials. Research reports have highlighted the vital roles played by plants in the maintenance of good health (Moerman, 1996, Achinewhu, 1996). Curry leaf plant is an important leafy vegetable with an outstanding taste which distinguishes it from several other vegetables (Sallkutty, 1985). The tender soft leaves of curry and the flavour it gives in soups and stew makes its usage highly cherished among the Niger Deltans. Like every other leafy vegetables, it provides dietary mineral nutrient to the body (Faber *et al*, 2007). Curry leaves are important in so many ways some of its uses include

For seasoning and adds special flavour to every dish. It contains carbohydrate, fibre, calcium, phosphorus, iron, magnesium, copper, minerals and vitamins such as nicotinic acid, vitamin C, vitamin A, vitamin B, vitamin E, antioxidants, plant sterols, amino acids, glycosides, and flavonoids. It helps the heart to function better. Curry fights infections. It also enlivens hairs and skin with vitality. It fights anaemia in the body. Anaemia does not only suggest lack of iron in the body, it also suggests the inability of the body to absorb iron and use it. In this case folic acid becomes very important to complement this abnormality as it helps the body to absorb iron. Curry leaf is a rich source of both the compounds and therefore a natural source to control anaemia. Curry leaf protects the liver from being damaged and helps it to work effectively. Curry leaf keeps the blood sugar level under check and as such fights diabetes (Arulselvan *et al*, 2006). It improves digestion and alters the way the body absorbs fat, thereby helping in weight loss. Curry leaf lowers cholesterol and protects the heart from disease because of the presence of antioxidants (Rashmee, 2004). It strengthens the organs of the stomach and helps indigestion. It helps in relieving symptoms of diarrhoea because of the presence of carbazole alkaloids that possesses anti -bacterial and anti- inflammatory properties that help to heal an upset stomach. It reduces the side effects of chemotherapy and radiotherapy. It not only protects the chromo-

somes from damage but also protects the bone marrow and prevents the production of free radicals in the body. It is also believed that the curry leaf is capable of fighting against cancer. It reduces congestion in the chest and nose due to the high amount of vitamins A, C and compounds such as kaempferol that is a very potent anti -inflammatory, anti- bacterial, anti- fungal, decongestant and anti -oxidative agent. Curry leaf can help loosen up and release congested mucous. When suffering from cough, take a spoon of powdered curry leaves and add honey to it. Make it a paste and take it twice a day. Curry leaf can help heal and reduce skin infection, early ageing and rid the skin of blemishes. Because of its anti- fungal, antibacterial, anti- protozoan properties, it can be used as home remedy against acne and fungal infections of the nails which are usually very difficult to control (Arulselvan and Subramanian, 2007). It can prevent hair breakage and fall, premature greying and accelerate hair growth.

Considering the various uses into which curry can be put, it still remains unexploited in the Niger Delta region and it is almost going extinct. This work therefore considered the possible way of effective production of curry leaf through seeds, the preservation of the leaves, its utilization and tried also to identify the diseases and pests of curry plants. The knowledge of these will boosts the production of this potent herb and at the same time prevent it from going extinct.

Materials and methods

Collection of curry seeds for planting

Two cups of dry curry seeds was purchased from Agricultural extension agents from oil mill market in Port Harcourt . The seeds were planted in polythene nursery bags and kept in the nursery. The seeds were watered regularly in the mornings and evenings until they started germinating.

Germination of seeds in the nursery

The curry seeds that were planted in the nursery bags were watered twice a day (morning and evening) and were monitored for germination on daily basis.

Land preparation

A piece of land measuring 10m x 10m was cleared by slashing and the grasses allowed to decompose and later incorporated into the soil to increase the soils' nutrient status. This measure was taken because the land has been under continuous farming. The soil was tilled three times to obtain a fine tilt for

effective root penetration.

Transplanting of the young seedlings into the field

Transplanting of the curry seedling from the nursery into the field was done at the three leaf stage in July at the peak of the rainy season. Planting distance of 1m x 1m plant per stand was used giving a plant population of about 10,000 plants per hectare. Prior to transplanting, about 10kg of farm yard manure in addition to the already incorporated plant debris was added into the soil and mixed thoroughly with the garden fork. No artificial fertilizer was added to the soil. The soil under cultivation was a well -drained and well aerated sandy loamy soil.

Weeding

The field was periodically hoed to avoid competition with weeds.
Other management practices carried out on the young plants was the removal of the terminal buds as soon as the plants attended 1 m in height. This stimulated branching and enhanced leaf production. In addition, groundnut was introduced as intercrop to the field to provide ground cover and for maximum utilization of the available land.

Harvesting

Curry plants were allowed in the field after the removal of the terminal buds until good canopies of leaves were formed. This was done because of the succulent nature of the plant.

Survey of diseases and pests of curry plants

The curry plant like most vegetables is prone to several field diseases and pests in the Niger Delta. General survey of diseases and pests of curry plant on the experimental plot and on curry plants in four other locations represented as locations A, B, C and D was carried out. The leaves, stems and flowers of curry plants were examined.

Proximate composition analysis of curry leave

The mature curry leaves were harvested and taken to the Department of Food Science and Technology for analysis. Some of the analyses done were the proximate composition, mineral and vitamins. The method of (AOAC, 2006) was used.

Methods of preservation of curry leaf for prolonged shelf life

Curry leaves are basically consumed fresh as is the case with several other vegetables. However, most of the harvested leaves get bad if not consumed within two days or up to three days if stored in the refrigerator. Curry leaves are also prone to chilling injury at very low temperatures. For prolong shelf life and to ensure its availability, during the dry seasons when most vegetables are scarce, the leaves were harvested and the leaves removed from the stems and washed in tap water. The curry leaves were put in a large kitchen towel and patted gently until they became dry. The leaves were arranged on a tray and covered with a perforated tray. The tray containing the leaves was sundried for three days during the dry season. The sun dried leaves were crushed into powder by rubbing in between the palms. The powdered leaves were put in clean air tight bottles and monitored for mould growth for 6 months (Chuku and Barber, 2013). During the rainy season when it is difficult to get sunlight, the leaves were slightly fried in a frying pan and spread on newspapers on a plat form and allowed to air dry for 3- 4 days. The crispy leaves were crushed in between the palms and stored in an air tight clean bottle. Palatability assessment using the hedonic scale of 1- 5 was employed to determine the acceptability of the preserved curry leaves for six months at one month interval. A scale of 5 represented (100%) acceptability, 4 represented (80%), 3 represented (60%), 2 represented (40%), while 1 represented (20%) respectively. The hedonic scale of 1 to 5 was used considering the sample size although the standard for hedonic scale is 1 to 10.

Mycological studies

Preparation of glass wares

The glass wares used for the mycological study were the Petri dishes, slides, conical flask, inoculating loops and sterile scalpel. These instruments were sterilized according to the methods of (Agrios, 2005)

Preparation of the mycological media

The mycological medium used for inoculation was the Sabouraud Dextrose Agar medium. This medium was prepared according to the manufactures instructions**.** The SDA was dispensed into sterile Petri dishes while still hot and allowed to solidify.

The crushed curry leaf samples were directly plated onto Sabouraud Dextrose Agar in Petri dishes and incubated for 5 days. This was repeated at 0ne month interval for six months.

Statistical analysis

Data generated from the study were subjected to statistical analysis and interpreted through percentages, means of series of observations and standard errors**.**

Results

Seed germination in the nursery

Germination of curry seeds in the nursery started after five days of planting. All the seeds planted germinated indicating 100% germination. However, the nursery plants were continuously watered until they were transplanted into the field.

Harvesting

Harvesting of the leaves started after 6 months of planting during which period the plants had fully established in the field. The leaf yields increased as the harvest time increased as enough time interval of between 3 – 4 months gap was given after each harvest which enabled the plants to produce maximum leaves before the next harvest. Harvesting of leaves continued for over three years due to effective crop management practices adopted such as periodic application of manure around the base of plants and regular application of wood ash on the leaf surfaces to deter insects from feeding on the leaves.

Proximate composition analysis of the leaves

Results of the proximate composition of the curry leaf are presented in Table 1. The minerals and vitamins compositions are also included. The results showed that curry leaf possesses adequate nutrient elements required for healthy growth and development of humans.

Table 1: Proximate, mineral and vitamins compositions of curry leaf:

Parameters	**Proximate values**
Moisture (%)	63.5 ± 0.003
Protein	5.90 ± 0.001
Fat	0.7 ± 0.002
Fibre	6.35 ± 0.001
Carbohydrate	15.66 ± 0.004
Ash	3.93 ± 0.003
Calcium (mg/100g)	826 ± 0.002
Iron (mg/100g)	0.94 ± 0.001
Ascorbic acid (mg/100g)	3.92 ± 0.003

Values are means ± SD from triplicate determinations.

Survey of diseases and pests

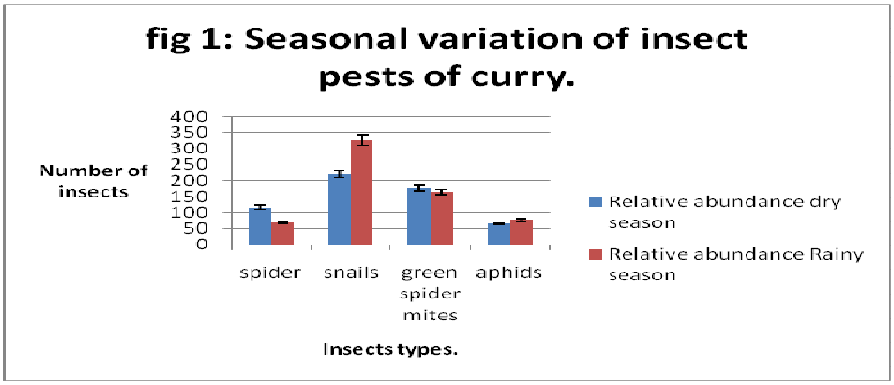
Field diseases of curry from the experimental plants and from general survey from the different locations are presented in figures 1 &2. Results revealed the presence of leaf spot which was quite prevalent during the rainy season than the dry season. The spot which initially appeared as a small round black patch, enlarged and become very large, weakened the leaf and caused the tissues around the spots to turn yellow and leaves fell prematurely. Another very common field disease of curry plant is the curry mosaic leaf virus. Most of the curry leaves were mottled with reduced stem, internodes and general stunting of the plants. This disease occurred both during the rainy and the dry seasons. However, the degree of incidence of this disease was highest during the rainy season. Blighting was another regular disease occurrence of curry plants. Leaves of curry suddenly turned yellow and dropped. In some cases the entire plants shed their leaves leaving only the stem which after two weeks dried up and died. This disease however, was most prevalent during the dry season. Powdery mildew was also found on the leaves, stems and flowers of the curry plants. As the name implies, the entire plant was as if white powder was applied on it which gave the plant an abnormal appearance thus hindering the harvesting of such leaves for consumption. The powdery mildew was most prevalent during the dry season than the rainy season.

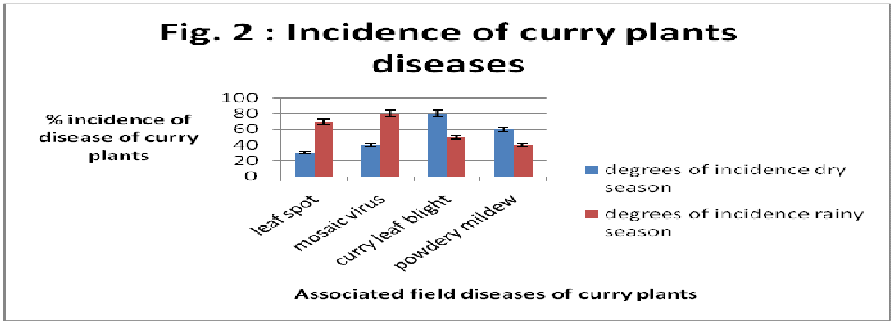
Insect pests of curry plants

Some of the insect /pests found to be associated with the curry plants include the following:

The spiders were found in large number on the curry leaves where they built

webs from one plant to another. The spiders were usually found in large number in the morning and tend to reduce in the afternoon. The population of these insects was highest during the dry season. The scale insects were also identified on curry plants. These are tiny insects that are whitish in colour which normally laid their eggs under the leaves of curry. The insect laid numerous eggs at a time which hatch and appears as scales on the leaves of the plant. The eggs sometimes could be found on the leaf axils of younger plants before they hatch. Very few of the scale insects were recorded from curry plants in course of this study. The aphids were also found in large number on curry plants. They are small pear shaped insects that may appear in a range of colours, including yellow, green, brown or white. Aphids suck juice from plants causing the leaves to mottle and curl and can introduce mould fungus. They feed in dense clusters and are slow to react when disturbed. The green spider mites were also identified on curry plant biting and chewing the curry leaves thereby causing defoliation. Other pests found on the plants were mollusc which crawled all over the plants depositing slimes on the leaves and stems. The number of snails found on the curry plants was very high during the rainy season than in the dry season.





Methods of preservation of curry leaves

The results of the preservation of curry leaves are presented in Table 2. Curry leaf samples incubated for 5 days on SDA in Petri dishes did not record any mould growth. However, palatability assessment revealed that the air dried and sun dried leaves maintained good food quality throughout their duration of storage.

Table 2: Preservation of curry leaves.

Storage duration of curry leaves	Moulds		Palatability assessment	
	Slightly fried and air dried leaves	Sun dried leaves	Slightly fried and air dried leaves	Sun dried leaves
I month	No growth	No growth	5	5
2 months	-	-	5	5
3 months	-	-	5	5
4 months	-	-	4	5
5 months	-	-	3	4
6 months	-	-	3	4

Legend
= No mould growth

Discussion

Curry seeds used for this experiment showed 100% seed germination in the nursery and when transplanted into the field performed creditably well. This implies that acquisition of good planting materials from known sources is very important in crop production (Onuegbu, 2002). The curry seeds used for this study were acquired from extension agents who are involved in the supplies of improved seeds as planting materials. Harvesting of the leaves started six months after planting plantings against the report that effective harvesting of curry leaves should commence from 8- 10 months after planting (NPGS/GRIN"www.ars-grm.gov). The reason for the early harvesting of the curry leaves was basically due to the improved curry seeds used for this study. Proper agronomic practices such as efficient weed control, pruning, and adequate manuring were also responsible for the luxuriant leaves which enhanced early production of harvestable leaves (Chuku and Ugorji, 2011, 2012, Chuku, *et al,* 2012). Several diseases and pests are known to be associated with vegetables in the Niger Delta. The high relative humidity and tem-

peratures tend to favour most disease causal organisms to proliferate (Chuku and Chuku, 2014). The occurrence of mosaic viral diseases and leaf spots on most vegetables in the Niger Delta regions have been reported (Onuegbu, 2002, Chuku, 2013). Spiders were found spinning webs on curry leaf surfaces thereby reducing the photosynthetic surfaces of the leaves. Scale insects greatly affected the curry leaves while aphids which are capable of causing the mosaic virus disease of curry leaf were also found in large number. The green spider mites created punch holes on the leaves further reducing the photosynthetic areas of the leaves. Snails which deposited slimes on the plant surfaces further reduced the intensity of light penetration on the leaves which also affected leaf yields. Pests infestation on cultivated fields have been reported to pose negative impacts on crop quality and yields (Ezulike *et al* 1993, Chuku *et al*, 2003) .

The results of the proximate composition of curry leaf as presented in Table 1 revealed that curry is rich in essential nutrient elements required for proper body functions. The protein, fat, fibre, carbohydrate ash calcium, iron and ascorbic acid contents of curry leaf are quite outstanding. Several researchers have recorded the high nutrient qualities of various leafy vegetables in the tropical and sub- tropical regions of the world (Achinewhu, 1996, Mensah *et al*, 2008, Ogbuji, *et al,* 2014, Elochukwu, *et al*, 2014,). The preserved curry sample did not harbour any mould indicating that the leaves were processed under hygienic condition. It has been reported that mould growth are enhanced due to improper handling, processing and storage (Okaka, 1997).

Limitations of the study

Some of the limitations of curry production in the tropics include the problems of disease and pests, weed control and extreme weather condition. High temperature led to scotching of plants and leaf fall because of high rate of evapo-transpiration, which high rainfall led to flooding of the cultivated site and eventual death of plants. These adverse environmental conditions cannot easily be predicted by farmers with the attending problems of low agricultural productivity

Conclusion

This work on curry production, preservation, utilization and associated field diseases and pests has shown that curry leaf tree can be effectively produced by seed and can also play hosts to various diseases and pests in the field. The leaves can be preserved by air drying of slightly fried leaves and sun dried leaves. The leaves of curry plant are rich in essential nutrient elements and as such can be used for culinary purposes and as herbs for the treatment of

some common diseases.

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