Indigenous Preservation Practices and Weight Loss of Stored Yams in Benue State, Nigeria

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Abstract
This study examined the effectiveness of existing indigenous preservation practices utilized by rural farming families in reducing the weight loss of stored yam tubers in Benue State, Nigeria. The study is anchored on the hypothesis that the application of existing indigenous preservation practices is not effective in reducing the weight loss of stored yam tubers in the study area. The study adopted a cross-sectional survey design, utilizing cluster and random sampling techniques in the selection of respondents. The study proportionately selected 255 respondents randomly from six (6) local government areas for the study to include Katsina Ala, Ukum, Buruku, Gboko, Otukpo and Okpokwu local government areas. The result of the chi-square test shows P value =0.000<0.05; hence, the study rejected the null hypothesis. A symmetric Phi value of 1.000 was obtained, showing a positively high association between the variables. The study recommended that existing indigenous preservation practices be combined with good practices of routine removal of sprout development in stores and change of attitude of yam farming families; of keeping unsound yam sets for planting. This attitude often leads to harvesting unsound yam tubers that are vulnerable to pathogenic attacks and weight loss, which negatively limits the effectiveness of existing indigenous preservation practices even when applied consistently to reduce the weight loss of stored yam tubers.

Key Words: Yam, Indigenous, Preservation, Practice, Benue, Weight loss

Introduction

Yam (*Discorea rotundata*), a staple crop, is produced for both subsistence and commercial purposes in Benue State, Nigeria. This crop is vital to the socioeconomic wellbeing of Benue inhabitants considering its nutritional and financial benefits. Yam crops are cultivated on over 4.6 million hectares of land in sub-Saharan Africa (FAOSAT, 2016). Nigeria alone cultivates 70-76% of the world's total yam cultivation area of over 3.045 million hectares (Regina, Hidehiko & Makoto, 2011). Africa, the largest producer of yam in the world, produced over 6.3 million tonnes, of which West Africa alone produced 6.1 million tonnes, while Nigeria produced 4.4 million tonnes (FAOSTAT, 2016). Buttressing further, Pine (2018) stressed that West and Central Africa account for approximately 93% of the world's total yam production.

Yam has a highly variable structure, which is a function of the species, the genetic makeup, and the environment, all contributing to the tuber size and shape that are produced as terminal enlargement from the primary nodal complex (Africa Yam Project, 2016). The West African yam production zone lies primarily in five countries known as the "Yam Belt". These countries include Nigeria, Benin, Togo, Ghana, and Côte d'Ivoire. This "yam belt" is the largest contributor in West Africa, extending from Ivory Coast to Cameroon, a distance of approximately 3200 km, which together produces approximately 92% - 95% of the world's total yam production (Food Agricultural Organization Statistics (FAOSTAT), 2014). Interestingly, the yam crop is also cultivated in far North Senegal, Sierra Leone and Congo as well as a few areas in Tanzania, with Ethiopia and Sudan being the largest producers of yams in East Africa (FAOSAT, 2016).

However, yam farming families in most of these developing nations of the world preserve the yam crop via indigenous preservation techniques. Indigenous preservation practice is the knowledge developed by a community as opposed to the scientific practice and technology that is generally referred to as "modern knowledge". Indigenous preservation practice is a characteristic of all societies; it reflects the dynamic ways in which the residents of an area have come to understand themselves concerning their natural environment and how they organize folk knowledge of flora and fauna, cultural beliefs, and history to enhance their lives (Awuor, 2011).

According to Semali and Kincheloe (2002), indigenous practice refers to the skills and philosophies developed by societies with long histories of interaction with their natural surroundings. Indigenous practice is the know-how unique to a given society or culture. This practice encompasses the cultural traditions, values, beliefs, and worldviews of local people and inform decision-making about fundamental aspects of day-to-day life. These unique ways of indigenous practices are important facets of the world's cultural diversity and provide a foundation for locally appropriate and sustainable development strategies (Nakashima, Prott, & Bridgewater, 2000).

Historically, human beings preserve produce/food so they can eat it later. The simplest historical indigenous practice of preserving food items was sun drying. Another ancient indigenous preservation practice is the use of salt. Drying and salting are also done together (Pine, 2018). Fermentation has similarly been used for thousands of years and is still in use today as an indigenous practice of preservation.

In Africa, invented indigenous preservation practices cannot be easily acquired without African indigenous education, which in most cases is lacking amidst modernization. African indigenous education is generally a lifelong process of learning whereby a person progresses through predetermined stages of life of graduation from cradle to grave. This implies that African indigenous education continues throughout a person's lifetime from childhood to old age. Mushi (2009) viewed African indigenous education as a process of passing among tribal members and from one generation to another the inherited knowledge, know-how, skills, cultural traditions, norms, and values of the tribe.

Yam crop preservation addresses the process of preventing decay or spoilage of yam crops, thus allowing it to be stored in a suitable condition for future use. According to Terrell (2009), preservation refers to keeping food safe to eat later. Preservation primarily involves preventing the growth of bacteria, fungi, and other microorganisms as well as retarding the oxidation of fats to reduce rancidity. The process of preservation also ensures that there is no discolouration or weight loss. Preservation entails that produce remains in a state where it is not contaminated by pathogenic organisms or chemicals and does not lose optimum qualities of colour, texture, flavour, and nutritive value or have mycotoxin.

In Benue state the yam hub of Nigeria, most rural yam farming families are faced with the challenge of weight loss of stored yam tubers despite evident use of one or a combination of existing indigenous preservation practices. These practices often include the use of wood ash, *neem* plants, scent leaves, ginger, tobacco, and mahogany, among others (Okigbo & Nmeka, 2005).

Empirical evidence, such as Iorzua, Ikwuba, Aan and Nwafor (2020), Akpehe and Bojande (2019), Shambe (2017), Asongwa (2017) and Okigbo (2004), among others, has examined issues of yam

crop and postharvest losses without emphasis on the effectiveness of existing indigenous practices used by yam farming families in tackling postharvest losses of yam tuber. Thus, this study examined the effectiveness of existing indigenous preservation practices utilized by rural yam farming families in reducing the weight loss of stored yam tubers in Benue State, Nigeria. Accordingly, the study is anchored on the hypothesis that the application of existing indigenous preservation practices is not effective in reducing the weight loss of stored yam tubers in the study area.

Study Setting

The study was conducted in Benue State, Nigeria. Benue State occupies a land mass of 34,059 square meters with a population density of 183 per km2 square and a projected population of 6,588,848 at a 3% growth rate (NPC, 2020 projection). Its geographical coordinates are longitude 70 47' and 100 0'E, latitude 60 25' and 80 8' N. The state lies within the Savannah zone of the country, which stretches from longitude 40 E to 10.20 E and latitudes 6.50 N to 11.00N.

Benue State has 23 local government areas and three dominant ethnic groups: Tiv, Idoma, and Igede. The state is divided into three agricultural zones: the eastern agricultural zone, comprising Katsina-Ala, Konshisa, Kwande, Logo, Ukum, Ushongo, and Vandeikya. The Central agricultural zone comprised Buruku, Taakar, Gboko, Makurdi, Guma, Gwer-West, and Gwer, while the Southern agricultural zone comprised Ado, Oju, Agatu, Okpokwu, Apa, Otukpo, Obi, Ushongo, Ogbadibo, and Ohimini.

The vegetation of Benue State is typically that of the southern Guinea savannah, characterized by sparse grasses and numerous species of scattered trees. Agriculture forms the main stay of the Benue State economy, engaging over 80% of the population (Benue State Development Plan (BSDP), 2016), and yam is one of the major root tuber crops produced in both commercial and subsistent quantities in the state, hence earning it the largest yam market in west Africa (Shambe, 2017).

Methodology

For the purpose of this paper, data were collected from primary sources through structured interviews and key informant interviews. Through cluster and random sampling techniques, the study selected two (2) local government areas in each of the agricultural zones, given a total of six (6) local government areas. A total of 255 respondents were selected proportionately in line with the population of yam farmers per local government area selected for the study (see BSDP 2016).

Results and Discussions

This section of the study analysed the data collected and offered explanations based on frequencies from the data obtained.

Mode of Application of Existing Indigenous Preservation Practices by Yam Farmers

Respondents either applied one or a combination of the existing indigenous preservation practices, either by surface coating of injuries (primary or secondary) or by spraying prepared powder substances on harvested yam tubers to check pathogenic attacks. Primary injuries here refer to surface bruises or deep cuts on the yam tissue that occur primarily during harvesting due to negligence or use of tools by unskilled personnel, while secondary injuries entail injuries that occur on the yam surface after the harvesting process is completed; injuries occur due to careless handling of yams, especially during transportation of yams and in stores.

Data gathered from respondents based on the preference (multiple indication) of existing indigenous practices showed that the majority (91.76%) of the respondents used tridox *coatbutton* for the treatment of both primary and secondary injuries on harvested yams tubers, either by directly spraying or coating wounds to arrest pathogenic attacks. Moreover, 77.65% of the respondents either directly spray or coat yam tubers with white melon *cucumis* to treat injuries. This was followed by 66.27%, 56.86%, 66.67%, 43.92%, 30.59%, and 17.65% of the respondents' utilization of mahogany,

scent leaves, wood ash, pawpaw leaves, *neem* leaves, and tobacco leaves, respectively, by spraying.

This section examined indigenous yam preservation practices applied by small-holder farmers in Benue State, Nigeria. Information on indigenous yam preservation practices applied by small-holder farmers in Benue State were examinee thus (see details in Table 3).

Table 3: Indigenous Yam Preservation Practices in Benue State

S/No	Indigenous substance	Frequency	Percentage
1	*Tridax procumbens (L)*	227	38.3
2	White Melon Cucumis	163	27.4
3	Mahogany	133	22.3
4	Scent leaves	30	5.0
5	Wood Ash	23	3.9
6	Pawpaw leaves	9	1.5
7	*Neem* leaves	6	1.0
8	Tobacco leaves	4	0.6

Source: Field Survey, 2021

Table 3 showed that 227 (38.3%) respondents used *tridax procumbens (L)* as indigenous substances for the preservation of yam in order to reduce postharvest losses in the study area, 163 (27.4%) respondents used white melon *cucumis* as indigenous preservation substance in checking the rottenness of yam, 133 (23.3%) respondents used backs of mahogany plants as indigenous yam preservation substance to minimizing postharvest losses of yam, 30 (5.0%) respondents indicated application of scent leaves as indigenous substance for preservation in order to minimizing postharvest losses of yam, 23 (3.9%) respondents used wood ash as indigenous yam preservation practice to reduce incidences of postharvest losses of yam, 9 (3.5%) respondents used pawpaw leaves as indigenous yam preservation practice for the control of postharvest losses, 6 (1.0%) respondents applied *neem* leaves as indigenous yam preservation practice in fighting postharvest losses, while 4(0.6%) respondents used tobacco leaves as indigenous preservative practice for the control of postharvest losses of yam in the study area.

Table 1: Mode of Application of Existing Indigenous Preservation Practices in Controlling Postharvest Losses of Yams in Benue State

Indigenous preservation practices	Mode of Application	Fre-quency	Per-centage	STD
Tridoxcoatbutton	Surface coating and powder spraying	234	91.76	58.65
White melon *cucumis*	Surface coating and powder spraying	198	77.65	58.65
Mahogany	Surface powder spraying	169	66.27	58.65
Scent leaves	Surface powder spraying	145	56.86	58.65
Wood Ash	Surface powder spraying	170	66.67	58.65
Pawpaw leaves	Surface powder spraying	112	43.92	58.65
Neem leaves	Surface powder spraying	78	30.59	58.65
Tobacco leaves	Surface powder spraying	45	17.65	58.65

Source: Field Data, 2022

Effectiveness of Existing Indigenous Preservation Practices in Reducing Yam Tuber Weight Losses in Benue State

Application can either be "consistent" over time or only at "sometimes", which forms the base for analysis. "Consistent application of existing indigenous preservation practices" refers to respondents who had applied existing indigenous preservation practices on harvested yam tubers in the last five years at all times, irrespective of circumstances. "At sometimes application of existing indigenous preservation practices" refers to respondents who applied existing indigenous preservation practices occasionally on harvested yams before storage despite their knowledge of available indigenous preservation practices in the study area in the last five years. These categories of respondents were used to examine the extent of effectiveness of existing indigenous preservation practices in fighting the weight loss of yam tubers in the study area.

Data collected revealed that 198 (77.6%) respondents consistently applied existing indigenous preservation practices on harvested yams before storage in the study area to avert weight losses in the last five years, while 57 (22.4%) respondents did not consistently applied existing indigenous preservation practices on harvested yams before storage to fight weight losses in the study area in the last five years (see details in figure 1).

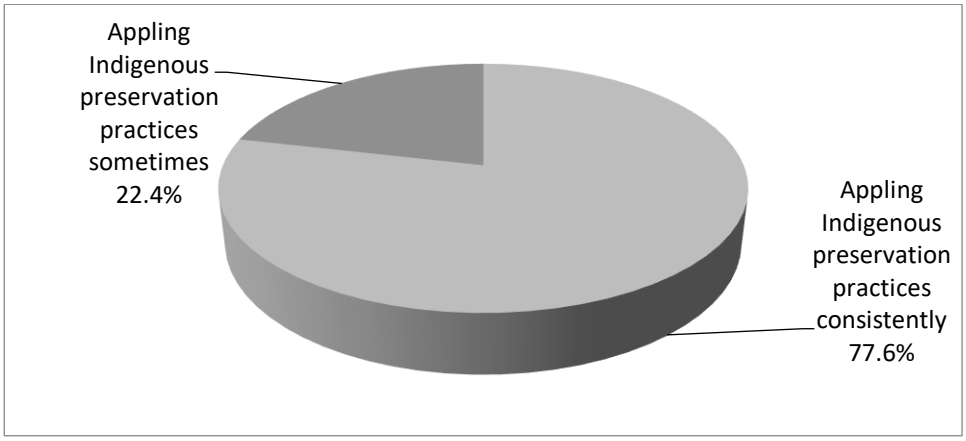

Figure 1: A Pie Chart Showing Application of Existing Indigenous Preservation Practices by Respondents in Benue State

Source: Field Data, 2022

The data in Figure 1 reveal that the majority (77.6%) of the respondents in the study area applied one or a combination of existing indigenous preservation practices consistently on harvested yam tubers to check incidences of weight losses in stores, while 22.4% applied existing indigenous preservation practices occasionally (not at all times) in fighting yam weight losses in the area within the period under study. These two categories of yam farmers constituted the basis for the examination of the extent of effectiveness of existing indigenous preservation practices in the study area in terms of weight loss.

Weight Loss of Yam Tubers Stored and Application of Existing Indigenous Preservation Practices

It is a known fact that yam tubers lose weight in storage; however, weight may vary among species of yam tubers (local and improved yam species) stored. Weight loss of yam tubers stored in the study area reveals an existence of a slim margin between local and improved yam species treated with existing indigenous preservation practices.

Data gathered indicated that out of 166 (65.10%) respondents who recorded weight losses of local yam tubers, 62.62% (124) consistently applied existing indigenous preservation practices on harvested yam tubers before storage, while 73.68% (42) applied existing indigenous preservation practices on harvested yam tubers before storage in the study area only at sometimes. Out of 89 (34.90%) respondents who recorded weight loss of improved yam species, 37.37% (74) consistently applied existing indigenous preservation practices on harvested yam tubers before storage, while 26.32% (15) applied existing indigenous preservation practices on harvested yam tubers before storage only at sometimes (see details in Table 2).

Table 2: Weight Loss of Yam tuber Species Applied with Existing Indigenous Preservation Practices before Storage

Weight loss of yam species	**Application of existing indigenous preservation practices**		
	consistently	**sometimes**	**Total**
Local yams species	124 (62.62%)	42 (73.68%)	166(65.10%)
Improved yam species	74 (37.37%)	15 (26.32%)	89 (34.90%)
Total	**198 (100%)**	**57 (100%)**	**255 (100%)**

Source: Field Data, 2022

Table 2 shows that local yam species lost weight earlier when stored than improved yam species, even when existing indigenous preservation practices were applied to both species before storage. These stem from the nature and structure of yam species stored (that most improved yam species have high water content and low level of oxidation than any local yam species). This implies that yam farmers in the study area turn to drift from cultivating fewer local yam species, such as *Gbongo*, *Alakpa*, *Gbagede*, and *Angawa*, to cultivating improved yam species, such as *Faketsa*, *Hembamkwase*, and *Pepa*, since the improved yam species lose less weight in storage and are attractive than local yam species. Improved yam species become preferred by most yam farmers, as they are capable of retaining more weight, attracting high demand by consumers, and ensuring higher revenue on investment after longer periods of storage when preserved with existing indigenous preservation practices.

Graphical analysis regarding monthly weight loss of stored yam tubers applied with existing indigenous preservation practices by yam farmers in the study area revealed that although both local and improved yam species stored by yam farmers who used existing indigenous preservation practices (either consistently or at sometimes) in the study area increased with time, local yams lost 10% of their weight within the first 2-3 months, while improved yams lost 5% of their initial weight within the first 2-3 months in store after application of existing indigenous preservation practices. By the 4th and 5th months, while local yams species lost up to 20% of their initial weight, improved yams species lost only 10% of their initial weight in stores. Furthermore, at 6 months and above, the local yams species lost more than 35% of their weight, while improved yams species lost 20% of their weight in stores with the application of existing indigenous preservation practices, as indicated in Figure 2.

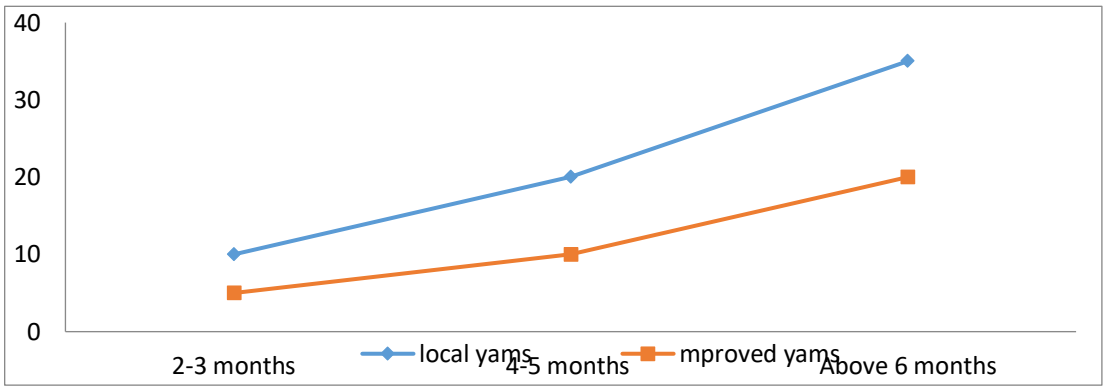

Figure 2: Monthly Weight Loss of Yam Tubers Stored with Application of Existing Indigenous Preservation Practices in Benue State

Source: Field Data, 2022

In examining the extent of effectiveness of existing indigenous preservation practices with regard to weight loss of stored yam tubers among yam farming families in the study area, the study employed chi-square-based statistics since the data collected were approximately normally distributed with a Shapiro–Wilk statistical value of 0.510 and a P value of 0.000 (Shapiro & Wilk, 1965, Razali & Wah, 2011).

Chi-square tests showed a Pearson Chi-Square Value of 252.000a, Asymp. Sig. (2-sided) = 0.00, degree of freedom 1, at alpha level of significance 0.05. Since the P value = 0.000<0.05 shows that the result is statistically significant, the study rejected the null hypothesis that "application of existing indigenous preservation practices is not effective in reducing yam tuber postharvest losses in the study area" and accepted the alternative hypothesis that "application of existing indigenous preservation practices is effective in reducing yam tuber postharvest losses in the study area" (see details in Table 3).

A symmetric Phi value of 1.000 was obtained. This showed a very strong positive association between the application of existing indigenous preservation practices and weight loss of stored yam tubers. This depicted that existing indigenous preservation practices are highly effective in reducing the weight loss of stored yam tubers beyond 6 months in the study area (see details in Table 3).

Table 3: Chi-Square Test on Weight Losses of Stored Yams with Application of Existing Indigenous Preservation Practices

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	252.000[a]	1	.000
Likelihood Ratio	261.868	1	.000
Linear-by-Linear Association	251.000	1	.000
N of Valid Cases	**255**		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 11.57.

b. Computed only for a 2x2 table

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	1.000	.000
	Cramer's V	1.000	.000
	Contingency Coefficient	.707	.000
N of Valid Cases		**255**	

Source: Field Data, 2022

Conclusion and Recommendations

Although differences in weight loss of stored yam tubers existed among the species of yams, a function of levels of oxidation among yam species stored, the study concluded that improved yam tuber species lost less weight than local yam tuber species after six (6) months of storage. The study recommended that existing indigenous preservation practices be combined with good practices of routine removal of sprout development in stores and change of attitude of yam farming families, keeping unsound yam sets for planting. This attitude often leads to harvesting unsound yam tubers that are vulnerable to pathogenic attacks and weight loss, which negatively limits the effectiveness of existing indigenous preservation practices even when applied consistently to reduce the weight loss of stored yam tubers.

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