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Effects of Gamma Irradiation on the Sprouting and Proximate Composition of Cocoyam (*Xanthosoma Specie*)

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ABSTRACT
Cocoyam *(Xanthosoma species),* is an important staple food crop in several tropical countries, particularly Nigeria, where it is vital to food security and rural livelihoods. Unfortunately, due to microbial spoilage, physiological deterioration, and poor storage conditions, many post-harvest losses diminish both the availability and the potential economics of the crop. The aim of this study was to examine the impact of gamma irradiation on both the cocoyam's storage quality and its proximate composition over a 5-month period of storage. A total of 60 healthy cocoyam tubers was divided into 6 groups. Each group was exposed to gamma irradiation at the following doses: 0 (control), 5, 10, 20, 30, and 50 Gy, from a Cobalt-60 gamma source. Rot incidence, sprouting, and weight loss, along with the effects on proximate composition, were determined. Gamma irradiation was shown to diminish cocoyam spoilage in a dose dependent manner. The control had 100% spoilage, while samples with 30 Gy and 50 Gy completely prohibited spoilage for the entire duration of the study. Weight loss was also significantly reduced from 24.10% in the control to 4.55% at 50 Gy. Storage stability and the storage tubers' survival were significantly improved with gamma irradiation at the higher doses. Sprouting was not observed in any of the samples, control or irradiated, during the entire storage period. This also indicated the natural dormancy of the tubers. Proximate analysis showed that irradiation improved a number of the nutritional parameters. Specifically, ash content increased from 1.07% to 1.68%, crude fibre from 3.00% to 3.85%, and protein from 6.38% to 8.63%, with a concomitant increase in carbohydrate content from 33.63% to 44.97%, along with a decrease in moisture content from 54.00% to 40.55%. The study showed that particularly at the higher doses, from 30 to 50 Gy, gamma irradiation was a viable post-harvest treatment.

KEYWORDS: Cocoyam, Gamma Ray, Post-Harvest, Irradiation, Proximate

I. INTRODUCTION
Cocoyam are plant species that develop edible tubers when mature, and are members of Dioscorea and Dioscoreaceae. Originating from Asia and West Africa, cocoyams are now cultivated in other places such as Latin America, the Caribbean and Oceania on about 5 million hectares of land in 47 countries distributed in tropical and subtropical regions globally (International Institute of Tropical Agriculture [IITA], (2010). Cocoyams *(Xanthosoma spp.)* plays a very important part in ensuring food security and livelihood systems of at least 60 million people in West Africa. It is cultivated mostly in the Derived and Southern Guinea Savanna (FAO, IFAD and WFP, 2014). There are multiple species of yams in Africa, Cocoyam *(Xanthosoma spp.)* is one of the main yam species grown in Nigeria and Africa at large (V., O. J. A. & A., A. I., 2019). These Cocoyams are not only economically important, but also culturally significant, with some tribes celebrating festivals in their annual harvest of these yams. Countries in the Sub-Saharan region of Africa are considered the major producers of yam in Africa, producing over 50 million tons of yams annually, 95% of this coming from just five countries which includes Nigeria, Benin, Togo, Ghana and Ivory coast (IITA, 2017). According to the report of the Food and Agriculture

Organisation (FAO), yams are produced in large quantity in Nigeria, accounting for 70-76 % of the production in the World. Nigeria's production is 35.017 million metric tonnes of equivalent value of US dollars of 5.654 billion. It is also worth noting that yams are also employed in the celebration of traditional ceremonies, which include marriage ceremonies and annual festivals, where the crop becomes a yardstick for wealth. In addition to all other crops grown in Africa and other continents, yams have many significances (Østergård et al., 2009).

Because the production of cocoyam is seasonal, there is a need for storage before subsequent planting or for use as food. Fresh cocoyam tubers are hard to store and prone to deterioration as a result of microbial rot and sprouting during storage (Onoja et al., 2025, James et al., 2012). The rate of postharvest losses generally ranges from 25 to 60% (Bawan & Abima, 2025). Cultivation of cocoyam is labour intensive and a period of 7-8 months between planting and harvest renders it little possible to achieve harvest more than once a year, which makes post-harvest cocoyam losses very alarming (Mignouna et al., 2009). In Nigeria, the current post harvest losses of cocoyam are estimated to be as high as 60% after 3-month storage with Nigeria farmers losing a lot of money annually due to the losses (Lim, 2016). Loss of cocoyam in storage due to sprouting is very high (Danso, et al., 2025). Several inhibitory chemical growth regulators such as maleic hydrazide, Tetrachloronitro benzene, acetic acid, naphthalene have been used to retard sprouting in stored yam tubers. Apart from unavailability of the right type of chemicals and their toxicity nature, widespread adulteration of the available ones across Africa especially in Nigeria is a serious problem (David, 2009). There are several reports on how temperature and age of the tuber affect sprouting of cocoyam (Nwachukwu, et al., 2024). Various products made from yams, such as flour can be used to reduce post-harvest losses and provide year-round availability.

Cocoyam (Xanthosoma spp.) is a high nutritional value and is a crop that is adapted to a wide range of growing conditions and is of importance in many tropical and subtropical countries. One of the difficulties of the farmers and traders, however, is the management of the sprouting during the storage which might result in loss of quality and marketability of the tubers. The sprouting process not only diminishes the nutritional content of the cocoyam but is also a natural process that hastens the deterioration. Gamma radiation, an ionizing radiation, has been used in agriculture for post-harvest storage and shelf-life extension and a delay in the sprouting for different crops (Rao et al., 2010).

The traditional methods of cocoyam storage and preservation have not changed significantly over the years with yam curing as the most important method of preservation but the inability to accommodate different factors contributing to the cocoyam post-harvest losses has contributed to the high rate of cocoyam losses after harvest. Post harvest losses of cocoyam are generally categorized as mechanical, physiological, pathological (microbial and entomological infestation). Also, rodent attack all of which translates to a significant loss of income yearly, rodent attacks can be remedied by using more secure locations but the other factors contributing to loss in cocoyam quality and quantity require a more scientific approach. Radiation technology can be integrated with other technologies to ensure food security and safety (Onoja et al., 2025). Food irradiation is a non-thermal technology or a "cold pasteurization" or "irradiation pasteurization" that is not a thermal process that raises the temperature of the food during treatment. The process is accomplished through the irradiation of food products with ionizing radiation. In addition, other nonthermal processing technologies such as high hydrostatic pressure, high intensity pulsed electric fields, ultraviolet (UV) light and cold plasma (Shafia et al., 2019) are also used. Food irradiation is a non-thermal technology often called "cold pasteurization" or "irradiation pasteurization" because it does not increase the temperature of the food during treatment. The process is achieved by treating food products with ionizing radiation. Other common non-thermal processing technologies include high hydrostatic pressure, high-intensity pulsed electric fields, ultraviolet (UV) light, and cold plasma (Shafia, et al., 2019). Anti-infestation of food grains and pulses; inhibition of sprouting in onions, potatoes, garlic, yam and ginger; preventing microbial contamination of spices; extending shelf-life under recommended conditions of storage; and overcoming quarantine barriers in international trade are some of the potential applications of radiation processing. Ionizing

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radiations can possibly help to minimize significant storage losses by preventing sprouting, inactivating food spoilage micro-organism, controlling insect pests and sterilization of food crops (Adetunji et al., 2018). The advantages of irradiation technology are easy application, cleaning and environment protection. It is a direct, simple and efficient on-line process. Cocoyam, Xanthosoma specie, is a food plant for more than 400 million people in the world; it is the most used aroid in West Africa (Abena et al., 2018). One of the most important goals of man over time has been to preserve food. Pests and microorganisms have caused serious problems to food and food products during storage, marketing and transportation (Agbaka and Ibrahim, 2020).

This research will cover the critical issue of sprouting during storage which results in high post-harvest losses, short shelf life, and economic losses to the farmers and traders. The study will provide an alternative, sustainable way to inhibit sprouting using optimal doses of gamma radiation, as compared to chemical sprouting inhibitors that are linked to health and environmental issues. This solution can help to prolong the shelf-life of tuber crops (cocoyam), enhance the quality of food and its availability, minimize wastage and ensure food security, which will contribute to economic sustainability of stakeholders in the agricultural sector.

II. MATERIALS AND METHODS

A. Experimental Procedure

Sixty (60) Cocoyam (Xanthosoma Specie) tubers each, was investigated in this research work. They were picked that same day from the farm and were carefully chosen to be free of rot or disease, serious bruises or injuries which might predispose them to spoilage. The Cocoyam tubers were divided into six groups each made of ten. Irradiation of the five (5) groups was done with the dose of 5 Gy, 10 Gy, 20 Gy, 30 Gy and 50 Gy of gamma radiation respectively, and the sixth group were kept un-irradiated as control. The tubers were irradiated using a cobalt-60 source at the Gamma Irradiation Facility, National Institute of Radiation Protection and Research, Queen Elizabeth way, Opposite Zoological Garden, P.M.B 39, University of Ibadan, Nigeria was used for the irradiation. It is a multipurpose semicommercial facility, set-up as a research and experimentation lab, characterized by its field size of 35 cm x 35 cm. It consists mainly of an irradiation room with a steel reinforced concrete walls thickness of about 1.8m to house the Co-60 radioactive sources of total current activity of about 5.5×10^{15} Bq (170 kCi), a continuous overhead conveyor transport system for large products and six different modes of operation (sample elevator, stationary irradiation, swivelling device, two-inner path, two-outer path and four path irradiation). The mode of operation will be determined by the type of product, quantity of product, shape & size and bulk density and required dose. All the modes of operations ensure uniform irradiation and accurate computer-controlled irradiation dosage (Oyeyinka and Adesanmi, 2008). The irradiation was performed in the stationary mode of operation and with the possibility of changing the dose in this study. The irradiation doses (5, 10, 20, 30, 50 Gy) were chosen as they have been reported to effectively suppress sprouting and to extend the storage life of root and tuber crops, and were well below the maximum absorbed doses recommended internationally for food irradiation applications. The previous research showed that low dose gamma irradiation effectively delayed the physiological deterioration without affecting the nutritional quality of the product (James et al., 2012; Adetunji et al., 2018; Nwachukwu et al., 2024). The selected dose-range also allowed the establishment of dose–response relationships for the possible commercial post-harvest treatment of cocoyam.

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Plate 1: Sampled Cocoyam Ready for Irradiation

Plate 2: Photo Splash of Gamma Irradiator Set Up

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Plate 3: Control Room for Monitoring of Radiation Dosages and Timing

Table 1: Parameters used for the Irradiation

Dose (Gray)	Time (Minutes)
5	14.60
10	29.21
20	58.42
30	87.63
50	145.80

Sprouting Measurement

The tubers were tagged for identification, and kept in an open store at ambient temperature for at least sixteen (16) weeks. The tubers were covered weekly for seven weeks to check for fresh shoots as an indication of sprouting. Records were taken of the sprouting tubers.

Observation of Rotting

Similarly, tubers were carefully examined every week for the appearance of soft spots and wet surfaces to determine point rotting and records was be made.

Weight Loss Measurement

The weight masses of all the tubers were measured and recorded before and immediately after irradiation and on a weekly basis for minimum of sixteen (16) weeks.

B. Proximate Analysis

The proximate composition (moisture content, ash content, crude lipid content, crude fibre content, protein content and carbohydrate content) of the tubers was determined using the standard methods of (A.O.A.C. 2005 and James *et al.,* 2012). This was carried out in the veterinary Medicine Advanced Laboratory, Joseph Sarwuan University, Makurdi, Benue State, Nigeria.

Procedures

(a). Determination of Moisture Content

An empty moisture can, W_1 was weighed and 2 g of sample was added and weighed, W_2. Then dried in an oven at 105^{0}C for 3-4 hrs and cooled in a desiccator and weighed, W_3 and repeated drying till constant weight.

$$\%\ \text{Moisture} = \frac{w_2 - w_3}{w_2 - w_1}\ X\ 100$$

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(b). Determination of Ash Content

An empty crucible was weighed and recorded, W_1 and then 2g of sample was added to the crucible and weighed, W_2. Then, char sample was carefully placed on a hot plate and subsequently placed in a muffle furnace at 550^0 C for 4-6 hours and allowed to cool in a desiccator and weighed, W_3.

$$\% \text{ Ash} = \frac{w_3 - w_1}{w_2 - w_1} X\ 100 \quad (2)$$

c) Determination of Crude Protein

A 1 g sample was placed in a digestive flask and then the catalyst and concentrated H_2SO4 was added and then digested until clear solution is formed. The solution was cooled and distilled with NaOH, collected ammonia in boric acid and then titrate with standard HCL.

$$\%\text{N} = \frac{Titre \times Normality \times 14.01 \times 100}{Weight\ of\ sample \times 1000} \quad (3)$$

$$\% \text{ Protein} = \%\text{N}\ X\ 6.25 \quad (4)$$

d) Determination of Crude Fat

2 g of the dried sample was put in thimble and the extract was made from the dried sample using solvent for 6 hours in Soxhlet apparatus then the solvent was evaporated and the residue was weighed.

$$\% \text{ Fat} = \frac{Weight\ of\ Extracted\ Fat}{Weight\ of\ Sample} X\ 100 \quad (5)$$

e) Determination of Crude Fibre

A sample residue without the fat was used. Samples treated with a dilute acid for 30 minutes and then filtered, rinsed, dry and weighed. The ash residue in the furnace was then reweighed.

$$\% \text{ Fibre} = \frac{Loss\ in\ Weight\ after\ Ashing}{Weight\ of\ Sample} X\ 100 \quad (6)$$

f) Determination of Crude Fibre

Calculated by Difference:

$$\%\ Carbohydrate = 100 - (\%Moisture + \%Ash + \%Protein + \%Fat + \%Fibre) \quad (7)$$

Plate 4: Photo Splash for Ashing Process for Proximate Analysis

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III. RESULTS AND DISCUSSION

A. Observation of Rotting

From table 2 and figure 1 -2, it can be seen that the rate of cocoyam rot reduced significantly during storage using gamma irradiation. The other sample that was not exposed to radiation showed no sign of resistance with 100% rot, which means that the sample was completely spoiled during the storage period. In samples exposed to 5Gy, 80% of the rot was recorded, and 40% of the rot were recorded in 10Gy. Only 20% rot was seen at dose 20Gy. Interestingly, no spoilage was observed for the cocoyam samples exposed to 30 Gy and 50 Gy of the dose throughout the storage period, meaning that the samples were totally inhibited against microbial and physiological deterioration. The percentage of spoilage decreased inversely with the dose of irradiation. The number of rotted cocoyam decreased gradually with increase in irradiation dose, while the percentage of rotted cocoyam decreased with increasing dose. It signifies that gamma irradiation is effective in shelf-life extension and preservation of quality of cocoyam.

The decrease in spoilage noticed on the irradiated cocoyam samples is attributed to the inhibiting effect of the gamma rays on the growth of microorganisms and activities of physiological factors that cause post-harvest deterioration. The higher doses of 30 Gy and 50 Gy seemed to be very effective in preserving sample integrity during storage. This is similar to the previous results from irradiation tests carried out on root and tuber crops like potato, onion and cassava, in which the irradiation decreased sprouting, delayed senescence, and microbial decay (Hodges et al., 2011, Basirat et al., 2020, Dhali et al., 2017). The results of this study indicate that irradiation is an effective method of preserving cocoyam, thus it can be recommended as a useful post-harvest technology to minimize food loss in tropical areas where storage problems are a common occurrence. The outcome will also facilitate the use of low-to-medium dose irradiation as a safe technology for preservation of agricultural commodities.

A statistical test called a Chi-square test was used to test the relationship between irradiation dose and cocoyam spoilage. The analysis yielded Chi-square of 36.67 and p value of 0.00000. The result shows that irradiation dose had a significant effect on the spoilage of cocoyam as the p-Value obtained was less than 0.05. From the results presented in figure 2 and table 2, it can be inferred that unirradiated cocoyam samples experienced a fast deterioration during storage. The survival probability of the cocoyam samples was increased with the increase in irradiation dose as shown in figure 3. The 30 Gy and 50 Gy-treated samples showed complete survival during storage, which resulted in good suppression of the spoilage organisms and extended shelf life.

Table 2: Rotting of Cocoyam During Storage

Sample	Dose (Gray)	Treatment	Initial Numbers of Cocoyam	Number of Rotted Per Month					Total	% Rotted
				1ST	2ND	3RD	4TH	5TH		
G	0	Unirradiated	10	-	5	5	-	-	10	100
H	5		10	-	-	2	3	3	8	80
I	10		10	-	-	-	1	-	3	40
J	20		10	-	-	-	-	-	2	20
K	30		10	-	-	-	-	-	-	-
L	50		10	-	-	-	-	-	-	-

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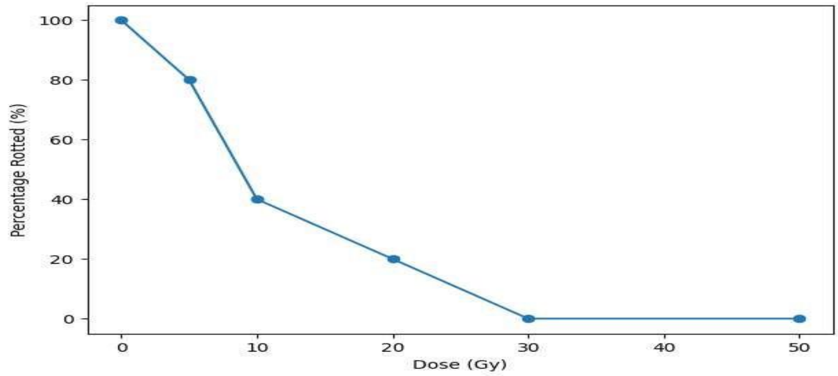

Figure 1: Effects of Gamma Irradiation Doses on Cocoyam Rot

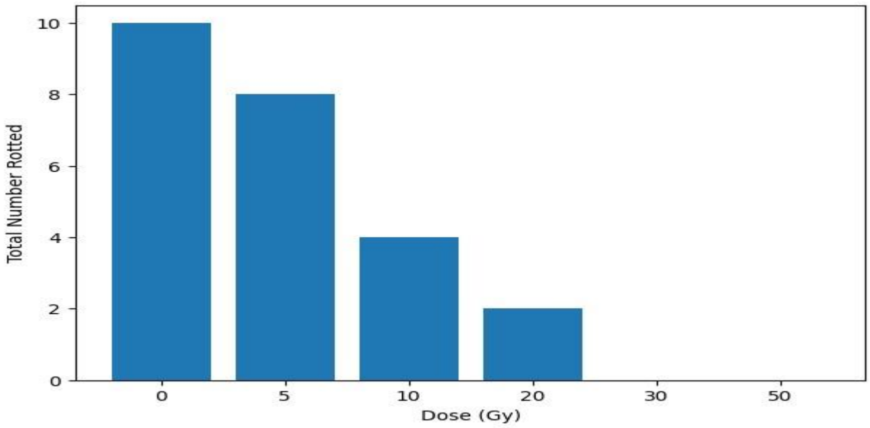

Figure 2: Total Number of Rotted Cocoyam at Different Irradiation Doses

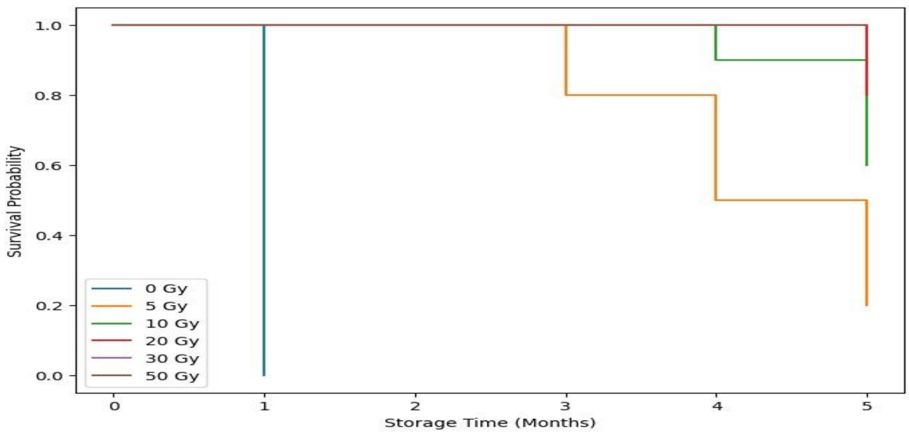

Figure 3: Kaplan–Meier Survival Analysis of Cocoyam During Storage

Kaplan–Meier survival analysis was used to evaluate the survival probability of Cocoyam samples during storage after gamma irradiation treatment.

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Plate 5: Rotten Cocoyam

B. Effect of Gamma Irradiation on Rot Suppression of Cocoyam

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C. Observation of Weight Loss

The unirradiated control sample had the highest percentage weight loss of 24.10 ± 26.60%, suggesting significant moisture and mass loss during storage. The percentage weight losses of all the irradiated samples ranged from 4.55 ± 2.31% to 10.14 ± 5.84% as seen in table 4. The treatments with 30 Gy, 50 Gy and 70 Gy showed the lowest percentages of weight loss (4.55 ± 2.31%, 4.85 ± 2.31%, and 5.17 ± 2.40%, respectively), indicating that the larger the dosage, the more effective it is in reducing the weight loss of stored fruits as depicted in table 4. This trend suggests gamma irradiation could be used to help preserve shelf-life, thus reducing physiological weight loss during extended storage. This reduction in

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this case may be correlated with reduced respiration rate, moisture loss and microbial activity in the sample being irradiated.

Table 4: Weight Loss of Irradiated and unirradiated (Control) Cocoyam During Storage

Sample ID	Dosage (Gray)	Mean Initial Weight (Kg) 1st day of storage		Five Months After Storage	
			Mean Final Weight (Kg)	Weight Loss (Kg)	Mean % Weight Loss
A	0 (Unirradiated)	0.83±0.07	0.60±0.06	0.20±0.22	24.10±26.60
B	5	0.56±0.05	0.51±0.05	0.05±0.05	8.93±8.97
C	10	0.91±0.08	0.82±0.07	0.09±0.01	9.89±1.40
D	20	0.75±0.06	0.70±0.06	0.05±0.02	6.67±2.72
E	30	0.69±0.05	0.62±0.04	0.07±0.04	10.14±5.84
F	50	0.88±0.08	0.84±0.07	0.04±0.02	4.55±2.31

D. Observation of Sprouting

The influence of gamma irradiation on sprouting of cocoyam during five months storage period is shown in table 5. It was observed that during the entire storage period none of the cocoyam samples sprouted. No sprouting occurred in the unirradiated control sample (0 Gy) and 0% sprouting was observed after five months of storage. With the same, all the samples were treated with 5 Gy, 10 Gy, 20 Gy, 30 Gy and 50 Gy of the radiation dose and were also observed for sprouting during the storage period, and no sprouting was observed in all the irradiated samples. No signs of sprouting on all the cocoyam tubers were observed till 5th month of storage. As a result, there was a total of zero sprouted tubers in all treatments. There was no sprouting trend as all cocoyam samples used were dormant during the storage period till some were found to be rotten. In the cocoyam storage this study, sprouting did not increase gradually with the storage period, as in usual storage studies.

Table 5: Sprouting Of Cocoyam During Storage

Sample	Dose (Gray)	Treatment	Initial Numbers of Cocoyam	Number of 1st	Sprouted 2nd	3rd	per Month 4th	5th	Total	% Sprouted
G	0 (control)	Unirradiated	10	-	-	-	-	-	0	0
H	5	Irradiated	10	-	-	-	-	-	-	-
I	10	Irradiated	10	-	-	-	-	-	-	-
J	20	Irradiated	10	-	-	-	-	-	-	-
K	30	Irradiated	10	-	-	-	-	-	-	-
L	50	Irradiated	10	-	-	-	-	-	-	-

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E. Proximate Analysis

The results in table 6 demonstrate that irradiation influenced all measured components, suggesting that gamma irradiation can improve the storage quality and nutritional characteristics of cocoyam.

Table 6: Proximate Analysis Result for Cocoyam

Sample ID	Dosage (Gray)	% Ash	% Crude Fibre	% Crude Protein	% Moisture	% Crude fat	% Carbohydrate
G	0 (Unirradiated)	1.07	3.00	6.38	54.00	1.92	33.63
H	5	1.39	3.19	7.94	47.00	0.97	39.51
I	10	1.41	3.22	7.25	58.66	1.88	27.58
J	20	1.43	3.26	8.63	44.33	2.80	39.55
K	30	1.51	3.57	8.25	50.33	1.44	34.90
L	50	1.68	3.85	7.75	40.55	1.20	44.97

The results in table 23 demonstrate that irradiation influenced all measured components, suggesting that gamma irradiation can improve the storage quality and nutritional characteristics of cocoyam.

A. Effect of Irradiation on Ash Content of Cocoyam

Ash content reflects the total mineral matter present in the sample. Ash content increased from 1.07% in the control to 1.68% at 50 Gy.

$$\text{Increase} = \frac{1.68-1.07}{1.07} \times 100 = 57.0\% \text{ increase}$$

An increase means that the mineral constituents are more concentrated or retained after irradiation as shown in table 7 and figure 4. The outcome indicated the mineral quality of cocoyam can be maintained by irradiation.

Table 7: Effect of Irradiation on Ash Content

Dose (Gy)	Ash (%)
0	1.07
5	1.39
10	1.41
20	1.43
30	1.51
50	1.68

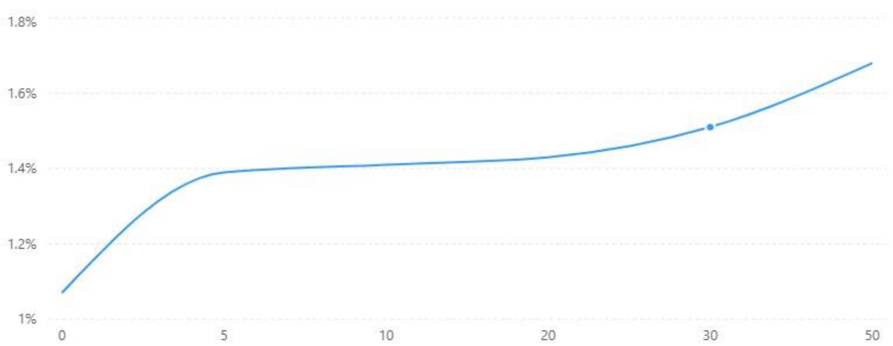

Figure 4: Ash Content Increased Steadily with Increasing Irradiation Dose

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B. Effect of Irradiation on Crude Fibre Content of Cocoyam

The crude fibre content increased gradually with irradiation dose. The peak value (3.85%) was recorded at 50 Gy as shown in figure 5 and Table 8.

$$\text{Percentage increase: } \frac{3.85-3.00}{3.00} \times 100 = 28.3\% \text{ increase}$$

The rise in fiber is due to structural alterations of polysaccharides and concentration effects ensuing from reduced moisture.

Table 8: Effect of Irradiation on Crude Fibre Content

Dose (Gy)	Crude Fibre (%)
0	3.00
5	3.19
10	3.22
20	3.26
30	3.57
50	3.85

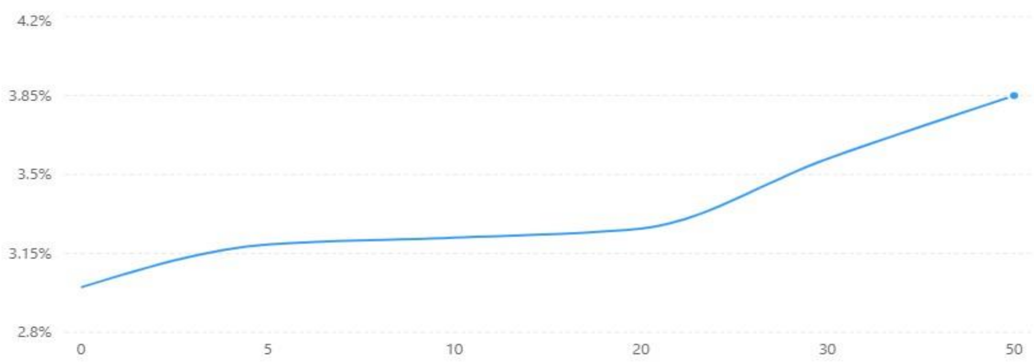

Figure 5: Gradual Increase in Crude Fibre Content with Increasing Irradiation Dose

C. Effect of Irradiation on Protein Content of Cocoyam

Protein content increased from 6.38% in the control to a maximum of 8.63% at 20 Gy as shown in Table 9 and Figure 6.

$$\frac{8.63-6.38}{6.38} \times 100 = 35.3\% \text{ increase}$$

The increase is ascribed to improved extractability of nitrogenous compounds and reduced squalor during storage. The trivial decay at higher doses may show mild protein denaturation. The best irradiation dose for protein retention seems to be 20 Gy.

Table 9: Effect of Irradiation on Protein Content

Dose (Gy)	**Protein (%)**
0	6.38
5	7.94
10	7.25
20	8.63
30	8.25
50	7.75

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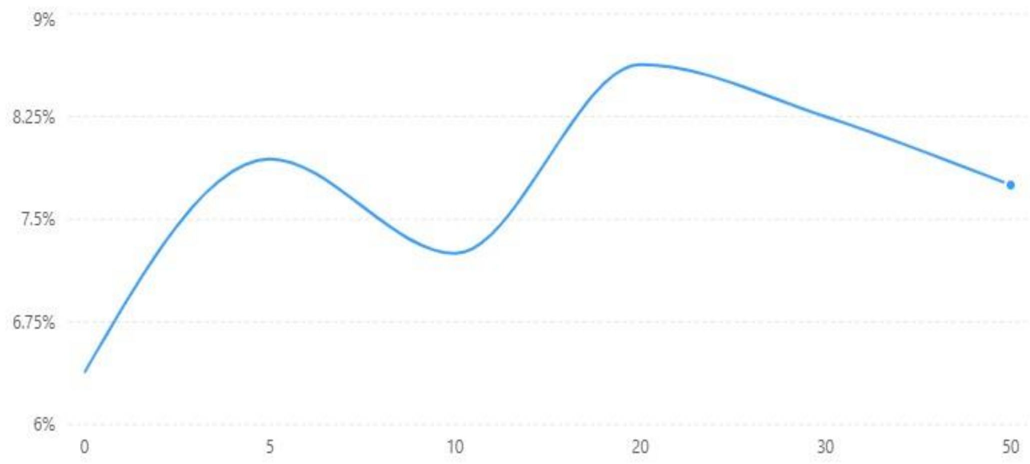

Figure 6: Protein Content Increased up to 20 Gy and Declined Slightly thereafter.

D. Effect of Irradiation on Moisture Content of Cocoyam

The 50 Gy had the moisture content (40.55%) at the lowest level compared with the control as shown in Table 10 and Figure 7:

$$\frac{54.00-40.55}{54.00} \times 100 = 24.9\ \%\ \text{reduction}$$

Dryness is beneficial as it decreases microbial growth and storage stability.

Table 10: Effect of Irradiation on Moisture Content

Dose (Gy)	Moisture (%)
0	54.00
5	47.00
10	58.66
20	44.33
30	50.33
50	40.55

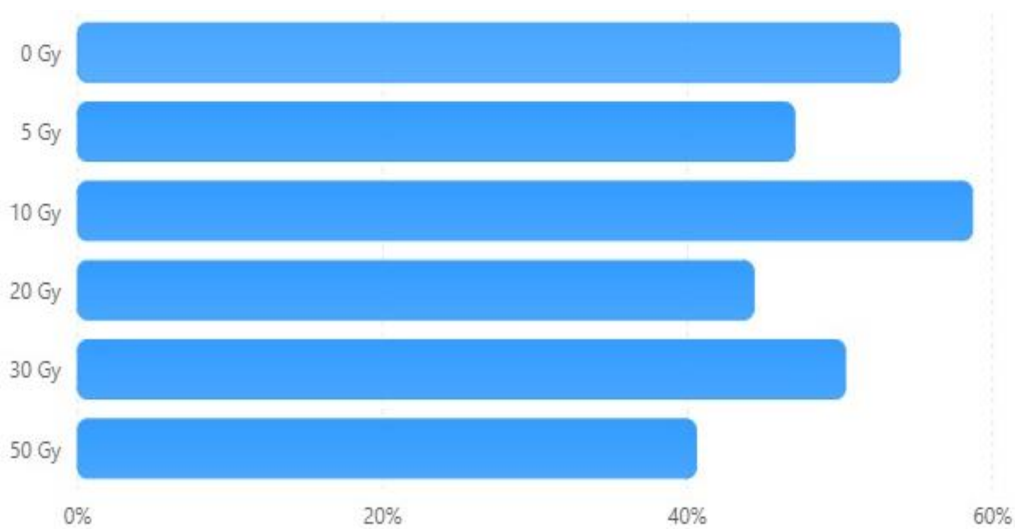

Figure 7: Moisture Content Difference after Irradiation Treatment

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E. Effect of Irradiation on Crude Fat Content of Cocoyam

Fat content in the crude (raw) fat was manipulated by dose level. The maximum value (2.80%) was at 20 Gy and the minimum value (0.97%) was at 5 Gy as depicted in table 11. These fluctuations are due to: changes in lipid extractability, oxidation reactions induced by radiation and structural modifications of lipid molecules. There was no obvious dose-response relationship seen for fat content, unlike for ash and fibre.

Table 11: Effect of Irradiation on Crude Fat Content

Dose (Gy)	Crude Fat (%)
0	1.92
5	0.97
10	1.88
20	2.80
30	1.44
50	1.20

F. Effect of Irradiation on Carbohydrate Content of Cocoyam

The highest carbohydrate content (44.97%) was observed at 50 Gy as shown in Table 12 and Figure 8.

$$\frac{44.97-33.63}{33.63} \times 100 = 33.7\% \text{ increase}$$

The rise is due to lesser moisture content that decreases respiration losses and concentration effects.

Table 12: Effect of Irradiation on Carbohydrate Content

Dose (Gy)	Carbohydrate (%)
0	33.63
5	39.51
10	27.58
20	39.55
30	34.90
50	44.97

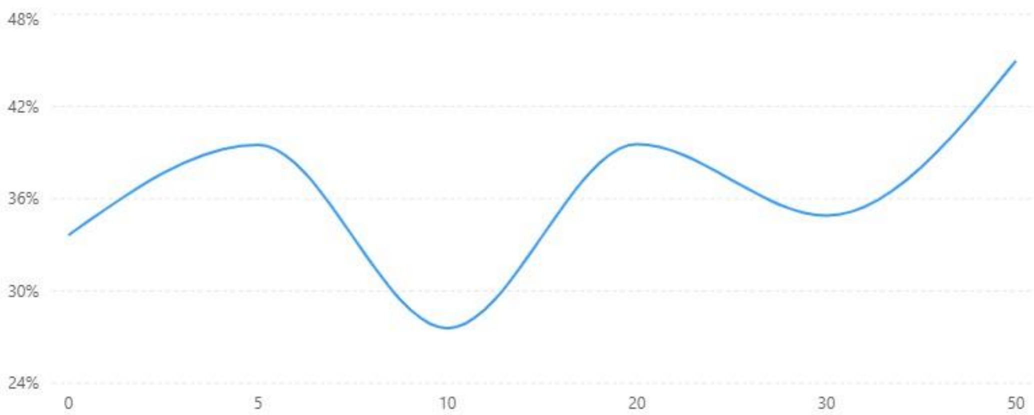

Figure 8: Irradiation Dose was Positively Correlated with the Content of Carbohydrates.

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IV. CONCLUSION

This study has shown that gamma irradiation technology is a good post-harvest technology for extending the storage life of cocoyam. Irradiation greatly decreased the weight loss and rot during 5 months storage, and 30 Gy and 50 Gy completely prevented the rot during storage. No sprouting was noted in either the irradiated or control samples since the variety used was naturally dormant; however, the irradiation had no adverse effect upon the quality of the tubers or did not promote sprouting. The proximate composition of the cocoyam was also affected by gamma irradiation with an increase in ash content and an increase in crude fibre and carbohydrate which was highest at 20 Gy with some reduction at higher doses. In addition, the decrease in moisture content with increase in irradiation doses added to better storage stability due to reduced microbial growth and physiological deterioration. he overall results suggest that Gamma irradiation is safe, effective and environmentally friendly technology for the reduction of post-harvest loss and preservation of quality of cocoyam in storage. Based on the overall storage performance, 30 Gy is recommended as the optimum dose to be used for storing cocoyam while 20 Gy is considered the most suitable for maximum protein retention. The implementation of this tech could help enhance food security, minimize post-harvest losses, and boost the economic returns of cocoyam growers in Nigeria and other tropical areas.

Based on the findings of this study, the recommendations are as follows:

(a). Gamma radiation doses of 30-50 Gy are recommended for the commercial storage of cocoyam as the doses completely inhibited rotting and significantly reduced weight loss and maintenance of the quality of the tubers during the five-month storage period.

(b). Investment in the development and expansion of irradiation facilities and awareness programmes by government agencies, agricultural institutions and other stakeholders should be made in order to promote the adoption of food irradiation technology as a safe and effective post-harvest preservation method.

(c). Gamma irradiation should be incorporated in strategies of national food security and post-harvest management to reduce storage losses, increase the availability of cocoyam throughout the year and increase income of farmers and traders.

(d). More studies should be carried out on different varieties of cocoyams and for longer storage periods to determine the optimum doses of irradiation for different cultivars and to establish the maximum storage life achievable under different environmental conditions.

(e). Future research should examine the microbiological, phytochemical, sensory and economic parameters of irradiated cocoyam. This should include consumer acceptability, nutritional quality, cost-effectiveness and synergistic application of irradiation and modern storage technologies for enhanced preservation efficacy.

(f). Doses between 30 and 50 Gy may be commercially feasible because they effectively reduced spoilage while preserving nutritional quality. Since these doses are considerably lower than internationally accepted maximum limits for food irradiation, they provide a promising option for commercial storage of cocoyam.

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CONFLICT OF INTEREST

There was no any form of conflict of interest during the period of this research.

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