Original Research Article

Influence of Temperature and Length of Storage on the Heat of Respiration of Cocoyam Varieties during Storage.

Abstract

This study investigates the impact of temperature and storage duration on cocoyam varieties' heat of respiration during storage. Four cocoyam cultivars ("EDE BUJJI," "AGBAKA," "EDE OFE," and "COCONDIYA") were exposed to temperatures of 10°C, 20°C, 30°C, and 40°C for up to 30 days. The heat of respiration, a crucial indicator of metabolic activity, was measured to understand the physiological responses to varying storage conditions. Results demonstrate that temperature significantly influences the heat of respiration in cocoyam varieties. Higher temperatures correspond to increased heat of respiration, reflecting heightened metabolic activity. Storage duration also affects the heat of respiration, initially showing elevated activity followed by stabilization or gradual decline. These patterns reveal the intricate relationship between metabolic processes and storage time. ANOVA analysis confirms the significant impact of temperature and storage duration on heat of respiration. An interaction effect between these factors underscores their combined influence. Mean separation analysis identifies distinct temperature subsets with significant heat of respiration differences, emphasizing temperature-specific metabolic effects. Hence, this study advances our understanding of heat of respiration in cocoyam storage. Findings offer insights into cocoyam's metabolic responses under diverse conditions, informing preservation strategies. This knowledge contributes to sustainable cocoyam management. Further research into underlying biochemical mechanisms will enhance our grasp and aid in optimizing cocoyam post-harvest practices.

Keywords: Cocoyam**,** Heat of Respiration**,** Temperature**,** Storage Duration**,** Metabolic Activity

1.0 Introduction

Cocoyam (*Colocasia esculenta* and *Xanthosoma spp*) is an important tropical root crop grown for its starchy corms or underground stem. [1]: Exploring the Production, Health and Trade Potentials in Sub-Saharan Africa]. It is regarded as one of the most important staple crops in many developing and underdeveloped countries, especially in tropical and subtropical regions of Oceania, Asia, and Africa [1]. Despite its importance, cocoyam production is still at the subsistence level in major growing areas, and farmers rely on traditional farming tools for production [1]. The lack of policy and research interventions for the promotion and growth of cocoyam has relegated its production to the background compared with other root and tuber crops [Otekunrin et al., 2021]. Therefore, it is important to investigate the effects of storage conditions on cocoyam to extend its shelf life and maintain its quality.

Several studies have investigated the effects of storage conditions on the quality of cocoyam [2; 1; 3; 4]. However, there is limited information on the influence of temperature and length of storage days on the heat of respiration of cocoyam varieties during storage. The heat of respiration is an important indicator of the metabolic activity of the cocoyam, which affects its quality and shelf life. Therefore, this study aims to investigate the influence of temperature and length of storage days on the heat of respiration of cocoyam varieties during storage. This study will contribute to the understanding of the effects of storage conditions on the heat of respiration of cocoyam, which is important for maintaining its quality and extending its shelf life. The objective of this study is to determine the effect of different storage temperatures and length of storage days on the heat of respiration of cocoyam varieties during storage.

Recent research works on cocoyam storage have investigated the effect of post-harvest water washing, chlorination, and curing on the respiration and/or ethylene production of sound or injured cocoyam (Xanthosoma sagittifolium L.) corms in storage [5]. Other studies have explored the production, health, and trade potentials of cocoyam in sub-Saharan Africa [1]. However, there is still a research gap on the influence of temperature and length of storage days on the heat of respiration of cocoyam varieties during storage. This study will, therefore, fill this gap and provide information on the optimal storage conditions for cocoyam, which will help to reduce post-harvest losses and improve the income of cocoyam farmers.

In a study conducted in the forest agro-ecological zone of Ghana, Boakye-Achampong et al. (2017) examined the economics of smallholder cocoyam production. The findings indicated that smallholder cocoyam production is currently not profitable, leading to reduced production scales focused on subsistence farming [6]. Oshunsanya (2016) quantified soil loss due to white and red cocoyam harvesting in a traditional farming system. The study highlighted the impact of cocoyam cultivation practices on soil erosion and emphasized the need for sustainable farming techniques [7].Knipscheer and Wilson (1981) investigated cocoyam farming systems in Nigeria. Their research provided insights into the cultivation practices, challenges, and potential improvements for cocoyam production in the country [8]. Azeez and Madukwe (2010) examined cocoyam production and the economic status of farming households in Abia State, South-East Nigeria. The study explored the socioeconomic factors influencing cocoyam production and the income generated by farming households [9].Otekunrin et al. (2021) conducted a comprehensive review on the production, health, and trade potentials of cocoyam in sub-Saharan Africa. The study highlighted the importance of cocoyam as a tropical root crop and discussed its potential for enhancing food security and income generation in the region. In a study assessing the productivity and socioeconomic feasibility of cocoyam and teak agroforestry for food security [1]. Aji et al.

(2022) emphasized the adaptability of cocoyam to agro ecological zones in Sub-Saharan Africa. They ranked cocoyam as the third most important root crop after cassava and sweet potato [10].

These research works collectively contribute to the understanding of cocoyam production, economics, cultivation practices, and its potential for enhancing food security and income generation. They highlight the challenges faced by smallholder farmers, the need for sustainable farming techniques, and the importance of cocoyam in the livelihoods of rural and urban dwellers. The findings from these studies provide a valuable foundation for further research on cocoyam storage and the optimization of storage conditions to maintain its quality and extend its shelf life.

2.0 Materials and Methods

2.1 Study Area

The storage structure was sited at no 14 Moses Akinyode crescent old kutunku Gwagwalada Abuja. Gwagwalada is located between latitude 08^{o} and 57$'$ N and longitude 07^{o} and 04$'$ E as shown in figure 1 and is characterized by annual rainfall of about 33 to 306.9 mm [11]. There are two main seasons in the area: wet season and dry season. The wet season is divided into major and minor seasons, the major season starts from May to August and peaks at August while the minor season begins from September to November and peaks at October. The main dry season in the area is from December to April. Temperatures throughout the year are usually high, with maximum usually between 29.4^{o}C and 37.7^{o}C and minimum between 26.4^{o}C and 14.5^{o}C [11]. The relative humidity in the area ranges from 27% to 86% [11].

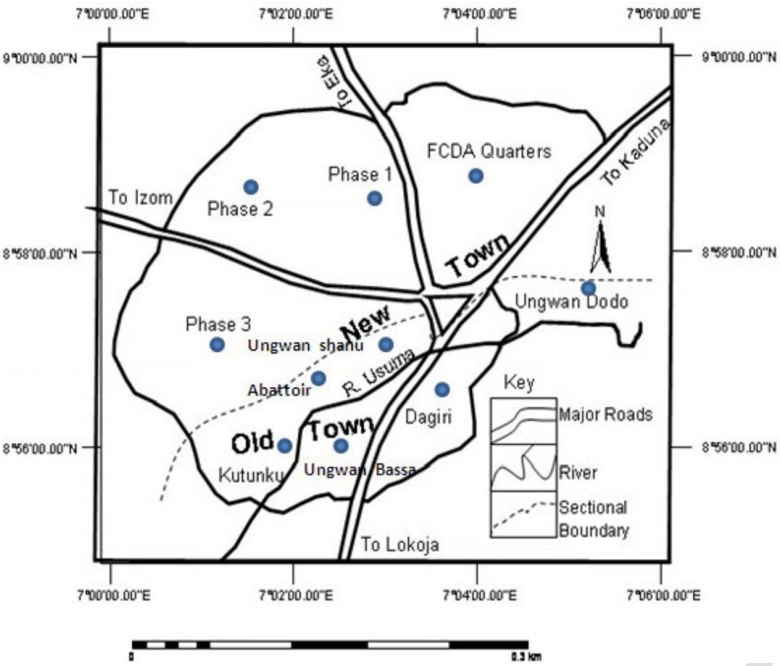

Figure 1: Map of Gwagwalada Town.

2.2 Materials

The materials used for this research work includes, four cultivar of cocoyam (*edeofe, agbaka, edebuji and coco india*), CO_2TEMP., RH DATA LOGGER, convective heater of 180 to 2000W, LG 1HP Air conditioner, Plastic rectangular box, Digital vennier caliper and Thermocouple.

2.3 Experimental setup for heat of respiration

The experimental setup for the measurement of respiratory rate was carried out in for different storage structures which include a Hier Thermocol deep freezer for 10 ^{O}C, a storage structure of 0.12 x 023 x 0.32 m with a one horse power LG Air conditioner mounted on the wall was used for 20 ^{O}C. A storage space of 0.13 x 0.24 x 0.32 m was used for 30 ^{O} C and 0.12 X 0.2 X 0.32 m with Phillips convective heater 180 to 2000W was used for 40 ^{O}C. Then a storage box of 0.02 X0.017 X0.0175 m as in plate 1 was used for measuring the rate of carbon-dioxide evolution.

2.4 Moisture content

The moisture content wet basis of four accessions (*Agbaka, Ede buji, Cocondiya and Ede ofe*) were determined by the air oven method as described by Aghbashlo*et al*. 2008 [12].

2.5 Determination of heat of respiration

The sample of 5kg per accession was bought from North bank market in Makurdi and packaged in a cartoon living it opened to allow air circulation and transported to Gwagwalada where the experiment was carried out. The sample were spread out of the cartoon and allowed to remain under shade for 72 hours so as to reduce the field heat before loading them into the various storage structures.

A rectangular box of 19.5 x 19 x 20 cm was constructed using fiber glass material, the temperature and relative humidity of the storage structure was measured, the

initial temperature and relative humidity of the box was measured then the sample which was stored in a predetermined temperatures of $10^{O}C$, $20^{O}C$, $30^{O}C$ and $40^{O}C$ was loaded into the box and the CO_2TEMP., RH DATA LOGGER was put on and placed on top of the sample and was covered to make the storage box air tight. Within 30 seconds, which is the response time of the DATA LOGGER, the initialCO_2 concentration is recorded and after 10min, the CO_2 concentration in the head space was measured and recorded directly from the Portable Digital CO_2 Meter. This was repeated in three replications for each cultivar in each storage condition for thirty (30) days. The rate of respiration was determined using equation 1 by Fonseca et al, 2000 [13].

$$RCO_2 = \frac{\left(p_{CO_2^F} - p_{CO_2^{in}}\right)V_v}{100 \times W \times \left(t^f - t^{in}\right)} \qquad (1)$$

Where,

PCO_2^{F-P} = final concentration of carbon-dioxide gas, %

$PCO_2^{F\text{-}in}$ = initial concentration of carbon- dioxide gas, %

V_v = Void volume, ml

W = weight of the sample, kg

t^f = final time, hr

t^i = initial time, hr

Superscript *in* and *f* = initial and final.

The value obtained for rate of respiration is multiplied by a constant (10.676 J/mg) to obtain the heat of respiration as in equation 2.

$$R_{ht} = 10.676 R_{rt} \quad (2)$$

2.6 Statistical Analysis

The heat of respiration of four (4) accessions of cocoyam was determined at four (4) different storage temperatures of 10, 20, 30 and 40 OC and other heat related properties was analyzed using SPSS version 20 software. The statistical design was Complete Randomized Design (CRD).

3.0 Results and Discussion

3.1 General Description of the Experimental Result

The experimental results presented in Table 1 provide insights into the influence of temperature and length of storage days on the heat of respiration of various cocoyam accessions. The heat of respiration is a crucial parameter that reflects the metabolic activity and physiological changes occurring within the stored cocoyam varieties over time. This section discusses the trends, patterns, and observations observed in the results.

The results demonstrate variations in the heat of respiration across different temperature conditions and storage days for each cocoyam accession. The cultivars investigated include "EDE BUJJI," "AGBAKA," "EDE OFE," and "COCONDIYA." Temperature settings of 10°C, 20°C, 30°C, and 40°C were employed to examine the impact of temperature on the heat of respiration. The storage period extended up to 30 days, allowing for an assessment of how the heat of respiration changes over time.

Across all cocoyam varieties, it is evident that higher temperatures generally correspond to elevated heat of respiration values. This observation aligns with the well-established principle that metabolic processes tend to accelerate at higher temperatures. Varieties stored at 40°C consistently exhibit the highest heat of respiration values, indicating heightened metabolic activity under these conditions.

In terms of the storage days, a pattern of change in the heat of respiration becomes apparent. At the initial stages of storage (days 1-5), there is often an increase in the heat of respiration, indicating an active metabolic phase as the cocoyam accessions adjust to the storage conditions. Subsequently, a trend of stabilization or gradual decrease in the heat of respiration is observed as the storage period advances (days 10-30). This pattern suggests a potential reduction in metabolic activity over time or the establishment of a metabolic equilibrium within the stored cocoyam varieties.

Additionally, variations in the heat of respiration among different cocoyam accessios are evident, with some accessions consistently displaying higher values compared to others across temperature and storage conditions. For instance, "COCONDIYA" tends to exhibit relatively higher heat of respiration values across the majority of temperature and storage combinations, while "EDE BUJJI" and "AGBAKA" often demonstrate intermediate values.

The standard deviation values provided in the table reflect the degree of variability within each data set. Higher standard deviations are generally observed at higher temperatures, which could be indicative of increased variability in metabolic activity under more extreme temperature conditions.

The experimental results obtained in this study on the influence of temperature and length of storage days on the heat of respiration of cocoyam varieties can be compared to the findings of other researchers who have worked on similar research. Although there are limited studies specifically focusing on cocoyam, there are related studies on the effects of storage conditions and temperature on the heat of respiration in other crops, such as yam and potatoes.

One study investigated the effects of storage conditions and storage period on the nutritional and other qualities of stored yam tubers [14]. While the focus of this study was on yam, it provides insights into the effects of storage conditions on the respiratory activity of tubers. Similarly, another study evaluated the effects of fruit size and initial storage temperature on the heat of respiration of dacryodes edulis [15]. Although this study focused on a different crop, it examined the impact of storage temperature on the heat of respiration, which can be compared to the findings of this study.

Furthermore, a study on the effects of processing and storage conditions of cocoyam strips on the quality of fries explored the sensory and textural properties of frozen cocoyam strips [16].Although the focus of this study was on processing and storage conditions, it provides insights into the changes in quality and metabolic activity of cocoyam during storage.

While there is limited research specifically on cocoyam and its heat of respiration during storage, these related studies can provide valuable insights and comparisons. By examining the effects of storage conditions, temperature, and metabolic activity in other crops, it is possible to draw parallels and make inferences about the heat of respiration dynamics in cocoyam varieties during storage.

Now, comparing the results obtained in this study with the findings of other researchers working on similar research can provide a broader understanding of the influence of temperature and length of storage days on the heat of respiration in cocoyam varieties. By considering related studies on yam and other crops, it is possible to gain insights into the physiological responses and metabolic activity of cocoyam during storage. Further analysis, including statistical tests and modeling, would be necessary to establish a comprehensive understanding of the heat of respiration dynamics in cocoyam varieties during storage [17; 18].

The experimental results in table 1 highlight the complex interplay between temperature, storage days, and cocoyam varieties in influencing the heat of respiration. The observed patterns offer valuable insights into the physiological responses of different cocoyam cultivars to storage conditions. Further analysis, including statistical tests and modeling, would be required to elucidate the underlying mechanisms driving these trends and to develop a comprehensive understanding of the heat of respiration dynamics in cocoyam varieties during storage.

Table 1: Heat of respiration of stored cocoyam varieties

ACCESSION	EDE BUJJI				AGBAKA				EDE OFE				COCONDIYA			
	Temperature (^oC)				Temperature (^oC)				Temperature (^oC)				Temperature (^oC)			
DAY	10^a	20^b	30^c	40^a	10^a	20^b	30^c	40^a	10^a	20^b	30^c	40^a	10^a	20^b	30^c	40^a
1	163.54	175.821	701.225	398.293	170.412	90.956	423.401	475.576	153.464	92.860	431.754	465.097	182.293	99.518	562.141	436.402
2	177.006	199.704	494.892	359.258	160.202	164.259	118.523	222.932	190.843	126.465	374.808	410.850	189.876	135.290	406.519	455.322
3	177.623	209.534	306.646	489.561	148.099	86.741	306.976	199.227	263.604	111.624	224.582	521.351	254.694	100.610	230.735	395.066
4	170.58	276.024	468.686	600.939	216.107	146.326	166.256	310.924	227.025	117.909	378.855	475.654	208.028	121.690	187.370	379.433
5	128.114	107.287	333.547	608.030	171.562	114.764	88.250	440.797	209.391	105.284	311.047	481.340	166.183	143.920	236.830	382.300
6	208.774	124.841	286.961	538.087	190.179	87.318	65.106	284.412	213.891	79.879	229.127	284.587	162.234	96.835	131.781	227.466
7	282.578	94.203	397.587	412.292	133.513	77.903	261.054	539.145	298.520	112.664	516.178	462.155	137.572	64.492	429.486	292.500
8	285.111	168.154	200.101	439.796	195.978	123.462	77.147	394.174	167.822	97.983	562.431	387.697	175.937	110.260	189.363	436.402
9	190.973	341.505	252.784	514.928	283.976	88.778	139.151	442.731	256.468	216.317	139.875	393.677	215.045	80.616	172.429	446.384
10	250.347	176.012	305.353	501.468	165.974	120.257	93.126	337.379	187.841	160.035	368.491	409.948	183.580	191.590	266.747	372.793
11	248.051	217.43	201.72	481.983	158.246	131.643	124.836	539.547	221.501	159.275	197.306	493.292	173.524	149.570	189.155	431.488
12	171.548	226.462	432.457	452.981	162.903	160.178	154.850	451.437	159.686	145.468	311.089	362.033	203.723	157.300	172.468	412.885
13	257.579	166.19	309.193	492.594	184.051	90.801	211.838	517.965	177.931	238.901	331.781	347.035	188.520	153.550	145.834	427.477
14	173.506	147.474	189.755	402.383	280.271	88.475	98.911	463.510	145.706	144.620	375.964	307.378	181.615	143.560	304.850	336.537
15	162.529	177.804	272.905	456.356	195.764	158.375	182.856	374.232	179.420	170.671	416.125	213.573	176.018	168.470	179.774	244.598
16	209.242	169.061	302.726	385.748	149.756	105.264	133.894	356.352	161.226	117.404	171.539	272.233	181.392	107.240	95.213	371.868
17	167.673	198.504	270.466	477.327	161.045	90.387	231.468	443.015	153.603	84.841	182.298	269.627	168.940	137.350	122.703	230.050
18	172.618	186.926	306.715	366.425	185.554	105.798	97.955	359.663	156.029	151.651	199.057	336.643	144.254	167.520	159.284	345.570
19	183.584	204.361	218.769	330.372	186.784	136.350	128.992	307.077	233.592	125.895	181.052	374.420	152.291	149.810	95.219	249.353
20	199.553	195.746	223.648	443.472	175.188	173.239	85.296	389.046	193.871	127.686	152.152	365.678	143.429	175.740	150.819	298.520
21	341.696	97.952	97.273	521.910	216.646	97.477	121.498	292.566	156.857	81.816	186.272	313.984	162.324	95.742	72.881	305.272
22	153.264	109.215	143.039	390.239	199.096	121.459	57.836	330.701	211.756	118.241	216.206	367.686	243.593	106.800	123.917	289.882
23	244.999	101.146	238.354	296.749	186.658	119.211	110.907	324.547	273.852	105.312	163.355	341.801	274.234	92.060	175.045	330.851
24	247.146	89.056	181.462	367.307	203.638	121.526	110.216	353.081	288.810	104.709	173.321	285.912	295.028	88.782	143.914	328.718
25	220.365	85.842	253.796	325.378	192.403	134.183	91.026	368.039	249.435	99.022	236.431	330.163	292.952	72.796	117.690	319.488

26	216.505	84.990	251.663	278.918	230.619	132.146	156.423	308.736	257.747	95.836	195.798	156.341	291.469	76.698	159.426	282.500
27	230.967	88.858	85.562	254.957	259.263	88.035	144.889	269.613	298.470	99.553	148.425	249.196	355.640	84.830	64.245	236.093
28	225.355	84.410	96.217	265.275	239.555	134.714	26.500	323.834	264.973	95.685	140.435	208.743	348.007	93.142	132.891	247.935
29	237.462	90.939	174.342	315.198	168.613	134.152	39.428	249.248	268.451	95.060	149.657	223.760	968.035	94.870	70.061	249.439
30	230.736	93.848	118.488	317.560	147.497	139.169	26.500	304.876	286.034	99.024	153.663	211.332	333.244	94.232	133.105	245.786

3.2 Factors Influencing the Heat of Respiration of Stored Cocoyam Varieties

The influence of temperature and storage days on the heat of respiration of cocoyam accessions was further investigated through an analysis of variance (ANOVA). The ANOVA results, as shown in Table 2, provide valuable insights into the individual and combined effects of these factors on the observed variations in heat of respiration.

Day Effect: The ANOVA results indicate that the factor "Day" significantly affects the heat of respiration ($F = 3.096$, $p < 4.05\text{E-}07$). This suggests that the length of storage days has a notable impact on the metabolic activity and heat of respiration of the stored cocoyam varieties. The variation in heat of respiration observed across different storage days underscores the dynamic nature of the metabolic processes occurring within the cocoyam samples over time. This effect aligns with the patterns observed in the experimental results, where initial increases in the heat of respiration are followed by stabilization or gradual decreases as the storage duration progresses.

Temperature Effect: The ANOVA results also demonstrate a significant effect of the factor "Temperature" on the heat of respiration ($F = 200.985$, $p < 1.46\text{E-}76$). This finding confirms that temperature plays a crucial role in influencing the metabolic activity and respiratory processes of cocoyam varieties during storage. Higher temperatures are associated with increased metabolic rates, leading to higher heat of respiration values. The strong influence of temperature on the heat of respiration is consistent with the well-established principle that temperature governs the rate of biochemical reactions within living organisms.

Interaction Effect (Day * Temperature): Furthermore, the ANOVA results reveal a significant interaction effect between "Day" and "Temperature" ($F = 2.853$, $p < 3.92\text{E-}12$). This interaction suggests that the combined influence of storage days and temperature is not simply additive; rather, it leads to unique variations in the heat of respiration. The interplay

Table 2: ANOVA of the factors affecting heat of respiration

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Remark
Day	516580	29	17813.113	3.096	4.05E-07	Significant
Temperature	3E+06	3	1156317.705	200.985	1.46E-76	Significant
Day * temperature	1E+06	87	16416.694	2.853	3.92E-12	Significant
Error	2E+06	360	5753.249			
Total	3E+07	480				
Corrected Total	7E+06	479				

between these two factors contributes to the observed trends and fluctuations in metabolic activity over time and across different temperature conditions. This interaction effect reinforces the notion that temperature impacts the rate of metabolic processes differently as the storage duration advances.

Error and Total Variance: The ANOVA also reports the error variance, indicating the unexplained variability in the data (Error = 2E+06). The total variance is partitioned into various sources of variation, with the corrected total variance being the sum of explained and unexplained variances (Corrected Total = 7E+06).

Therefore, the ANOVA results provide robust statistical evidence supporting the significant influence of both storage days and temperature on the heat of respiration of cocoyam varieties during storage. The interaction effect further highlights the complex relationship between these two factors and their combined impact on metabolic activity. These findings enhance our understanding of the physiological responses of cocoyam varieties to varying storage conditions and lay the foundation for informed management practices to optimize the storage and preservation of cocoyam.

3.3 Temperature Effects on Heat of Respiration in Cocoyam Varieties

To further investigate the specific effects of different temperature conditions on the heat of respiration in cocoyam varieties, a mean separation analysis was conducted and the results are presented in Table 3. This analysis allows us to understand how variations in temperature impact the metabolic activity and respiratory processes within the stored cocoyam samples.

Duncan's Mean Separation: The Duncan's mean separation test was applied to compare the mean heat of respiration values among different temperature conditions. The results reveal distinct subsets of temperature conditions that exhibit statistically significant differences in the heat of respiration.

- The first subset (Subset 1) includes cocoyam varieties stored at 20°C, with a mean heat of respiration value of 129.0767 $kJkg^{-1}$ h. The significance level for this subset is also 1, indicating a statistically significant difference in the mean heat of respiration between this subset and the others.
- For the second subset (Subset 2), which includes cocoyam varieties stored at 10°C and 30°C, the mean heat of respiration values are 214.2506 $kJkg^{-1}$ h and 213.6034 $kJkg^{-1}$ h, respectively. The significance level (Sig.) for this subset is 0.947, indicating that there is no statistically significant difference in the mean heat of respiration between these two temperature conditions.
- In the third subset (Subset 3), cocoyam accessions stored at 40°C exhibit a significantly higher mean heat of respiration value of 364.9311 $kJkg^{-1}$ h. This indicates that the metabolic activity within the cocoyam samples is notably increased at the higher temperature of 40°C. The significance level for this subset is 1, indicating that the difference in mean heat of respiration between this subset and the other subsets is statistically significant.

Therefore, the mean separation analysis reveals temperature-specific effects on the heat of respiration in cocoyam accessions. While no statistically significant difference was detected between the mean heat of respiration values for cocoyam samples stored at 10°C and 30°C,

Table 3: Temperature effects on heat of respiration on cocoyam varieties

TEMPERATURE		N	Subset		
			1	2	3
Duncan[a,b,c]	20	120	129.0767		
	10	120		213.6034	
	30	120		214.2506	
	40	120			364.9311
	Sig.		1	0.947	1

significant differences were observed between the samples stored at 20°C or 40°C and those stored at the other temperatures. This analysis provides valuable insights into the temperature conditions that lead to variations in the metabolic activity of cocoyam during storage. Further studies could explore the physiological and biochemical mechanisms underlying these observed differences in the heat of respiration and their implications for cocoyam preservation strategies.

4.0 Conclusion

This study investigated the influence of temperature and length of storage days on the heat of respiration of various cocoyam varieties during storage. Through a comprehensive analysis of experimental results and statistical evaluations, several key findings have emerged that contribute to our understanding of the metabolic dynamics and physiological responses of cocoyam varieties under varying storage conditions.

The experimental results revealed that temperature and storage days significantly impact the heat of respiration in cocoyam varieties. Higher temperatures were consistently associated with elevated heat of respiration values, reflecting increased metabolic activity. Moreover, the observed patterns in the heat of respiration over storage days indicated an initial phase of heightened metabolic activity, followed by stabilization or gradual decreases as the storage period extended. These patterns underscore the intricate interplay between metabolic processes and storage duration.

The ANOVA results provided robust statistical evidence for the significant effects of both temperature and storage days on the heat of respiration. The interaction effect between these two factors further emphasized the complex relationship between temperature and storage duration in influencing metabolic activity. These findings offer valuable insights into the physiological responses of cocoyam varieties to changing storage conditions, providing a foundation for informed management practices to optimize cocoyam preservation.

Additionally, the mean separation analysis highlighted distinct temperature subsets that exhibited significant differences in the heat of respiration. The analysis underscored the importance of temperature-specific effects on metabolic activity and demonstrated how certain temperature conditions can significantly influence the respiratory processes within cocoyam samples.

Hence, this study advances our understanding of the factors that influence the heat of respiration in cocoyam varieties during storage. The findings underscore the importance of temperature and storage duration in determining the metabolic activity and physiological changes occurring within the stored cocoyam samples. This knowledge can inform the development of effective storage and preservation strategies for cocoyam, contributing to the sustainable management of this valuable agricultural commodity. Further research, including the exploration of biochemical mechanisms underlying these observations, would provide deeper insights into the metabolic responses of cocoyam and enhance our ability to enhance its post-harvest quality and shelf life.

References

1. Otekunrin, O. A., Sawicka, B., Adeyonu, A. G., Otekunrin, O. A., &Rachoń, L. (2021). Cocoyam [Colocasia esculenta (L.) Schott]: Exploring the Production, Health and Trade Potentials in Sub-Saharan Africa. Sustainability, 13(8), 4483.
2. Onyeka, J. (2014). Status of Cocoyam (Colocasia esculenta and Xanthosoma spp) in West and Central Africa: Production, Household Importance and the Threat from Leaf Blight. CGIAR Research Program on Roots, Tubers and Bananas (RTB): Lima, Peru. Available online: www.rtb.cgiar.org (accessed on 5 February 2021).
3. Agbelemoge, A. (2013). Utilization of cocoyam in rural households in South Western Nigeria. African Journal of Food Agriculture, Nutrition and Development, 13, 7944–7956.
4. Boakye, A. A., Wireko-Manu, F. D., Oduro, I., Ellis, W. O., Gudjónsdóttir, M., Chronakis, I. O. (2018). Utilizing cocoyam (Xanthosoma sagittifolium) for food and nutrition security: A review. Food Science and Nutrition, 6, 703–713.
5. Mbonomo R. B., Brecht J. K., Nana P., Awono J. P. M.. (2015). Effect of Post-Harvest Water Washing, Chlorination and Curing on Respiration and/or Ethylene Production of Sound or Injured Cocoyam (Xanthosoma Sagittifolium L.) Corms in Storage. Journal of Multidisciplinary Engineering Science and Technology (JMEST), Vol. 2 Issue 6. ISSN: 3159-0040.
6. Boakye-Achampong, S., Ohene-Yankyera, K., Aidoo, R. (2017). Is there any economics in smallholder cocoyam production? Evidence from the forest agro-ecological zone of Ghana. *Agric & Food Secur* **6**, 44 (2017). https://doi.org/10.1186/s40066-017-0121-9.
7. Oshunsanya, S. O. (2016). Quantification of soil loss due to white cocoyam (Colocasia esculentus) and red cocoyam (Xanthosoma sagittifolium) harvesting in

traditional farming system. Catena, Volume 137, p. 134-143. 10.1016/j.catena.2015.09.013.

8. Knipscheer, H. C., & Wilson, G. F. (1981). Tropical root crops: research strategies for the 1980s. Proceedings of the first triennial root crops symposium of the International Society for Tropical Root Crops, Africa Branch, 8-12 September 1980, Ibadan, pp.247-254.

9. Azeez, A. A., &Madukwe, O. M. (2010). Cocoyam production and economic status of farming households in Abia State, South-East, Nigeria. Retrieved from http://www.fspublishers.org/published_papers/60618_..pdf.

10. Aji W., Eva Fauziyah, Suhartono, Ary Widiyanto, Sanudin, Aris Sudomo, Mohamad Siarudin, Aditya Hani, YonkyIndrajaya, Budiman Achmad, and et al. 2022. "Assessing the Productivity and Socioeconomic Feasibility of Cocoyam and Teak Agroforestry for Food Security" *Sustainability* 14, no. 19: 11981. https://doi.org/10.3390/su141911981.

11. Latlong.net 2012 – 2023. www.latlong.net. Accessed 12th April, 2023.

12. Aghbashlo M, M. H Kianmehr and S. R Hassan-Beygi (2008). Specific and Thermal Conductivity of Berberis Fruit (Berberis vulgaris). American Journal of Agricultural and Biological Sciences, 3(1):330-336.

13. Fonseca S. C, Oliveira, F. A. R and Brecht J. K (2002). Modelling Respiration Rate of Fresh Fruits and Vegetables for Modified Atmosphere Packages: A review. *Journal of Food Engineering*. 52 (2) PP 99-119.

14. Osunde, Z. D., &Orhevba, B. A. 2009. Effects of storage conditions and storage period on nutritional and other qualities of stored yam (Dioscoreaspp) tubers. *African Journal of Food, Agriculture, Nutrition and Development*, *9*, 678-690.DOI: 10.4314/ajfand.v9i2.19219.

15. Ijabo, O. J., &Obetta, S. E and Madugu E. O, (2012). Effects of fruit size and initial storage temperature on the heat of respiration of dacryodes edulis. *American Journal of Scientific and Industrial Research, 3*, 150-156.DOI: 10.5251/ajsir.2012.3.3.150.156.

16. Oguntowo, O., Obadina, A. O., Sobukola, O. P., &Adegunwa, M. O. 2016. Effects of processing and storage conditions of cocoyam strips on the quality of fries. Food Science & Nutrition, 4(6), 906-914. https://doi.org/10.1002/fsn3.358.

17. Obetta, S. E., Satimehin A. A. and Ijabo, O. J. 2007. Evaluation of a Ventilated Underground Storage for Cocoyams (Taro)". Agricultural Engineering International: the CIGR Ejournal. Manuscript FP 07 017. Vol. IX. November, 2007.

18. Siddiqui, S., Ahmed N. and Phogat, N. 2022. Starch - Evolution and Recent Advances. Chapter:Potato Starch as Affected by Varieties, Storage Treatments and Conditions of Tubers. 1-15. DOI: http://dx.doi.org/10.5772/intechopen.101831.

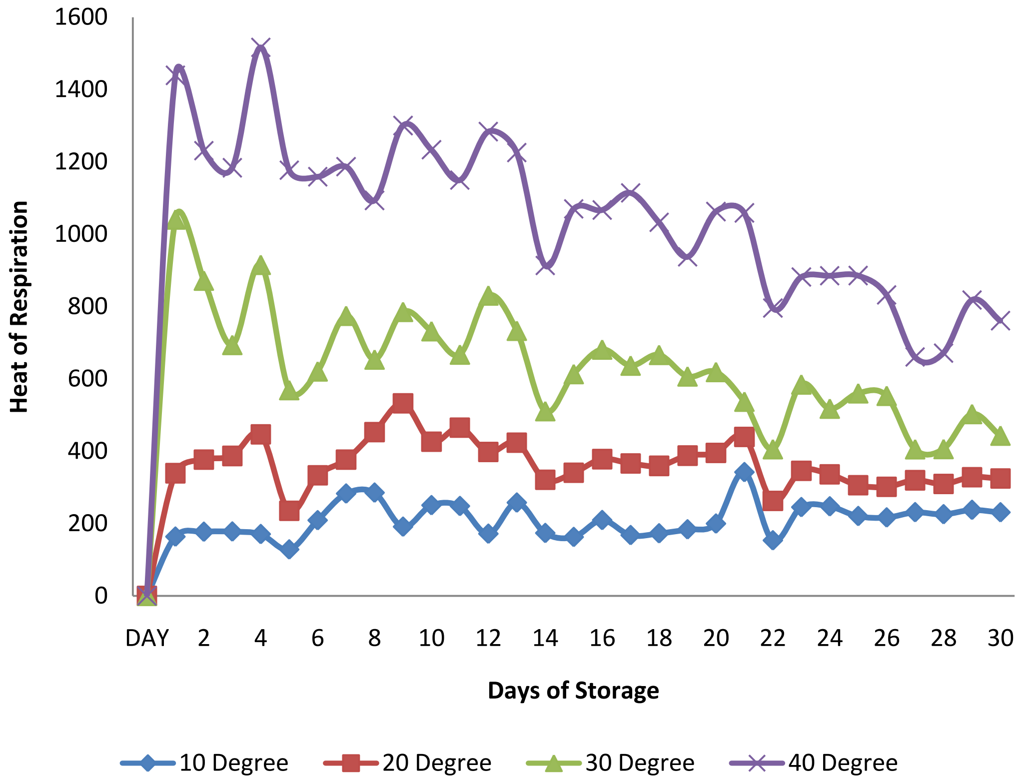

Figure 2: Heat of Respiration versus Days of Storage (*edebujji*)

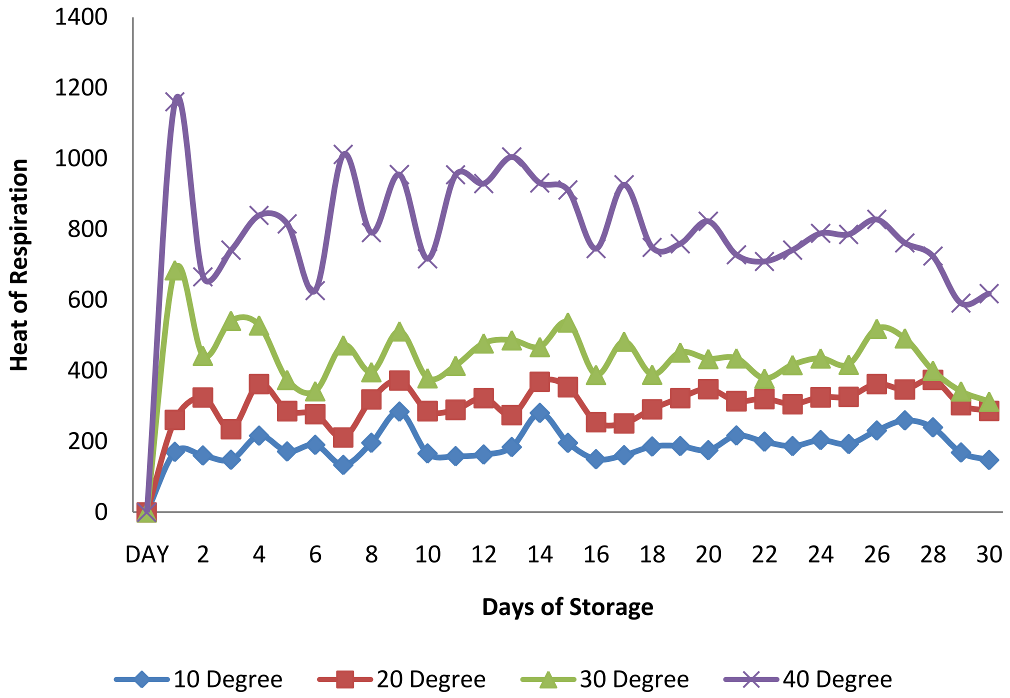

Figure 3: Heat of Respiration versus Days of Storage (*agbaka*)

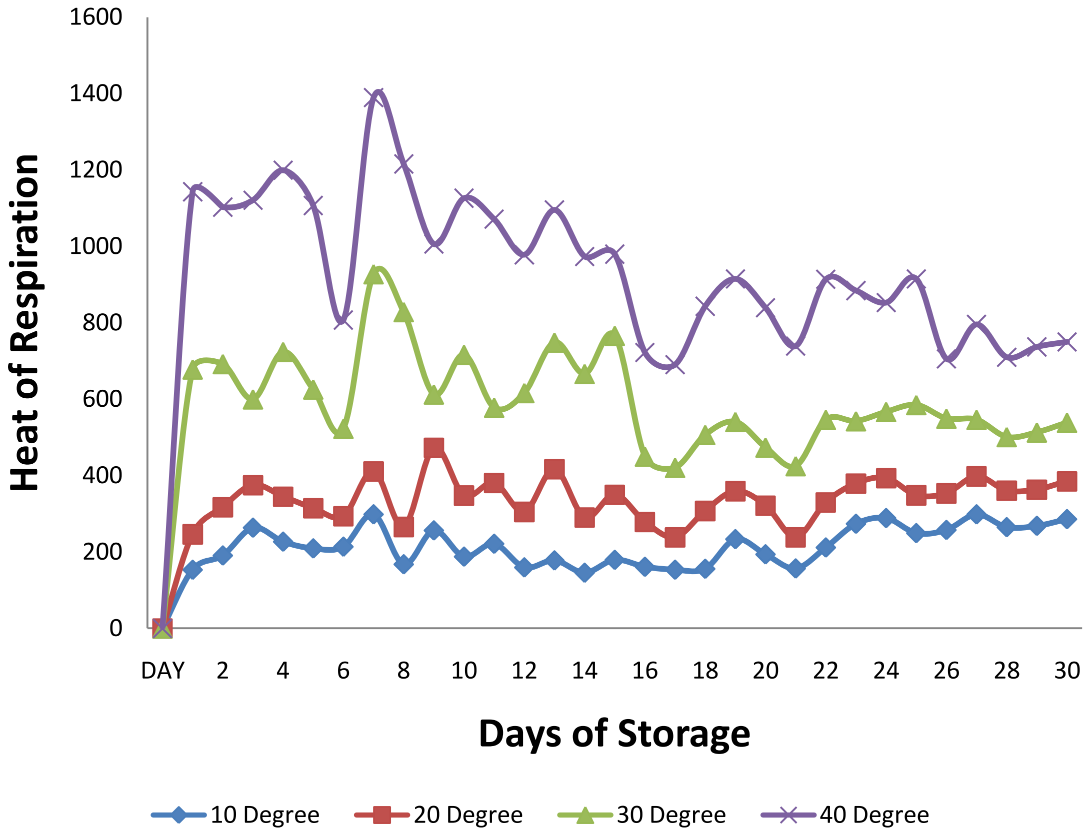

Figure 4: Heat of Respiration versus Days of Storage (*edeofe*)

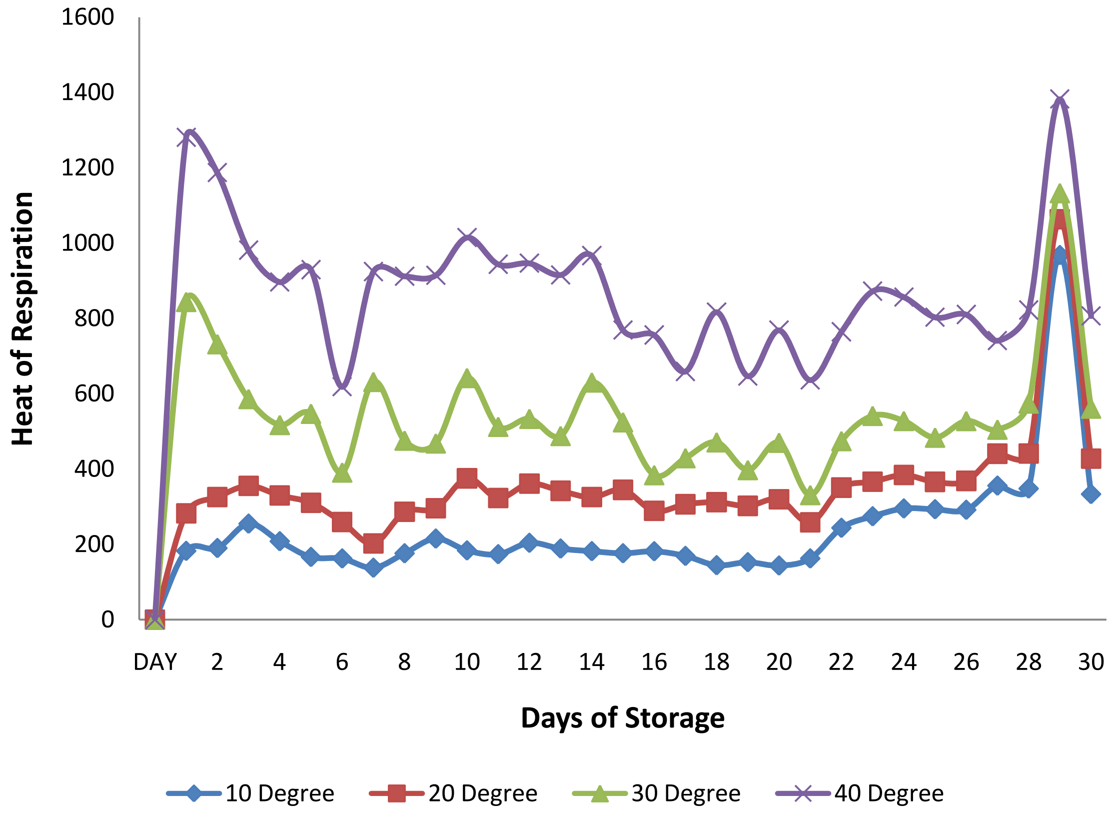

Figure 5: Heat of Respiration versus Days of Storage (*cocondiya*)