The drying characteristics of bitter and sour sop leaves are affected by temperature.

Dear Sir,

Title

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Abstract

One of the earliest techniques for food preservation is the drying method. Drying is important because it reduce the moisture content of the food hence reducing the breeding ground for microorganism that causes food spoilage. Due to this marked effect, the study was aimed at investigating the effect of temperature on the drying characteristic of bitter leave (*Vernonia Amygdalina*) and Soursop (*Annona Muricata*). The methodologies employed in this researches are drying kinetics and Rehydration ratio. Result obtained from this research shows that there was a remarkable loss of water as the days increases in both the samples dried at room temperature and those dried in the sun interestingly, those dried in the sun lost more water than those dried at the room temperature this result was significant at p(<0.05). Furthermore, as the day increase the rate of drying of both plant subjected to different temperatures (sundried and room temperature) decreases. Also, the rehydration capacity and rehydration ratio of the plant was higher in the sample dried at room temperature. However, bitter had a higher rehydration capacity and rehydration ratio than sour sop. This was significant at p (<0.05). It proves that the rehydration capacity and ratio of bitter was higher than that of sour sop leaves. From this study, it is important to note that temperature may affect the drying characteristic of plant samples and may play a role in the nutritional properties and also the shear life of plants.

Keywords: bitter leave, soursop, drying temperature, room temperature and sundried

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INTRODUCTION

Globally, food industries is aiming toward establishing different preservation methods/technologies to inhibit pathogenic bacteria, preserve food nutritional value, reduce agricultural waste, and reduce the cost of production (Burton, 2018).

One of the direct drying methods is open sun drying, which means that solar rays heats the product directly. The simplest, least expensive, and most often used technique for drying agricultural products—including medicinal plants—is open sun drying. When exposed to direct sunlight, plants lose their scent and are discolored, which detracts from their consumer attractiveness. Furthermore, mouse infestations, bird droppings, bug infestations, and other incidents may arise. Agriculture products are highly susceptible and perishable at some times or during abrupt changes in environmental or storage conditions, as stated explicitly by Mouhoubi et al. in 2022. During the drying process, the volatile chemicals (low boiling point compounds) found in leaves evaporate. The nutritional, physical, and chemical components of dried leaves are all impacted by oxidative alteration. The heat degradation of active components during drying reduces the fidelity of a medicinal plant (Rao and Murugan, 2021). Drying is one food preservation technique that has been discovered to be useful in food processing. By lowering the moisture content of food, drying serves as a preservative for food and food products. The development of various drying equipment has been made feasible by advancements in science, technology, and engineering (Bennamoun & Li, 2018). Drying is a popular preservation technique used to extend the shelf life of many fruits and vegetables.The drying process has numerous benefits such as reducing storage volume, and extending shelf life and ensuring the microbial safety of biological products (Gao, *et al.*, 2012).

Conversely, bitter leaf also known as *V. amygdalina* (VA) is a perennial plant with a height range of one to six meters (Nwosu, *et al.*, 2013). *VCommonly referred to as "bitter leaf," amygdalina Del is locally known as "Shuwaka" in Hausa and "Ewuro" in Yoruba (Farombi and Owoeye, 2011). In addition to being used as medicine for a number of ailments, VA leaves are also used as soup seasonings after being cleaned and boiled to eliminate any bitter flavor (Hamzah et al., 2013). It is specifically used in Nigeria to make the well-known bitter leaf soup known as "Onugbo" and as a spice in the Cameroonian cuisine known as "Ndole" (Ho et al., 2012).*

Furthermore, sour sop also called Annona is a genus of the tropical fruit trees belonging to the family Annonaceae. (Pinto *et al*., 2005). One of the earliest angiosperms is the Annonaceae. Most Annona species have their origin from South America and the Antilles, with Mexico as its center of origin (Hernández and Fuentes, 2022). Etymologically, Annona is a term coined from the Latin word Annona which means 'yearly produced' (Bourke, 1976). In the genus Annona, edible fruits are produced by Annona cherimola, Annona muricata, Annona reticulata, Annona squamosa, Annona atemoya (a natural hybrid of Annona cherimola and Annona squamosa), and Annona diversifolia (Anuragi *et al*., 2016). Soursop fruit which is a member of the Annona family, has 2.9% fleshy receptacle, 85.5% pulp, 3.3% seeds and 8.9% skin (Paull *et al.*, 1983). The seed make up about 4% of the whole fruit (Fasakin *et al*., 2008), and can be stored for several months before used for planting (Badrie and Schauss, 2009). The seed germinate differently under different condition for instance, in optimal conditions, it will germinate three (3) weeks after planting, while it takes 2-3 months to germinate in suboptimal conditions (Badrie and Schauss, 2009).

Due to these mark phenomena and observation, this studied was aimed at investigating effect of temperature on the drying characteristic of bitter leave and sour sop leave.

Methodology

Sample collection

Sour sop and bitter leave were gotten from Auchi polytechnic, Auchi botanical garden and was identified by a botanist.

Drying Kinetics

The method used for drying kinetic was a modification of Ahmed *et al.* (2001). The leaves were dried on a foil paper in the at room temperature and in the sun. An approximately 5g sample of each sample was placed in a metal can. Hourly withdrawals of the samples were made, and a computerized weighing machine was used to track weight loss from the samples' moisture content. The equation was used to determine the samples' percentage moisture contents (%MC) at different drying times on a dry basis.

%MC= $\frac{Mi-Md}{Md}\ X100$

Drying rate (DR) =$\frac{Mi-Md}{t}$

Where;

Mi = Mass of the sample at time i

Md = mass of the dry solid

t= time

Ratio of Rehydration (RR)

The dried product's quality was assessed using its capacity and rehydration ratio (Velić et al. 2004). A 250 ml laboratory glass was filled with about 2.0g of the dried vegetable sample, 150 ml of distilled water, and the glass was covered and brought to a boil in three minutes. After ten more minutes of gentle boiling, the contents of the lab glass were chilled. After cooling, the material was filtered for five minutes and weighed.

The rehydration ratio and capacity was calculated as:

RR= $\frac{Weight\ of\ hydrated\ material}{dehydrated\ material}$

RC= $\frac{Regain\ moisture\ (g)}{Initial\ moisture(g)-Residual\ moisture\ (g).}$

Results

The result obtained from the percentage moisture content of sour sop leaf shows that there was a marked difference in the moisture content in the sun dried sample and the one dried at room temperature (fig.1). In order to monitor the drying rate, their weight was taken on a daily interval for five days as these samples took about five days to dry completely the result is displayed below (fig1) this was significant at p (<0.05). Furthermore, the drying rates of sour sop leaf was equally monitored this was done to track the rate of drying by the plant samples (fig 2).

To further understand fully the drying kinetics of plants, another plant was used to compare bitter leaf was used and it was observed that it behaved differently from sour sop leaf as there was an increase in loss of moisture a shown below (fig.3). The drying rate for bitter leaf was the same as that of sour sop leaf as there was a drastic decrease in weight in both the sundried and the room temperature (fig.4). Also, The rehydration ratio and rehydration capacity of bitter and sour sop leaf is displayed in the chart below (fig. 5) and it was observed that there was a slight difference between the rehydration capacity of the plants with bitter leaf dried at room temperature having the least and sour sop dried at room temperature having the greatest on the other hand, bitter leaf dried at room temperature has the highest rehydration ratio as compared to others.

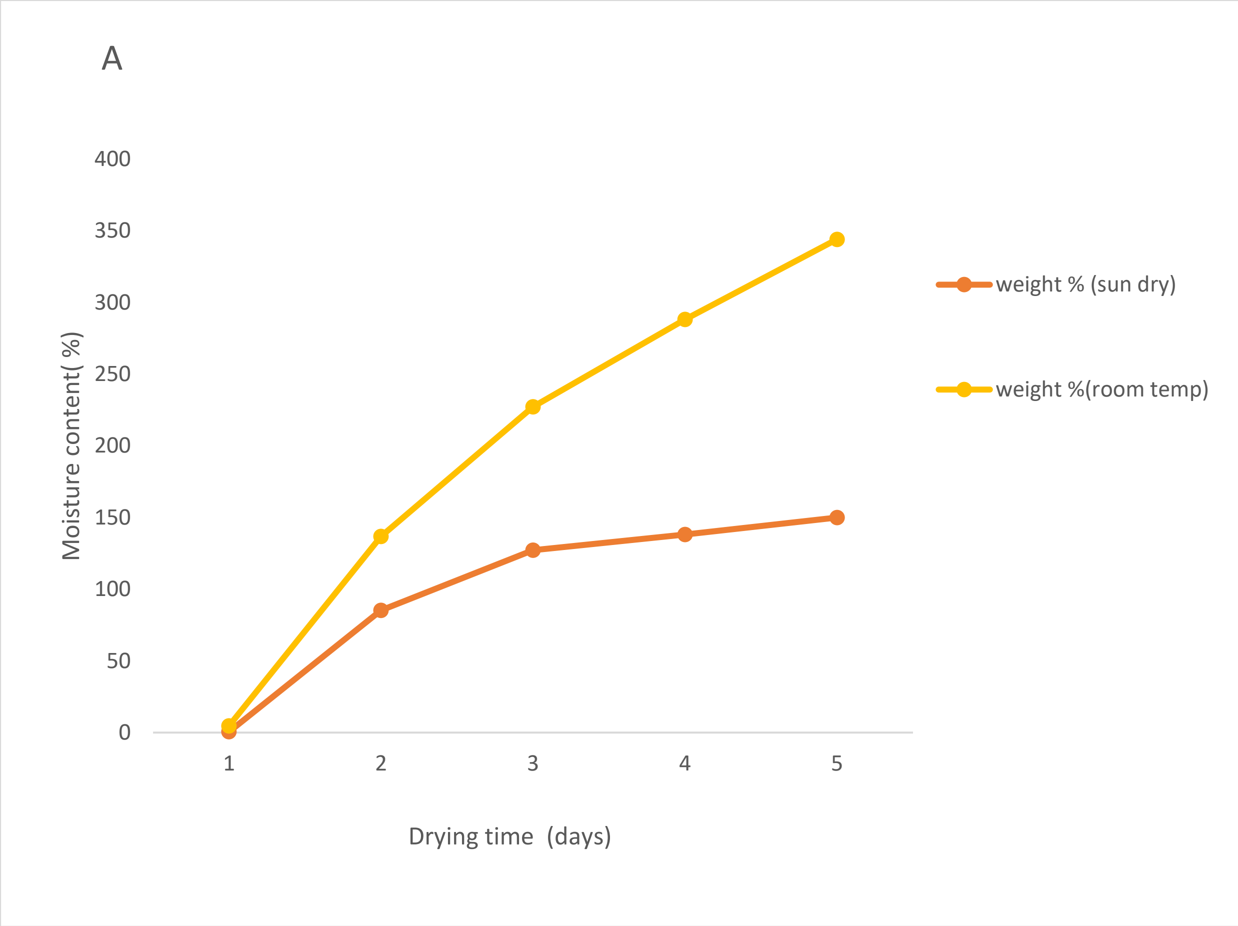

Fig.1. Variation of moisture content with drying time of sour sop leave subjected to different drying temperatures.

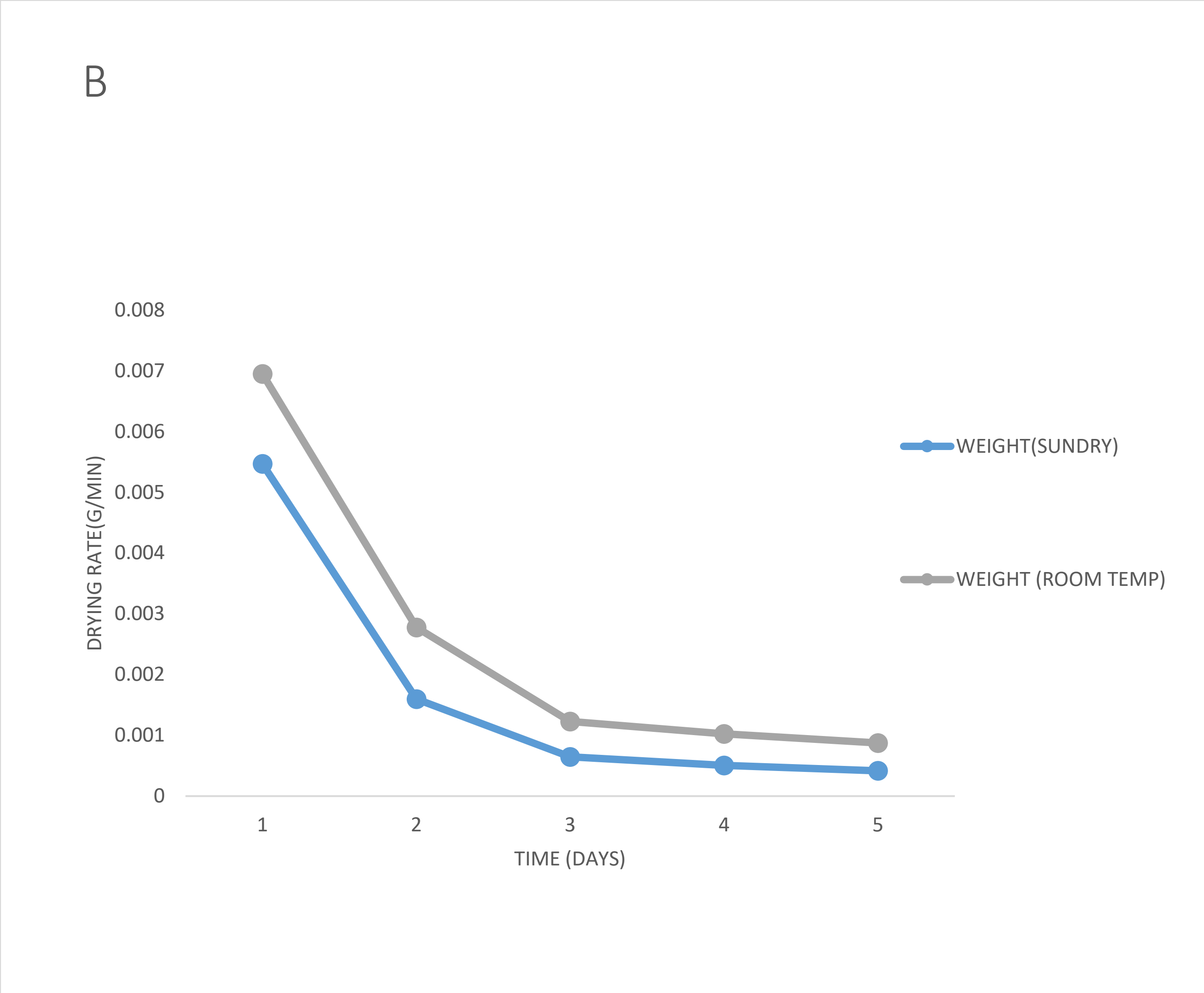

Fig.2. variation of drying rate with drying time for sour sop subjected to different drying temperatures.

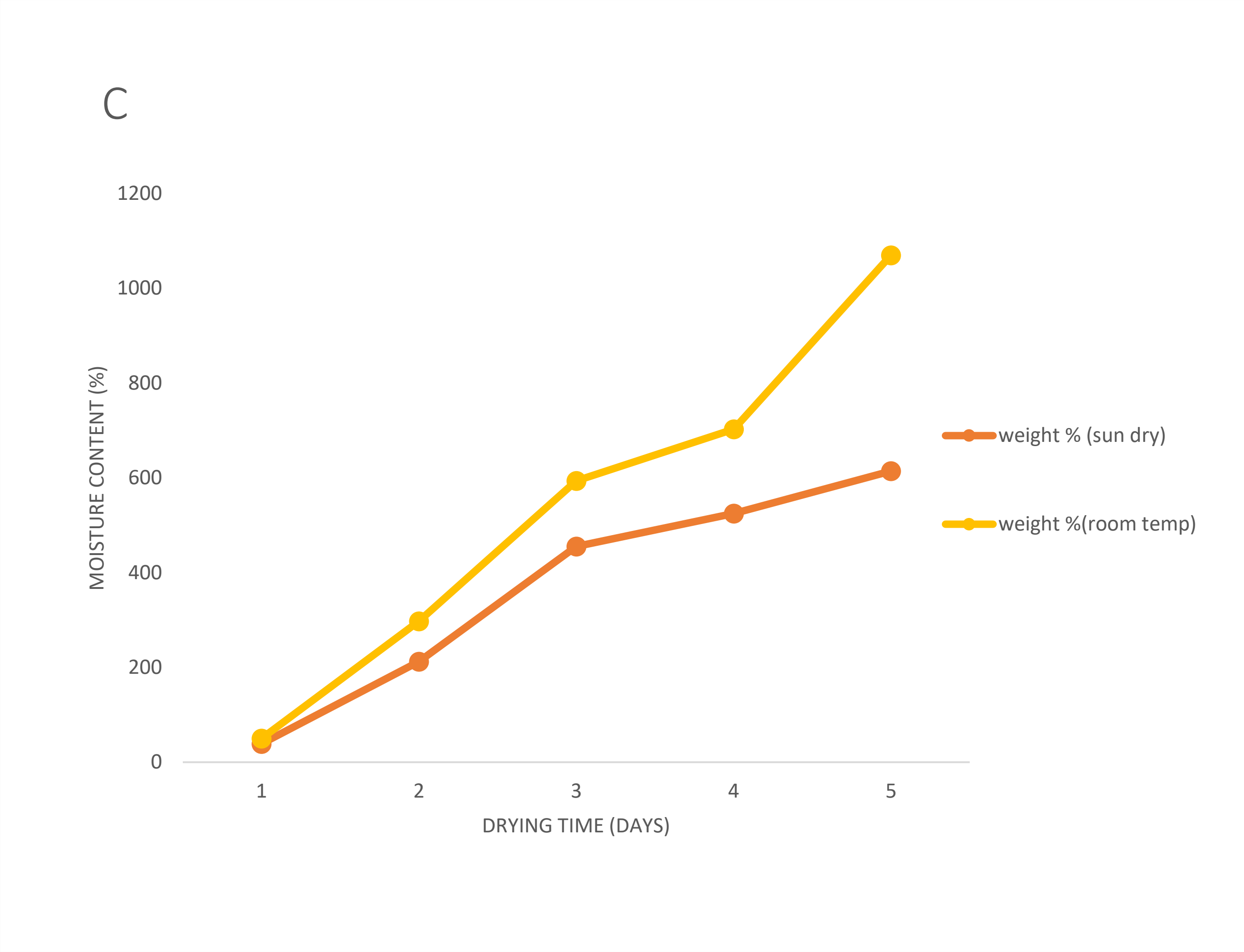

Fig.3. Variation of drying temperatures with different times on bitter leaf exposed to different drying temperature.

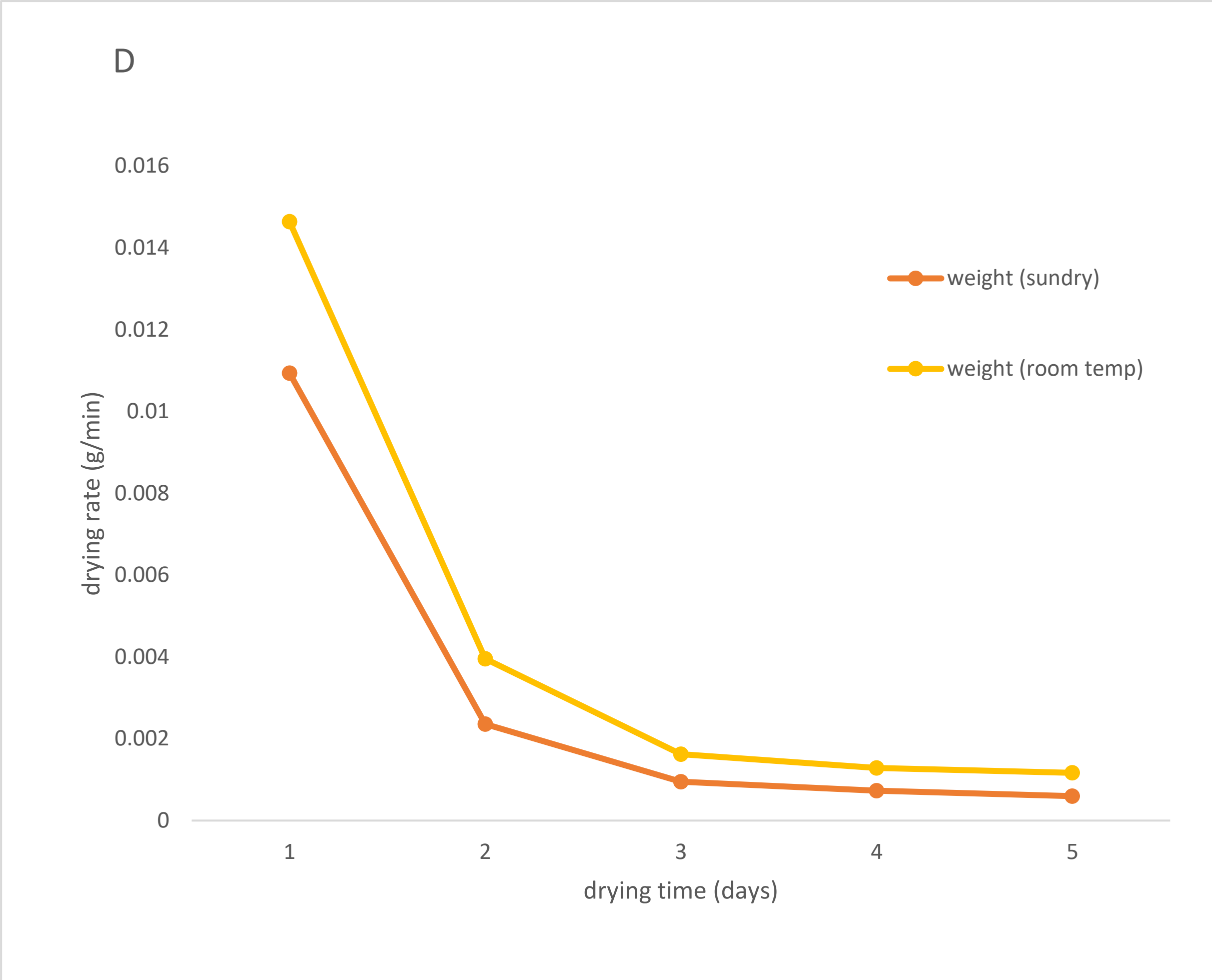

Fig.4. variation of drying rate with drying time on bitter leaf subjected to different drying temperature.

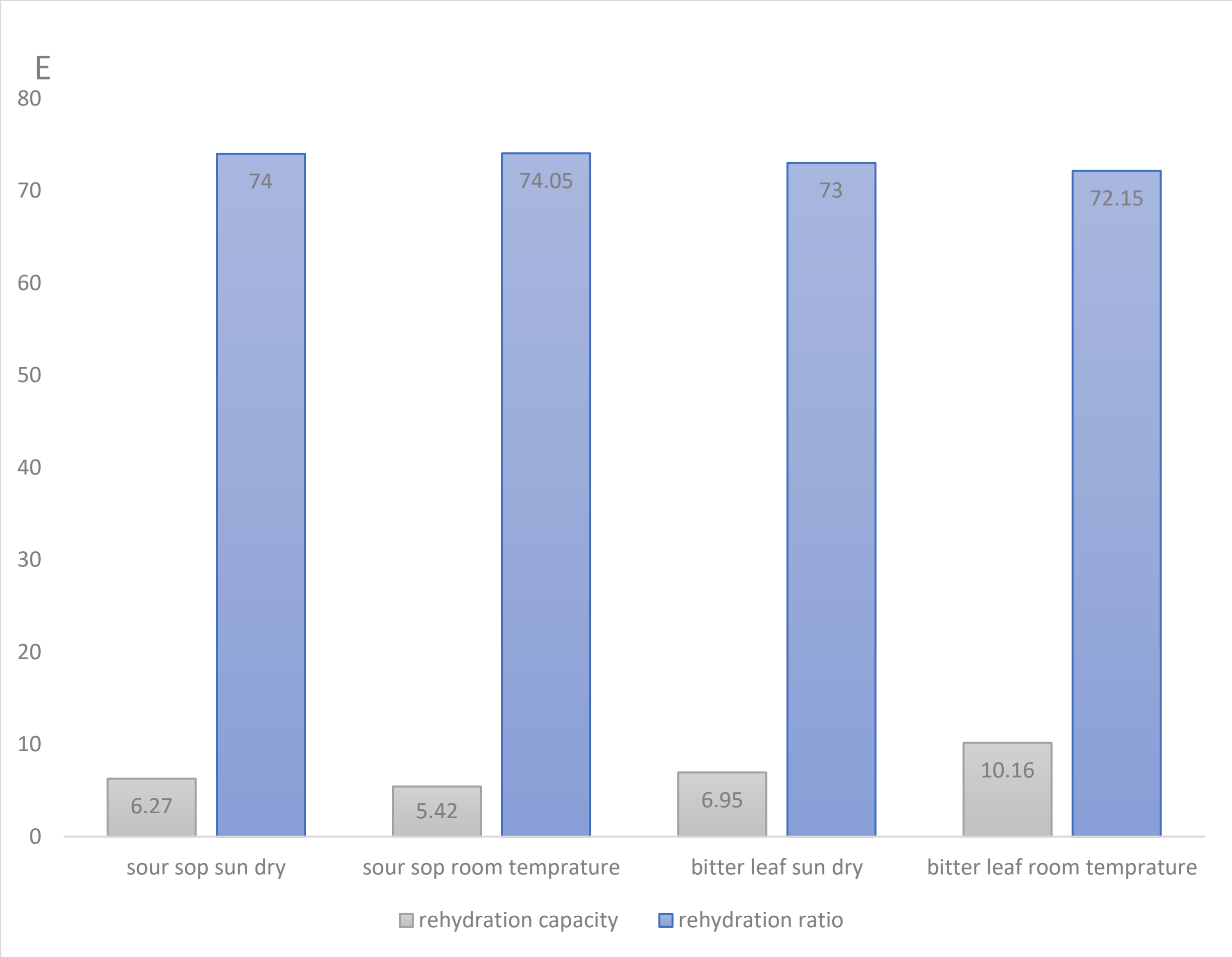

Fig.5. rehydration properties of bitter leaf and sour sop leaf subjected to different drying temperature.

Discussion

Vegetables plays a major role in the body as they provide the body with antioxidant, vitamins, minerals and a whole lot of chemical of nutritional importance. However, the way and methods these vegetables are been processed affected their nutritional properties. Among the various methods used to maintain the quality and nutritional value of vegetables drying is one of the oldest methods used for this purposes. However, plant respond differently when subjected to different drying temperature as we shall see in the results we have obtained.

In other to fully understand the drying behavior of plants, the drying kinetics which comprises of the percentage moisture content and drying rate was considered. Apparently, the result of drying behavior of sour sop leaf (fig1) shows that there was an increase in the moisture content of the plant on a daily basis this increase was more visible for those dried at room temperature than those dried in the sun. This changes can be attributed to the fact that evaporation rate was slower in those sample dried at room temperature on the other hand, it was faster in those dried in the sun. Conversely, result obtained from fig.3. Shows that there was a marked increase in the moisture content of bitter leaf irrespective of the drying condition. The implication of this is that it will take a longer time for bitter leaf to dry as compared to sour sop leaf due to high level of water present in the leaf. This finding is in line with what Donald (2014) which stated that "it will take a longer time to dry a vegetable with higher moisture content then it will for other vegetable with slightly lower moisture content. However, this study did not cover the proximate analysis which would have given us a more in-depth knowledge on the moisture content in both bitter leaf and sour sop exposed to various drying temperature.

Conversely, the present of constant rate period can also be tracked by the drying rate curve for all vegetables dried at different temperature. The duration of constant rate was observed at day 3-5 however, higher drying rate was observed from day 1and 2 respectively. This could be due to the excessive moisture on the surface of the vegetables. Similar result was gotten from Mahesh *et al.*, (2017) for some selected vegetables of Punjab, India which shows that there was a sharp decrease in drying rate in the first six hours were water was removed. Both plant reached a stable drying rate on the third day down to the last day.

Furthermore, the rehydration properties was equally considered the term 'rehydration' means the act of moistening a dried product and is an indicator of the quality in most dried foods. It is also an indicator of cellular and structural disintegration that take place during dehydration (Rastogi *et al.*, 2000). The internal structure of the dried pieces and the degree to which the water-holding components work together determine how well food products reconstitute. (e.g proteins) has been damage during drying (Krokida and Philippopulos, 2005). The result in figure 5 shows that bitter leaf dried at room temperature has the lowest rehydration ratio and the highest rehydration capacity as compared to the sundry and sour sop leafs. This shift might be the result of altered osmotic characteristics and decreased water diffusion over the surface during rehydration (Kaymak-Ertekin, 2002). The higher rehydration ratio observed in sundried sample of bitter leaf and sour sop dried at room temperature and equally in the sun indicate that better dried product and this was observed in the bitter leaf dried in the sun and sour sop dried at room temperature and in the sun as well. This phenomenal change may be due to minimum changes in the structural protein and consequently minimum change in protein functionality (Jayathunge and Illeperuma, 2001).

Finally, the rehydration capacity of the vegetables was higher in bitter leaf dried at room temperature compared to the sundried sample, and that of sour sop (both sundried and those dried at room temperature). Ahmed *et al.* (2011) stated that the rehydration capacity of the dried samples is important to consumers and food technologist. These properties are more important, especially if these vegetables are used for example in instant soup (Jokici *et al.,* 2009).

Conclusion

Form this present study, it can be concluded that temperature can influence the drying characteristic of plant samples and this plays a vital role in the nutritional properties and also affect the shear life of these plants.

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