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Refractometric Analysis of Some Local Onion Cultivars (*Allium cepa* L.) Bulbs for Dehydration

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Abstract: Onion is one of the oldest cultivated bulb producing plant species and second most valuable vegetable after tomatoes in the world but is subject to great production loss due to its poor storability. Refractometric analysis was carried on some randomly selected production stock of onion bulbs in Bade district of Yobe state, Nigeria. This is because, soluble solid constitute most of the content of the onion bulb and dehydrator onion cultivars are developed from lines with high dry matter contents. Although dehydration is considered as one of the oldest and important method of onion processing for storage, it is yet to be utilised in this part of the world. The results of the study showed that different cultivars have different amount of soluble solid determined by their refractive index values which varies considerably and that smaller and medium size bulbs have more dry matter content than larger bulbs. The local white and red onion bulb cultivars have the potentials for dehydration compare to the other cultivars within the location of the study area.

Key words: Dehydration · Cultivar · Refractive Index · Onion · Correlation

INTRODUCTION

Onion (*Allium cepa* L.) is an economically most important bulb vegetable crop in Nigeria cultivated mostly for its distinctive flavour and the many medicinal purposes which it serves. It is a member of the family *Alliacea*. The world production of onion is 64.48 million tons from 3.45 million ha area with at least 175 countries involved [1].

Onion is one of the world most popular and significant vegetable grown for its pungent bulbs. The bulb of typical onion composed of concentric, fleshy, enlarged leaf bases. The outer leaves loss moisture and becomes scaly while the inner leaves generally thickened as the bulb develops. The green leaves above the bulb are hollow and arise subsequently from the meristem at the innermost point of the base of the bulb with the stem being very small and insignificant during vegetative growth [2].

The production of onion for dehydration requires cultivar with high soluble solid or dry matter content. Soluble solid/dry matter content is a very important trait related to onion flavour and storability and is often considered significant in determining onion cultivars for breeding of dehydrator varieties. Previous studies on sugar contents of onions [3] showed that, there is high positive correlation between sugar contents and dry matter found in onion bulbs and that such cultivars can be dried and packed as powder for use as spices or exported, because, if in powdered form deterioration is limited, considering the high rate of spoilage of onions during storage. Study of an alternative approach to dry matter content of dehydrated food products such as oven drying method was carried out by [4]. This can only be effective if the onion used are varieties with high soluble solid contents, thus the need to develop such cultivars through effective breeding of selected varieties.

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Although dehydration is considered as one of the oldest and vital method of onion processing, it is yet to be utilised in this part of the world, consequence of which leads to mass loss of produce during storage and great economic loss to the local producers and marketers. The advantages of dehydrated onion include reduction in cost of transportation due to reduced size of dehydrated onion products (Flakes and powder) and avoidance of mass loss of onion bulbs during storage due to its high perishability. In addition, dehydrated onions are more uniform in flavour than fresh once. When kept in cool, dry and moisture proof containers, it can be stored for long period of time.

The determination of dry matter content of onion cultivars is very important in tropical countries where they are mostly grown and loss due to storage is very significant as a result of high temperature and poor storage means. In consideration of these advantages, the idea of this work was conceived, with the aim of using refractometric analyses to test the evaluation of different local Onion cultivars for dehydration potentials so that breeding of such cultivars can be accepted.

MATERIALS AND METHODS

Plant Material: The plant materials for the study were Local Red, Geidam Brown, Ex-Borno and Local White onion (*Allium cepa* L.) bulbs obtained from the production stock of local farmers within Bade district of Yobe state, Nigeria.

Experimental: One hundred and twenty bulbs of each of the four different cultivars making a total of four hundred and eighty were used for the experiment. They were analysed for soluble solids in triplicate using refractometer (Bellingham and Stanley, refractometer, London) [4]. To do this, each bulb was peeled off and the fresh inner layer removed and squeezed with a hand presser to obtain the juice. Two drops of the juice was dropped on the sensor of the refractometer. The instrument was then directed toward a convenient light source to shine into the small glass window (c.a 1cm^2) located at the rear of the top plate, then observe through the eye piece, by looking through the top scope. Adjust the bottom dial until the dark/light interface is seen. The position at which the demarcation line passes the scale gives the reading. The instrument requires no further adjustment. It gives reading of percentage sucrose in terms of refractive index. The prism sensor is cleaned off using fine cotton wool immersed in distilled water after each reading. Readings were obtained in triplicate using randomised complete block design. Bulb weights were measured at the beginning of the experiment using acculab electronic balance and mettle PC 2200, Delta range.

Data Analysis: The data obtained from this study were analysed using the SPSS statistical software package. Basic statistics for all parameters (means, standard deviation, minimum and maximum values) and analysis of variance (ANOVA) and mean performance of the different cultivars were computed. The Duncan multiple range test was used to determine the level of significance which was declared at 0.05.

RESULTS AND DISCUSSION

Dehydrator Parameters: Previous workers [4], used different methods to measure solidity and dry matter contents of onion bulbs and concluded that, the refraction value of the pressed juice gives reliable information on the dry matter of the bulbs. Determination of the quality of fruits and vegetables is important for both producers and consumers and can be achieved through modern techniques which involves the use of non-destructive analytical methods such as Vis/NIR [5], spectrometers and refractometers to determine the percentage soluble solids or dry matter contents of onion bulb which is known to be highly correlated to the refractive index of the pressed juice [6].

The two most important dehydrator parameters measured in this research among other parameters are the refractive index, which gives an idea of the estimated amount of soluble solids content and the weight of the bulbs. The local white cultivar is a better cultivar compared to the others analysed, because of its high soluble solids/dry matter content indicated by the higher mean refractive index value of 1.3751, having a range of 1.3572 to1.3801 as presented in table1. This is followed by the local red cultivar with a mean value of 1.3705. Although these cultivars were found to be small in size with mean weight of 150.69 and 165.11 for the local white and red respectively. The Ex-Borno and Geidam brown cultivar recorded mean refractive index values of 1.3471 and 1.3470 with weight of 350.12 and 335.0 respectively. This showed that higher weight is associated with low refractive index and thus low soluble solid/dry matter contents and vice versa. It can therefore be suggested at this point that, using effective breeding selection program, these adoptable cultivars can complement

Table 1: Mean, standard deviation and range of dehydrator parameters for four local onion cultivars

Cultivar	SoV	Mean	S.D	Max	Min
Local Red	R I	1.3705	0.5321647	1.377	1.355
	Weight (g)	165.11	65.32	232.2	63.21
G. Brown	RI	1.3470	0.0012435	1.345	1.341
	Weight (g)	335.0	45.693218	487.3	135.6
Ex-Borno	RI	1.3471	0.0005123	1.347	1.341
	Weight	350.12	56.231002	498.2	120.1
Local White	RI	1.3751	0.7879156	1.3801	1.3572
	Weight (g)	150.69	80.13	186.2	50.60

SoV=Source of variation, RI=Refractive index, S.D=Standard deviation, G. Brown= Geidam Brown

Table 2: Combine analysis of variance showing mean squares for the four different cultivars

SoV	D.F	RI	Sucrose	Weight (g)
Treatment	3	0.00126088^{**}	769.91825^{**}	10186636.6^{ns}
Replication	3	0.00001936^{ns}	19.130703^{ns}	5669881.52^{ns}
Error	238	0.00001070	6.9524496	5337290.46

D.F=Degree of freedom, ** highly significant at p=0.01, ^{ns}= non-significant. g= grams

Table 3: Mean performance for the four different cultivars

Treatment	RI	Weight (g)	S.D
Local Red	1.3700^{a}	167.0^{a}	0.6004321^{a}
G. Brown	1.3475_{b}	340.0^{b}	0.0009651^{b}
Ex-Borno	1.3473^{c}	351.9^{b}	0.0006551^{b}
White	1.3705^{d}	159.9^{a}	0.7561120^{a}

Mean with the same superscript are not significantly different.

each other's weakness in terms of size/weight and soluble solid content (Determined by refractive index in this case), being two among the most important parameters in determining onion for dehydration.

Analysis of Variance: The combined analysis of variance with the mean squares of the cultivars studied is presented in table 2 below. The treatment mean squares for refractive index and sucrose content were observed to be highly significant and positive. This is in close agreement with previous workers [3, 7] as stated earlier, that reported highly significant correlation between percentage dry matter or soluble solids and refractive index of pressed juice of onions. However, non-significant effect was observed for weight treatment mean square. The relationship between weight/size and refractive index need to be investigated in these local onion cultivars and varieties.

Mean Performance: The mean performance is presented in table 3 for all different cultivars. It was observed that the refractive index were all significantly different from each other, suggesting that any small change in the value of the refractive index will affect the soluble solid/dry matter content of the bulbs. Although the difference in values was seen to be very small, the change in content will be large. The performance in weight did not follow similar trend. The Local White and Red were found to be statistically similar and same applicable to the Ex-Borno and G-Brown. It also get to show here that cultivars with high bulb weight have lesser RI values which are significantly different and the reverse applied to the smaller size bulbs.

CONCLUSION

The result showed that different onion bulb types have different refractive index values and amount of soluble solid/dry matter contents with weight which varies considerably. The local white cultivar and the red proved to be more promising in terms of their suitability for dehydration considering their higher refractive index values compared to the Ex-Borno and G-Brown. These cultivars showed tendency for improvement if selection for the desirable traits will be carried out considering their adaptability to the environment and choice to the local populace.

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