Bulb Moisture, Ash and Dry Matter Contents of Onion Provenances in Northern Bauchi, Nigeria

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ABSTRACT----- ***Onion (Allium cepaL.) bulb composition varies widely, both within and between varieties. One hundred and twenty physiologically matured bulbs of six provenances were randomly selected and evaluated for moisture, ash and dry matter contents by standard laboratory measurements. Mean separation was carried out using Duncan multiple range test (DMRT).Statistical analysis of data showed significantly high moisture in Fara and Hauke. The trend was further observed inHauke and Kano red as well as Kano red and Gindintasa. Significantly low moisture was recorded in Maikanmakwarwa and Doguwa onions. Ash was significantly high in Hauke, followed by Kano red, Gindintasa and Fara as well as Doguwa and Maikanmakwarwa. High and significant dry matter was obtained in Doguwa and Maikanmakwarwa respectively. Gindintasa and Kano red gave dry matter at par. The least dry matter content was recorded in Hauke and Fara. Therefore Doguwa provenance is recommended for Northern-Bauchi, because its bulb composition has low moisture, low ash and high dry matter.***

Keywords--- Bulb moisture, ash, dry matter, onion provenances, northern Bauchi, Nigeria

1. INTRODUCTION

Onions are an important vegetable world-wide (Dantata and Damar, 2008), ranking second among all vegetables in economic importance with an estimated value of $6 billion dollars annually (FAO, 1992). While onions contribute significant nutritional value to the human diet and have medicinal properties(McCallum*et al.*, 2008),they are primarily consumed for their unique functional food, delivering prebiotic fructans, antioxidant flavonoids and organo-sulfur compounds with anticancer and cardiovascular health benefits (Griffiths *et al.*, 2002).Proper agronomic and handling techniques such as cultivation and establishment methods, plant population densities, fertilizers, time of fertilizer application and methods, soil moisture, weeds, pest and disease-control measures, harvest time, curing regimes and storage duration and typesenhance onion produce (Wien, 1997; Dantata, 2006; Kabir, 2007; Gómez and Oberpaur, 2007; Dantata *et al.*, 2009).

Sustainability of such cultural practices results in significant decrease in post-harvest losses in onions (AVRDC, 2000; Hussaini*et al.*, 2000;Duli Zhao *et al.*, 2001;Khan *et al.*, 2003;Muoneke*et al.*, 2003; Babatunde *et al.*, 2004; Katung *et al.*, 2005;Dantata *et al.*, 2006;Murashkina*et al.*, 2006;Dantata *et al.*, 2008a;Dantata *et al.*, 2009). Decrease in post-harvest losses will be instrumental in market stability and exploiting opportunities to export onion and earn foreign exchange (FAO, 1992; AVRDC, 1994; Odebode, 2006; Agbaraevoh and Nworie, 2005; Dantata and Machunga, 2007;Hayami *et al.*, 1990; Kintomo *et al.*, 1997; Ojeifo *et al.*, 2006).

Despite the global culinary and economic significance, research in onions in Nigeria falls behind that of other major vegetable crops. With respect to northern Bauchi related ecologies, only few works has so far been reported (Dantata, 2008 and 2011; Dantata and Damar, 2008; Dantata *et al.*, 2008b; Gambo *et al.*, 2008). Therefore the present experiment was carried out to determine the moisture, ash and dry matter contents of onion bulbs obtained from six provenances, cultivated under the prevailing agro-climatic conditions of northern Bauchi agricultural zone. This is essentially for comparison with international standards for exports and foods reported elsewhere in the literature (FAO, 1992;AVRDC, 1994;AVRDC, 2000;Griffiths *et al.*, 2002; McCallum *et al.*, 2008).

2. METHODOLOGY

The sampling area was Katagum zone. It was located at the Northern part of the Bauchi State. It lies between latitude $11^0 15^{"}$ N and longitude $9^0 55^{"}$ E and $10^0 45^{"}$ E, it has an area of about 14,241 km^2 (MOI/Bauchi, 1977). The area is made up of seven local government areas (LGAs) namely: Gamawa, Gyade, Itas – Gadau, Jama'a're, Katagum, Shira and Zaki with tropical type climate. The dry season lasts from November to April while the wet season spans between May to

October. The annual rainfall in the area ranges between 550mm in the extreme Northern part to 700mm in the Southern part. The minimum and maximum annual temperatures ranges between 26 -38^{0}C, while the soil type is sandy loam (Kowal and Knabe, 1972). The sampling covered 3 farming communities in each LGA with total number of 630 farmers, randomly sampled. Thus 90 farmers were considered from each LGA with 30 farmers per rural farming community (Dantata, 2011; Dantata and Damar, 2008).

2.1Laboratory Analysis of Moisture, Ash and Dry matter Contents of the Onions Sample selection

Physiologically matured onion bulbs of six most cultivated indigenous varieties; *Kano* red, *Maikanmakwarwa*, *Hauke*, *Fara*, *Gindintasa* and *Doguwa* were obtained from the farmers' field during the 2007 dry season harvest. Samples were transported to the Abubakar Tafawa Balewa University, Bauchi, Soil and Plant Laboratories within 48 hours. The onion bulbs were bulked variety wise and from each bulked; twenty (20) bulbs, with each four (4) representing a replicate were selected randomly (Dantata, 2006 and 2011) for laboratory analysis of moisture, ash and dry matter contents.

2.2Sample preparation

Samples for the laboratory analysis were prepared and analyzed as described by Ruck (1969), Dantata *et al.* (2006) and Dantata *et al.* (2008c) in vegetable tomatoes. A total of 120 bulbs were used. The bulbs were sliced using table knife. The blade of the knife was rinsed with distilled water at each slicing between samples. The sliced bulbs were then dried in an electric oven (Gallenkamp) at 80^{0}C for 24 hours.

2.3 Moisture content

Moisture content of the bulbs was determined using the formula (Dantata and Oseni (2009) :

$$\text{Moisture (\%)} = \frac{\text{Weight loss (g) on drying}}{\text{Initial sample weight (g)}} \text{x } 100 \quad \ldots\ldots (1)$$

2.4Ash content

Ash content was determined by igniting dried samples at 525^{0}C to a white ash in muffle furnace and the percentage ash in the samples was determined (Dantata *et al.*, 2006).

The percent ash was converted into gram per kilogram as follows (Dantata and Oseni, 2009):

% Ash x 10……..(2)

2.5Dry matter content

The dry matter content was determined using the loss weight and the fresh sample weighed to the nearest grams using the formula (Ruck, 1969; Dantata *et al.*, 2008c):

$$\text{Dry matter content} = \frac{\text{Dry weight (g) of sample}}{\text{Total weight (g) of sample}} \quad \ldots\ldots..(3)$$

Data collected were statistically analyzed using SPSS computer software version 17 and where the 'F' test showed significance the means were compared using the Duncan Multiple Range Test (DMRT) procedure at 5% level of probability (Duncan, 1955).

3. RESULTS AND DISCUSSION

3.1Moisture content

The result of the investigation revealed that, *Fara* provenance had high percentage moisture content at par with *Hauke*. However, moisture content in *Hauke* and *Kano* red provenances was statistically the same. This trend was further observed in *Kano* red and *Gindintasa* respectively. Significantly low moisture content was recorded in *Maikanmakwarwa*, followed closely by *Doguwa* onion bulbs (Table 1).High moisture content in *Fara* was associated with its white bulb colour, spindle bulb shape, moderately-heavy bulb weight and mild or low bulb pungency index (Dantata, 2011). These onion-bulb characteristics are pronounced with moisture accumulation (Platenius and Knott, 1941;Mamodou and Djiby, 1994; Thompson *et al.*, 2004).

Previous studies on bulb onions (Smittle, 1998; Lancaster and Shaw, 1991;Debaene *et al.*,1999;Galmarini*et al.*,2001)demonstrated that bulb moisture contents of onions, amongst several other bulb properties, was influenced by agronomic practices, however the response varies among cultivars (Kopsell and Randle, 1997; Galmarini *et al.*, 2001). Approximated-bulb moisture content of cultivars in this work ranged between 81 – 90% (Table 1), much higher than a range of81 – 86% reported by Abd-El Rahman and Ebeaid (2009) and Nabi *et al.* (2010). This could be critical for post-harvest handling, especially in the area of curing and storage. For instance, excessive bulb scaling during storage caused in part by intensive curing regime was necessitated by high moisture content of bulbs (Dantata, 2006).Post-harvest bulb decay and development of *Aspergillus spp* beneath the outer bulb scales of onions (Dantata, 2011;Yang and Lee,2000) were contributed by high bulb moisture content. Moisture level required for acceptability and export preference was approximated to 60.5 ± 0.5% on wet basis according to quality standard for fresh onions (Ministry of Economics and Foreign Trade,1992). In this case, bulbs have a complete drying of neck and several layers of skin (Abd-El Rahman and Ebeaid, 2009).Moisture accumulation in onions may be lowered by implementing important cultural practices such as decreasing water supply, increasing photoperiods, withdrawing fertilizer supply a few days prior to harvest and curing for a few days (2-3 weeks) depending upon the circumstances of bulbs and the weather conditions (Bahnasawy, 2000; Abd El-Rahman, 2004; Grahame,2005;Marita,2006;Lisa and Kader, 2004; Abd-El Rahmanand Ebeaid, 2009).

3.2Ash content

Result of this study in Table 2 showed that *Hauke* had significant and high ash content. Whereas *Kano* red, *Gindintasa* and *Fara*as well as *Doguwa* and *Maikanmakwarwa* onion bulbs have ash contents statistically the same (P= 0.05).Ash accumulation in this study was not in lined with the one reported by Babatunde *et al.* (2010) in irrigated garlic, which showed that high ash content result in reduction of important bulb contents such as moisture. Onions with seemingly high ash contents (*Hauke, Kano* red, *Fara* and *Gindintasa*) relatively have high moisture contents and *vice vasa* with low ash onions (*Doguwa* and *Maikanmakwarwa*) (Tables 1 and 2).

This observation can be attributed to the different growing conditions under which the onion varieties were subjected (Bahnasawy, 2000; Abd El-Rahman, 2004; Dantata 2006 and 2011; Grahame, 2005; Marita, 2006;Kopsell and Randle, 1997;Lisa and Kader, 2004; Abd-El Rahman and Ebeaid, 2009;Galmarini*et al.*, 2001;Dantata *et al.*, 2009; Babatunde *et al.*, 2010;Nabi*et al.*, 2010).For instance, cultural practices even when followed rigidly in producing onions from year to year, cultivar, mineral nutrition and environment play major roles in composition of *Alliums*(Vavrina and Smittle, 1993; Babatunde *et al.*, 2008).

3.3Dry matter content

Significantly high dry matter content was recorded in *Doguwa*, followed by *Maikanmakwarwa* onion variety. This parameter was at par in *Gindintasa* and *Kano* red onions. The result further revealed significant and low dry matter content in *Hauke* and *Fara* (Table 3). The trend in dry matter accumulation in this work revealed onions of relatively low moisture (*Doguwa*,and *Maikanmakwarwa*) having high dry matter contents and onions of high moisture contents (Table 2) in order of *Gindintasa*>*Hauke*>*Fara* giving low dry matter. This corroborates the earlier report of Babatunde *et al.* (2010).Reasons for the occurrences however, have been demonstrated by several investigators (Randle, 1992;Bahnasawy, 2000; Abd El-Rahman, 2004; Dantata 2006 and 2011; Grahame, 2005; Marita, 2006;Vavrina and Smittle, 1993; Kopsell and Randle, 1997;Lisa and Kader, 2004; Abd-El Rahman and Ebeaid, 2009; Galmarini *et al.*, 2001;Dantata *et al.*, 2009; Nabi *et al.*, 2010).

The minimumof11.6 g kg^{-1}dry matter concentrations was below the standard of 14.5 g $kg^{-1}$and maximum of 21.6 g kg^{-1}realized in the present study was above the maximum of 18.9g kg^{-1} reported by Mojsevich (2008), Masalkar *et al.* (2005), Hassanpouraghdam *et al.* (2008) and Nabi *et al.* (2010).Disparity in dry matter content, in the current and preceding works could be explained by reports of the numerous investigators stated above.

4. CONCLUSION AND RECOMMENDATION

Results of this study revealed that, bulb moisture content was significantly high in *Fara* and statistically the same with *Hauke*. So also between *Hauke* and *Kano* red as well as between *Kano* red and *Gindintasa* provenances. Significant and low moisture content was obtained in *Maikanmakwarwa* and *Doguwa* onions. *Hauke* had significantly high ash content, followed by *Kano* red, *Gindintasa* and *Fara* as well as *Doguwa* and *Maikanmakwarwa*. Significant and high dry matter content was recorded in *Doguwa* and *Maikanmakwarwa* onions. *Gindintasa* and *Kano* red gave similar dry matter. The result further revealed that significant and low dry matter content was recorded in *Hauke* and *Fara.* Therefore *Doguwa* provenance is recommended for northern-Bauchi. This is for its bulb composition of low moisture, low ash and high dry matter.

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Table 1: Distribution of onion bulbs moisture contents based on indigenous varieties in arid lands of Bauchi State, Nigeria in 2007 dry season.

Onion provenances	Moisture content (%)
Kano red	87.01bc
MaikanMakwarwa	82.62d
Hauke	88.40ab
Fara	89.63a
GindinTasa	86.15c
Doguwa	80.95e
LS	*
SE±	0.42

Mean with the same letter (s) are similar at 5 % level of probability using DMRT.
LS. Level of significance
* Significant at 5% level of probability

Table 2: Distribution of onion ash concentration (g kg^{-1}) based on provenances in arid lands of Bauchi State, Nigeria in 2007 dry season.

Onion provenances	Ash concentration(g kg^{-1})
Kano red	3.05b
MaikanMakwarwa	2.16c
Hauke	3.98a
Fara	2.74b
GindinTasa	2.87b
Doguwa	2.38c
LS	*
SE±	0.09

Mean with the same letter (s) are similar at 5 % level of probability using DMRT.
LS. Level of significance
* Significant at 5% level of probability

Table 3: Distribution of onion bulbs dry matter concentration based on provenances in arid lands of Bauchi State, Nigeria in 2007 dry season.

Onion provenances	Dry matter concentration(g kg^{-1})
Kano red	14.37c
MaikanMakwarwa	18.67b
Hauke	13.12d
Fara	11.59e
GindinTasa	15.18c
Doguwa	21.55a
LS	*
SE±	0.31

Mean with the same letter (s) are similar at 5 % level of probability using DMRT.
LS. Level of significance
* Significant at 5% level of probability