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Quality of 'Gari' as Affected by Age at Harvest, Cropping System and Variety of Cassava Roots

Idowu, M.A.[a], Adeola, A.A.[b*], Oyatogun, R.M.[a], Adebowale, A.A.[a], Adeola, O.O.[c]

[a] Department of Food Science and Technology, Federal University of Agriculture, Abeokuta
[b] Food and Nutrition Research Programme, Institute of Food Security, Environmental Resources and Agricultural Research, Federal University of Agriculture, Abeokuta, Nigeria
[c] Department of Chemistry, University of Ibadan, Nigeria

Abstract

Cassava is a foremost crop of food security in Nigeria since it is a source of many indigenous food products that are commonly eaten by the populace. Many resource-restricted farmers engage in its production, adopting diverse agronomic practices that could affect the quality of products derivable from cassava. 'Gari' is the most commonly traded and consumed cassava product. This study investigated the effect of age at harvest (AH), cropping system (CS) and variety on the quality attributes of 'gari'. Five cassava varieties (white- and yellow- fleshed) planted under two different CS (sole and intercropped) and harvested at different AH (12, 15, and 18 mo after planting) were converted into 'gari'. 'Eba', a popular traditional food derived from 'gari' was prepared. Quality of 'gari' such as proximate and mineral composition, total carotenoids, pH, total titratable acidity, bulk density, water absorption index, dispersibility, swelling power, solubility index, and pasting properties, as well as the sensory properties of both 'gari' and 'eba' were determined. Data obtained were analysed using a generalised linear model. The chemical composition, functional and sensory properties of 'gari' were significantly ($P < 0.05$) affected by AH, CP and variety. The moisture, ash, crude fibre, protein, fat and carbohydrate contents of 'gari' ranged from 3.70 to 11.60%, 0.50 to 2.03%, 1.44 to 2.40%, 0.23 to 1.87%, 0.20 to 1.32%, and 83.12 to 90.65%, respectively. The water absorption index, bulk density, dispersibility, swelling power and solubility index of 'gari' varied from 270.80 to 527.60%, 0.41 to 0.77 g/ml, 1.50 to 45.50, 6.36 to 11.01, and 3.5 to 25.0%, respectively. The moisture and carbohydrate contents and dispersibility of 'gari' decreased with increase in AH. The bulk density was highest at 15 mo AH. Preference for the colour and aroma of 'gari' increased with increase in AH. The overall acceptability of 'eba' increased with increase in AH. It is therefore desirable to harvest cassava for 'gari' and 'eba' preparation at 18 mo.

Keywords: Cassava: 'Gari': Cropping system: Variety: Chemical composition: Functional properties

***Corresponding author:** adeolaroni@yahoo.com

Introduction

Cassava (*Manihot esculenta*) has become a household name in Nigeria, for some obvious reasons. First, Nigeria is the largest global producer of cassava. Second, cassava roots are adaptable to wide ranges of climatic and soil conditions (Kuyper, 2017). Cassava is a viable option in the production of many common household and industrial products (Lasekan et al., 2015). 'Gari' is a fermented, creamy-white (or yellow, if from yellow-fleshed roots or fortified with red palm oil), partly gelatinized, roasted, and free flowing granular flour obtained from cassava (Sanni et al., 2009). It is the most traded cassava product in West Africa, with demand rate that competes well with such cereals as maize, rice, sorghum, etc. This may be due to the fact its consumption requires little or no cooking (unlike the cereals), it is convenient and possesses good storability. Researchers have reported on different aspects of 'gari' such as its aromatic compounds, shelf life, production methods and enrichment (Bamidele et al., 2014; Lasekan et al., 2015; Bechoff et al., 2019; Ndam et al.,2019). Agronomic practices such as variety, age at maturity, fertiliser type and dosage have been reported to have effect on the quality attributes of cassava flour (Rasaq et al., 2020). Hence, this study investigated the effect of age at harvest, cropping system and variety on the quality of 'gari'.

Methodology

The five cassava varieties (TMS 30572, TMS 97JW2, TMS 98505, TMS 01/1371 and TMS 01/1368) used for this study were planted as sole crop or inter-cropped with maize, and were harvested at 12, 15 and 18 months (mo) after planting. 'Gari' was prepared by washing and grating the cassava roots, pressing and fermenting the mash, pulverising, roasting (Fig. 1) and sieving the 'gari' (Fig. 2). 'Eba' was prepared by stirring the 'gari' in boiling water to a desired consistency.

The proximate and mineral composition, functional and physicochemical properties of 'gari', as well as the sensory properties of 'eba' were determined using standard methods.

Fig. 1: Roasting of 'gari' in a 'garifier'

Fig.2: 'Gari' (TMS 97JW2)

Results and Discussions

Proximate Composition of 'Gari'

AH had the most significant effect ($P<0.05$) on 'gari' while CS was only significant on its fat content. Variety had no significant effect on the proximate composition ($P>0.05$). The interactive effects of AH*CS, AH*Variety, Variety*CS, and AH*CS*Variety significantly affected the proximate composition of 'gari'. The moisture content of 'gari' reduced between 12 and 15 mo AH and then slightly increased at 18 mo AH. The ash content increased between 12 and 15 mo AH and slight decreased at 18 mo AH. Most of the samples were within the regulatory standard for 'gari' (Sanni *et al*., 2005).

Mineral composition of 'Gari'

The mineral composition of 'gari' were significantly ($P<0.05$) affected by AH, variety, CS and their interactions. 'Gari' from TMS 98505 (sole-cropped; 12 mo AH) had the highest manganese content while the one from TMS 30572 (inter-cropped; 18 mo AH) was lowest. Magnesium was highest in 'gari' from TMS 98505 (sole-cropped; 12 mo AH) and lowest in 'gari' from TMS 30572 (sole-cropped; 18 mo AH). Iron was highest in 'gari' obtained from both TMS 01/1371 (inter-cropped; 15 mo AH) and TMS 30572 (inter-cropped; 12 mo AH) and lowest in 'gari' from TMS 01/1371 (inter-cropped; 18 mo AH). Potassium was highest in 'gari' from TMS 01/1371 (inter-cropped; 18 mo AH) and lowest in 'gari' from TMS 98505 (sole-cropped; 18 mo AH).'Gari' obtained from TMS 98505 (inter-cropped; 18 months age at harvest) had the highest sodium content while the one from TMS 30572 (inter-cropped; 15 mo AH) had the lowest.

Functional Properties of 'Gari'

AH and variety, as well as the interactive effect of variety*CS, had significant effect ($P<0.05$) on the water absorption index (WAI), bulk density (BD), dispersibility, swelling power (SP) and solubility index (SI) of 'gari'. The WAI increased between 12 and 15 mo AH, with a slight decrease at 18 mo AH. The highest WAI was recorded in 'gari' prepared from TMS 01/1371 (sole-cropped; 15 mo AH) and lowest in 'gari' from TMS 97JW2 (sole-cropped; 12 mo AH). The BD and dispersibility were highest at 15 mo AH. High BD increases dispersion in water. The highest BD was observed in 'gari' prepared from TMS 98505 (for both sole- and inter-cropped; 15 mo AH), while 'gari' from TMS 01/1371 (sole-cropped; 18 mo AH). Dispersibility was highest in 'gari' prepared from TMS 98505 (inter-cropped; 15 mo AH) and lowest in 'gari' from TMS 01/1368 (inter-cropped; 12 mo AH). The SP and SI of 'gari' reduced with increase in AH. The SP was highest in 'gari' from TMS 01/1368 (inter-cropped; 12 mo AH) and lowest in 'gari' from TMS 01/1371 (sole-cropped; 18 mo AH). The highest SI of 'gari' was obtained with TMS 97JW2 (inter-cropped; 18 mo AH) and lowest with TMS 30572 (both inter- and sole-cropped; 18 mo AH).

Physicochemical Properties of 'Gari'

The pH, total titratable acidity (TTA), and colour of 'gari were significantly affected ($P<0.05$) by AH, variety and CS, as well as their interactive effects. The pH of 'gari' reduced with increase in AH. Thr pH values of 'gari' were within the recommended range of 3.5 – 4.5 for acid fermented products (Bainbridge et al., 1996). The TTA values were within Nigerian Industrial Standard (NIS, 2004). The highest pH was observed in 'gari' obtained from both TMS 30572 (inter-cropped; 12 mo AH) and TMS 98505 (sole-cropped; 15 mo AH) while 'gari' prepared from TMS 01/1368 (inter-cropped; 18 mo AH) had the lowest. 'Gari' prepared from TMS 98505 (inter-cropped; 18 mo AH) had the highest TTA while 'gari' from TMS 98505 (sole-cropped; 18 mo AH) had the lowest. The highest L* value was obtained in 'gari' from TMS 98505 (sole-cropped; 15 mo AH) while 'gari' from TMS 01/1371 (inter-cropped; 12 mo AH) had the lowest. The L* value increased between 12 and 15 mo AH but slightly reduced at 18 mo AH. Also, a* value was

highest in ‘gari’ prepared from TMS 01/1368 (sole-cropped; 15 mo AH) and lowest in ‘gari’ from TMS 01/1371 (sole-cropped; 12 mo AH). ‘Gari’ from TMS 01/1371 (inter-cropped; 18 mo AH) had the highest value of b* while the lowest was found in ‘gari’ from TMS 97JW2 (inter-cropped; 15 mo AH).

Pasting Properties of ‘Gari’

AH significantly ($P<0.05$) affected the trough and breakdown viscosity, as well as the peak time of ‘gari’. The trough viscosity increased, while the breakdown viscosity reduced, as the AH increased. ‘Gari’ prepared from TMS 01/1371 (inter-cropped, 18 mo AH) had the highest trough viscosity while ‘gari from TMS 98505 (inter-cropped, 12 mo AH). The breakdown viscosity was highest in ‘gari’ obtained from TMS 98505 (inter-cropped, 12 mo AH) and lowest in ‘gari’ from TMS 01/1371 (sole- cropped, 12 mo AH). The highest peak time was observed in ‘gari’ obtained from both TMS 01/1371(inter-cropped, 12 mo AH) and TMS 01/1368 (sole-cropped, 15 mo AH). On the other hand, ‘gari’ prepared from TMS 97JW2 (inter-cropped, 15 mo AH) had the lowest peak time. Peak viscosity reflects the ability of starch to swell before their physical breakdown (Sanni et al., 2004).

Sensory Properties composition of ‘Gari’ and ‘Eba’

AH, variety and CS significantly ($P<0.05$) affected the sensory properties of ‘gari’ and ‘eba’. Additionally, the interactive effects of AH*variety, AH*CS, variety*CS, and AH*variety*CS were found to significantly ($P<0.05$) affect the sensory properties of ‘eba’. ‘Gari’ prepared from TMS 97JW2 (inter-cropped; 15 mo AH) was the highest overall acceptability while ‘eba’ from TMS 30572 (inter-cropped; 18 mo AH) was the most acceptable.

Conclusion and Outlook

This study revealed that age at harvest, variety and cropping system had differing effects on the quality of ‘gari’. Age at harvest is the most important factor in determining the proximate composition of ‘gari’. Age at harvest, variety and cropping system are key factors in determining the mineral composition (Mn, Fe, K and Na), pH, titratable acidity, and colour of ‘gari’, as well as the sensory attributes of ‘gari’ and ‘eba’. On the other hand, age at harvest and variety are vital factors affecting the water absorption, bulk density, dispersibility, swelling power and solubility index of ‘gari’. TMS 97JW2 intercropped and harvested at 15 mo produced the most acceptable ‘gari’ while TMS 30572 intercropped and harvested at 18 mo gave the most acceptable ‘eba’. This study did not consider the effect of other processing methods on the quality of ‘gari’ and ‘eba’. Also, due to the fact that customs and ethnicity influence the acceptability of ‘gari’, the conclusion of this research may not be applicable in other climes different from this study. Hence, a comparative evaluation of the sensory attributes of ‘gari’ and ‘eba’ in the six geopolitical zones of Nigeria should be conducted.

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