

Diastatic Power and Hot Water Extract Development During Malting of Two Nigerian Millet Varieties

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Abstract: Two millet varieties (*P. maiwa* and Sossat) of similar nitrogen contents were malted for 6 days under similar conditions to investigate the pattern of diastatic power and hot water extract development of their endosperm materials. Both parameters were found to increase as germination lasted up to the 5th day of germination, supporting high amylolytic activity of starch degradation of enzymes. A very strong correlation analysis value of 0.9444 was found between the two varieties over the same germination time. In like manner when correlation analysis for the development of hot water extract was performed for both samples over the same period, a strong correlation value of 0.9287 was obtained. Both varieties have demonstrated high potential of producing enzymes during malting making them very good candidates for producing high quality malts for beverage production.

Key words: Millets, diastatic power, hot water extract, correlation analysis, production, Nigeria

INTRODUCTION

Malting of barley is a recognized process associated with beer production. The malting potentials of different cereals have been studied from over the time (Malleshi and Desikachar, 1986). Malts from wheat, sorghum and maize have been studied with respect to their use in food formulations and also as brewing adjuncts (Novellie, 1977).

Diastatic Power (DP) is a measure of amylolytic activity of starch degrading enzymes. Hot water extract is another quality parameter that measures the soluble materials from malt when some hydrolytic enzymes have acted optimally (Agu, 1996; Agu and Palmer, 1996; Badau *et al.*, 2006). The potentials of major cereals such as barley, sorghum and wheat have dominated past and recent studies with little contribution from other cereals such as millet. Millet is grown in abundance in many northern states of Nigeria. Nigeria is the second largest producer of millet in the world after India (Anonymous, 2008). Therefore, the present study was undertaken to assess the diastatic power and hot water extract potential of this indigenous cereal found in large quantities in Nigerian soil.

MATERIALS AND METHODS

Procurement of materials: The two millets varieties (*P. maiwa* and Sossat) were obtained from Cereal Research Institute, Zaria and Lake Chad Research Institute, Maiduguri, Nigeria, respectively. The millet grains (1 kg batch) were surface sterilized in limewater, followed by washing with water and then steeped in water at 30°C for 16 h followed by a 2 h air rest and a further 16 h wet steep and germinated for 6 days at 30°C. The grains were sprayed with water occasionally and turned daily to avoid matting and to ensure uniform germination.

Processing of grains and steepings: After germination, the grains were dry kilned at 50°C for 24 h in hot air oven (Genlab, England, Model M 30 C, S/N 92B056). Dried malts were rubbed in between palms to remove the rootlets and shoots from the kernels. The kernels were thereafter milled.

Determination of diastatic power of millet malt: The malt Diastatic Power (DP) was determined using Fehling's solution as described by Institute of Brewing

recommended method of analysis (Anonymous, 2008) and diastatic power reported as Linter (°L). Fischer chemical starch was used to prepare the starch solution (2%) for this determination. A malt infusion extract of the malt was prepared. A 3 mL aliquot of the extract was pipetted into 100 mL of 2% buffered starch solution in 200 mL flask. The mixture was shaken and maintained at room temperature for 1 h from the time the aliquot was added. At the end, 15 mL of 0.1N OH was added to stop the reaction and total volume now raised to 200 mL with distilled water.

Into a 150 mL narrow-necked boiling flask, 5 mL of mixed Fehling Solutions A and B were also added. Titration was effected by adding from a burette containing the digested starch solution to the flask with 1 mL of the final end point. The contents of the flask were thoroughly mixed and boiled for 2 min and 3 drops of methylene blue indicator were added to complete the titration. The end point was attained when the methylene blue had been changed to reddish colour in appearance. The blank was earlier prepared by titrating the undiluted 2% starch solution against 1 mL of mixed Fehling's Solution A and 2 mL Fehling's Solution B using methylene blue indicator as described in this study. The diastatic power was calculated using this equation:

$$DP = \frac{2000 - 200}{Xy - xs}$$

Where:

- x = Number of mL of malt extract
- Y = Number of mL of converted starch to 5 mL of the Fehling's solution
- S = Titre for starch blank

Determination of Hot Water Extracts (HWE): The recommended method of analysis of the Institute of Brewing in 1969 was used in this determination. About 50 g of the ground sample was weighed into the mashing beaker and placed in a hot water bath for 15 min and 360 mL of equilibrated water (65°C) was added, stirred at 30 min interval for 1 h to eliminate all lumps. The mash was later cooled and transferred to a 515 mL measuring flask. The beaker was rinsed inside into the flask and made up to 515 mL and mixed by inversion. Thereafter, the mash was filtered off and the specific gravity was obtained. The extract yield was obtained from the relation:

$$\text{Extract (as is)} = \frac{\text{Excessgravity} \times 10.31^\circ}{\text{kg}}$$

$$\text{Extract (day/dry)} = \frac{\text{Extract (as is)} \times 100}{100 - m}$$

where, m is moisture content of grain.

RESULTS AND DISCUSSION

The diastatic powers of the two malts increased from 2nd day of germination up to the 5th day thus supporting amyolytic activity of starch degrading enzymes. Figure 1 shows the correlation for development of diastatic power of *P. maiwa* malt with germination time. The correlation for DP production ($R^2 = 0.8884$) obtained for *P. maiwa* over the same period for which correlation result ($R^2 = 0.9672$) was found (Fig. 2). However when correlation analysis was performed for the development between the two millet varieties over the same germination time, a very strong correlation ($R^2 = 0.9444$) was obtained (Fig. 3). This shows that both millet varieties have high potential of producing high diastatic power enzyme levels during malting making both millet varieties very good candidates for producing high quality millet for brewing purposes.

The increase in the development of diastatic power as germination progressed is in agreement with other findings in millet (Peleme *et al.*, 2002, 2004; Muoria *et al.*, 1998; Nzeribe and Nwasike, 1995). Subramanian *et al.* (1995) stated that the most important characteristics of good malt are high enzyme levels (measured by diastatic power to degrade starch and obtain high extract yield).

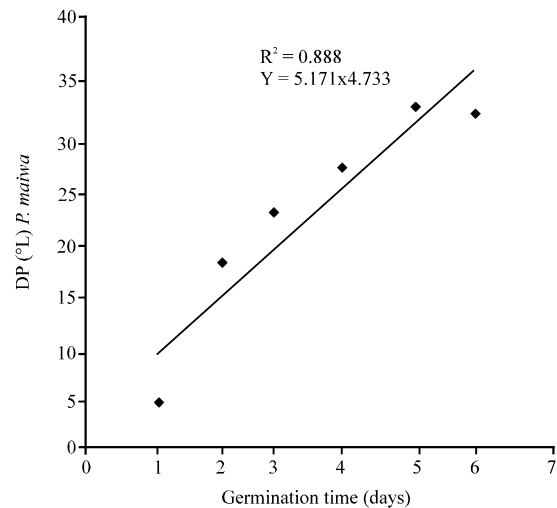


Fig. 1: Diastatic power development during malting for *P. maiwa* malt with germination time

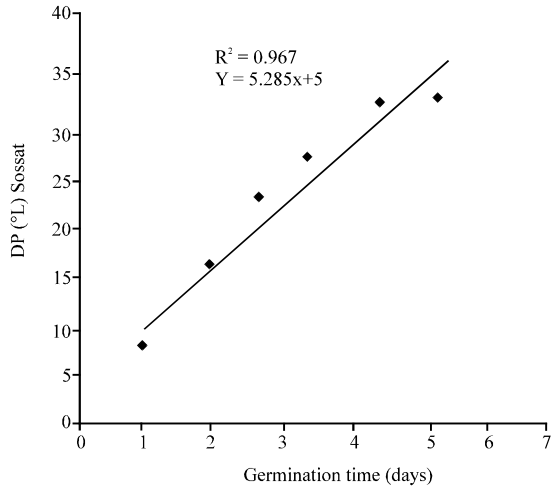


Fig. 2: Diastatic power development during malting for Sossat malt with germination time

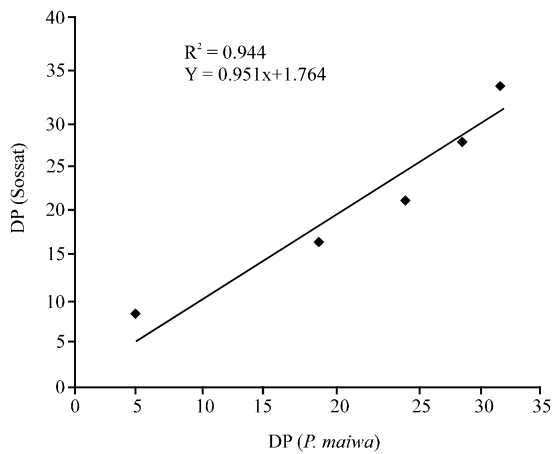


Fig. 3: Correlation between diastatic power developed in *P. maiwa* and Sossat during malting of millet

Muoria *et al.* (1998) working on diastatic power and Amylase of pearl millet, sorghum and barley suggested that sterilization of sorghum and millet for malt would require the addition of exogenous enzymes or other malt types.

The Hot Water Extract (HWE) is another important quality parameter. It measures the soluble materials from the malt when some hydrolytic enzymes have acted optimally. The hot water extract of millet is lower than hot water extract of barley due to lower diastatic power (Nzeribe and Nwasike, 1995).

Extending the statistical analysis to HWE, it is further confirmed in the correlation analysis results between diastatic power and hot water extract (Fig. 4). Here, the malt samples were mashed at the optimum mashing conditions

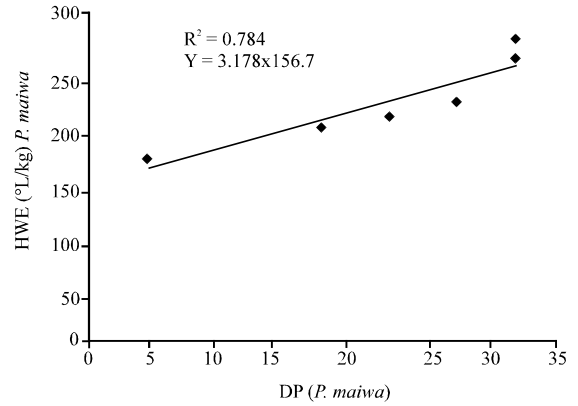


Fig. 4: Hot water extract produced during malting of millet (*P. maiwa*) malt with germination time

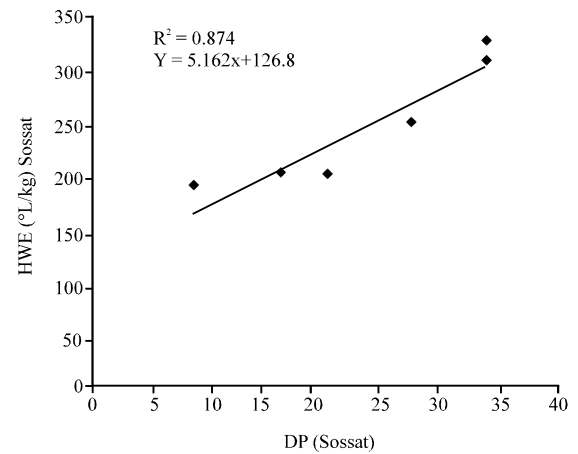


Fig. 5: Hot water extract produced during malting of millet (Sossat) malt with germination time

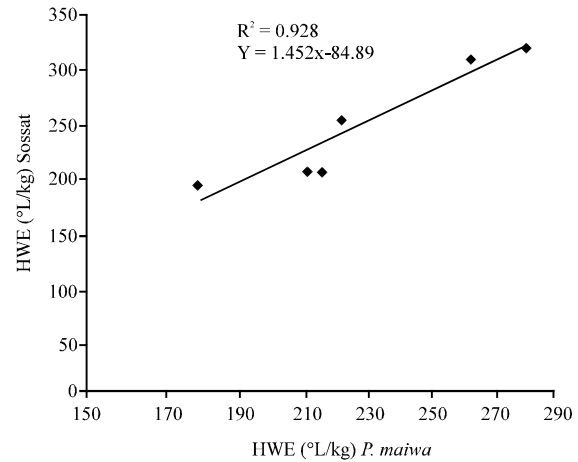


Fig. 6: Correlation between HWE produced in *P. maiwa* and Sossat malts after malting of millet

for obtaining HWE from tropical cereals such as sorghum (Agu and Palmer, 1996). Clearly, the correlation results shown in Fig. 5 revealed that Sossat is a better candidate in releasing higher HWE than *P. maiwa* because it gave much stronger correlation ($R^2 = 0.8746$) between DP and HWE (Fig. 6) than correlation result ($R^2 = 0.7849$) between DP and HWE found for *P. maiwa* (Fig. 5). This notwithstanding, it is important to note that although, *P. maiwa* had lower correlation result when correlation analyses were performed between HWE and DP compared with similar correlation result obtained for Sossat (Fig. 5). The correlation between HWE produced in *P. maiwa* and Sossat is shown in Fig. 6. The value $R^2 = 0.9283$ obtained is a strong relationship.

CONCLUSION

The millet varieties under study have potentials to produce good quality malts for brewing purposes. Nigeria is blessed with large quantities of the millet and can thus offer the malt-based industries the opportunities to explore its use in production. However, in malting, the grain size causes inconvenience to the maltsters but this can be solved by giving attention to the design of convectional malting equipment to accommodate the small sizes.

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