Full Length Research Paper

Comparison of the mashing and brewing potentials of crude extracts of *Abrus precatorius*, *Burnatia enneandra* and *Cadaba farinosa*


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The mashing and brewing potentials of crude extracts of three plants commonly used in Northern Cameroon to make starch gruels were assessed using sorghum cultivar *Safrari* as an adjunct. Alpha-amylase activities of the extracts fluctuated between 18 and 122 U/g, while the diastatic power and the β-carboxypeptidase activities ranged between 83 and 123 WK, and 16 and 63 mg FAN/min/µL, respectively. A longer mashing time (180 min) was necessary to obtain higher yields of extracts. Extract obtained was 18.7 °P for malted *Safrari*, 14.6 °P for malted barley, and 9.5, 13.5 and 11.4 °P after mashing *Safrari* adjuncts with extracts from *Abrus precatorius*, *Burnatia enneandra* and *Cadaba farinose*, respectively. Similar levels of reducing sugars ranging between 60 and 65 g/L were obtained when mashing was carried out using *A. precatorius*, *B. enneandra* and crude extracts, but about 50 g/L were obtained for *C. farinosa*. Free amino nitrogen fluctuated between 56 and 72 mg/L for *C. farinose* and *B. enneandra*, respectively, but was as low as 17 mg/L for *A. precatorius*. Fermentability was low for the worts obtained after mashing *Safrari* adjuncts using the extracts of the three plants, as compared to the worts of malted sorghum cultivar *Safrari* and barley.

**Key words:** *Abrus precatorius*, *Burnatia enneandra*, *Cadaba farinosa*, α-amylase, extract, free amino nitrogen (FAN).

INTRODUCTION

The use of technical enzymes has tremendously facilitated and improved food processing for the past decades (Hudson, 1986; Delrue, 1987; Law, 1990). Mashing with high amounts of adjuncts or with poorly modified barley malts using exogenous enzymes in the brewing industry improves yields in extracts (MacFadden and Clayton, 1989; Dale et al., 1990; Bajomo and Young, 1992; Agu and Palmer, 1998; Goode et al., 2002; Goode and Arendt, 2003; Goode et al., 2003; Desobgo et al., 2010). Malted sorghum is known to have low levels of important mashing enzymes such as α-amylase and β-amylase, but mash easily when supplemented with adequate commercial enzymes (Arri, 1990; EtokApan and Palmer, 1990; Dufour and Melotte, 1992; Nso et al., 2003; Nso et al., 2006). These enzymes and others are extracted from microorganisms and plants and commercialized as technical enzymes.

In Northern Cameroon, sorghum, maize and rice based starch gruels are traditionally made sweet using crude extracts of the plants *Abrus precatorius*, *Burnatia enneandra* and *Cadaba farinosa* (Glew et al., 2010). In this paper, we assessed the mashing and brewing...
potentials of crude extracts of these plants using unmalted Safrari sorghum as an adjunct.

MATERIALS AND METHODS

Biological materials

Sorghum cultivar Safrari was obtained from the Institute of Agronomic Research and Development (IRAD) in Maroua, Cameroon. Barley malt was obtained from "Société Anonyme des Brasseries du Cameroun" (SABC) in Garoua, Cameroun. B. enneandra and C. farinosa were obtained from Yagoua and A. precatorius from Ngaoundere, Cameroun.

Obtaining crude enzyme extracts

A. precatorius and C. farinose extracts

The leaves and tender stems of these plants were harvested, chopped using a knife and air dried at 40°C for five days using a CKA 2000 AUF-type dryer Ngaoundere, Cameroun. The chips were ground into coarse particle sizes using a Fryma machine AG mill type ML-150 (CH-4310 Rheinfelden, Switzerland) and next into fine particle sizes (Ø≤1 mm) using a laboratory hammer mill of model-Polymix PX-MFC 90D apparatus type (VWR International S.A.S. Le Périgas 201, rue carnot, 94126 Fontenay-sous-Bois Cedex, France). Fifty milliliters of 0.2 M phosphate buffer (disodium-potassium di hydrogen phosphate)/pH 6 were added to 10 g of the powder and agitated after every 10 min for 1 h. The mix was then filtered using a Whatman paper No. 42. The filtrate was retained as the enzyme extract for liquefaction and saccharification of sorghum grits during mashing.

B. enneandra extract

B. enneandra nuts were washed clean repeatedly with tap water. The fibrous coating was scrapped off with a knife and the kernels obtained by cracking of the nuts. The kernels were then chopped into small chips. They were dried at 40°C for five days and enzyme extract was obtained as described above for A. precatorius and C. farinosa.

Determination of the α-amylase activity of the extracts

Alpha-amylase activity of the extracts was determined using the 3,5-dinitrosalicylic acid (DNS) method of Fischer and Stein (1969).

Determination of the diastatic power of barley and Safrari malts, A. precatorius, C. farinosa and B. enneandra powders

Diastatic power was determined according to the method described by Analytica-EBC (2006).

Determination of carboxypeptidase activity

The carboxypeptidase activities of the plant extracts, barley and Safrari malts, were obtained by the method described by Okolo and Ezeogu (1995).

Mashing

Mashing unmalted Safrari grits using crude enzyme extracts

Two hundred milliliters of distilled water were put into a 600 mL beaker and 50 g of sorghum flour (Ø<1 mm) was added with continuous stirring until a homogenous mixture was obtained. This mixture was incubated at 45°C for 30 min in a water bath with intermittent stirring at intervals of 5 min. The temperature of the mash was then raised to boiling so as to gelatinize sorghum starch during 40 min with intermittent stirring at intervals of 5 min before cooling to 65°C. Fifty milliliters of crude enzyme extracts were added to the mash and allowed to incubate for 1 h 30 min with intermittent stirring at intervals of 10 min.

Mashing of Safrari malt grist

Mashing was carried out as described above but 250 mL of distilled water were used. A portion of the supernatant (50 mL) was removed after 30 min decantation of the mix at 45°C. Starches in the endosperms tissue of the sorghum grits was gelatinized as described above. Decanted enzymic supernatant fractions (50 mL) were added to appropriate gelatinized sorghum mashes after they were cooled to 65°C. Mashing time for this mash mixture was 1 h, 30 min. The mashes were stirred at intervals of 10 min.

Mashing of barley malt grits

Mashing was done as described for Safrari malt grits with omission of boiling mash. The mashes were filtered during 1 h using Whatman paper No 42.

Determination of reducing sugars

Reducing sugars were determined according to the DNS method of Bernfeld (1986).

Determination of free amino nitrogen

Free amino nitrogen (FAN) was determined as described by Analytica-EBC (2006).

Determination of attenuation limit

Apparent fermentability of wort was determined according to the method described by Analytica-EBC (2006).

RESULTS AND DISCUSSION

The enzymatic brewing potential (α-amylase, diastatic power and β-carboxypeptidase) of malted cereals for mashing is an important criterion for accepting such raw material for beer brewing (Briggs et al., 2004). This enzymatic brewing potential of crude extracts of the plants A. precatorius, B. enneandra and C. farinosa, as well as the malted sorghum cultivar Safrari and barley, as reference malt, are compared in Table 1. Alpha-amylase
Table 1. Alpha-amylase and β-carboxypeptidase activities, and diastatic power of crude extracts of *A. precatorius*, *B. enneandra* and *C. farinosa* and malts.

<table>
<thead>
<tr>
<th>Property</th>
<th>Extract type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>A. precatorius</em></td>
</tr>
<tr>
<td>α-Amylase activity(U/g)</td>
<td>34.04 ± 0.00</td>
</tr>
<tr>
<td>DP (WK)</td>
<td>83.43 ± 0.10</td>
</tr>
<tr>
<td>β-Carboxy-peptidase (mg FAN/min/µL)</td>
<td>67.62 ± 0.06</td>
</tr>
</tbody>
</table>

Table 2. Effect of duration of mashing unmalted *Safari* grits using the crude enzyme extracts of *A. precatorius*, *B. enneandra* and *C. farinosa* on the wort extracts.

<table>
<thead>
<tr>
<th>Sample type</th>
<th>Extract (<em>°P</em>)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mashing time (min)</td>
</tr>
<tr>
<td></td>
<td>90</td>
</tr>
<tr>
<td>Unmalted <em>Safari/A. precatorius</em></td>
<td>7.8 ± 0.11</td>
</tr>
<tr>
<td>Unmalted <em>Safari/B. enneandra</em></td>
<td>8.8 ± 0.13</td>
</tr>
<tr>
<td>Unmalted <em>Safari/C. farinosa</em></td>
<td>8.0 ± 0.30</td>
</tr>
<tr>
<td>Malted <em>Safari</em></td>
<td>16.6 ± 0.11</td>
</tr>
<tr>
<td>Malted Barley</td>
<td>13 ± 0.09</td>
</tr>
</tbody>
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Table 3. Reducing sugars, FAN and fermentability after mashing *Safari* and barley malts, and unmalted *Safari* using crude extracts of *A. precatorius*, *B. enneandra* and *C. farinosa*.

<table>
<thead>
<tr>
<th>Wort characteristics</th>
<th><em>Safari</em> malt</th>
<th>Barley malt</th>
<th>Unmalted <em>Safari/A. precatorius</em></th>
<th>Unmalted <em>Safari/B. enneandra</em></th>
<th>Unmalted <em>Safari/C. farinosa</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Reducing sugars (g/L)</td>
<td>34.29 ± 0.18</td>
<td>83.40 ± 0.09</td>
<td>64.31 ± 0.03</td>
<td>60.34 ± 0.15</td>
<td>49.56 ± 0.33</td>
</tr>
<tr>
<td>FAN (mg/L)</td>
<td>139.14 ± 0.01</td>
<td>173.27 ± 0.13</td>
<td>17.18 ± 0.02</td>
<td>71.60 ± 0.01</td>
<td>55.85 ± 0.03</td>
</tr>
<tr>
<td>Fermentability (%)</td>
<td>58.2</td>
<td>58.2</td>
<td>41.6</td>
<td>45.8</td>
<td>37.5</td>
</tr>
</tbody>
</table>

The importance of the plant extracts was highest for *B. enneandra*, followed by *A. precatorius* and then *C. farinosa*. The importance of this activity is in the ratio of 100:28:15%, respectively. This activity was however highest for barley malt extract, about two times that of malted *Safari* extract, and three times that of *B. enneandra* extract. Similarly, diastatic power of the extracts was in the ratio of 100:89:68% for *B. enneandra*, *C. farinosa* and *A. precatorius*, respectively. It was however highest for barley extract, about two times that of malted *Safari* extract and four times that of *B. enneandra*. The ratio for β-carboxypeptidase activity is, 100:30:25% for *A. precatorius*, *C. farinosa* and *B. enneandra*, respectively. The activity of this enzyme for *A. precatorius* extract is comparable to that of malted *Safari* and barley malt. Though the enzymatic potential of these crude extracts are lower than that for malted barley and *Safari*, longer mashing periods or highly concentrated purified extracts will help obtain acceptable mashing performances.

The importance of time (90 and 180 min) on yields of extracts when mashing unmalted *Safari* grits using the crude enzyme extracts of *A. precatorius*, *B. enneandra* and *C. farinosa* was also compared. The results obtained (Table 2) show that yields of extracts were higher after mashing for 180 min as compared to mashing for 90 min. The greatest impact of mashing time on yields of extracts was obtained for unmalted *Safari/B. enneandra* sample type, a difference of about 5 °P. A difference of about 2 °P was obtained for unmalted *Safari/A. precatorius* extract, *Safari* and barley malts was obtained and about 3 °P for unmalted *Safari/C. farinosa* sample type. A mashing time of 180 min was therefore generally considered appropriate if higher yields of extract are to be obtained particularly when mashing with *B. enneandra* extracts.

Sugars and free amino nitrogen (FAN) are decisive in the fermentability of worts during beer brewing (Hough et al., 1982; Briggs et al., 2004; Edney et al., 2007). Three major brewing properties of wort compared were: the reducing sugars, FAN and fermentability (Table 3).
Reducing sugars are about the same level after mashing unmalted *Safrai* with *A. precatorius* and *B. enneandra*, but slightly lower with *C. farinosa*. The level was two times on the average as low after mashing *Safrai* malt, as compared to those obtained for mashing unmalted *Safrai* using *A. precatorius* and *B. enneandra* extracts, but about three times as high after mashing barley malt. FAN was highest after mashing unmalted *Safrai* with *B. enneandra*, followed by *C. farinosa* and then *A. precatorius* extracts and this is in the ratio of 100:78:24%. The free amino nitrogen content of malted barley wort was about 120% that of malted *Safrai* worts. The fermentability levels of *Safrai* and barley worts were similar but were much higher than those of the extracts and adjuncts. Worts obtained after mashing unmalted *Safrai* using the crude enzyme extracts of *A. precatorius*, *B. enneandra* and *C. farinosa* showed fermentabilities fluctuating between 37 and 46%, with *C. farinosa* giving the lowest results and *B. enneandra* the highest. The fermentation performance of the yeast strain used in this study was however lower than expected (Briggs et al., 2004). The results obtained after carrying out the iodine test during mashing are shown in Figure 1.

**Figure 1.** Iodine test during mashing of unmalted *Safrai* sorghum using crude extracts of *A. precatorius*, *B. enneandra* and *C. farinosa*.

**Conclusion**

The crude extracts of *A. precatorius*, *B. enneandra*, and *C. farinosa* used in northern Cameroon to make sweet starch gruel for local consumption do have amylase and proteolytic activities. These extracts can be used for mashing and brewing of sorghum and other cereals. Further fractionation and purification of the crude extracts in order to concentrate their various enzyme components, would be of great use not only to the people of this part of Cameroon but also for industrial purposes.

**REFERENCES**


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