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Research article

STUDIES ON PHYSICOCHEMICAL PROPERTIES OF FRESH PASTE OF THE YOUNG GROWTHS OF *BORASSUS AETHIOPUM*

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ABSTRACT: The physical characteristics of young growths of *Borassus aethiopum* showed that the circumference of the root range of 10-21cm while that of the tapered ends was 3-7.4 cm. Total length of the root ranged from 18.69-34.01 cm. Chemical composition of paste of young growths investigated was relatively high. With moisture content of 52 %, the crude protein, the lipid content, the starch content, the amylose content, ash and other carbohydrates were 4.62 %, 0.95 %, 35.24 %, 1.44 % , 0.72 % and 6.47 % respectively. it was also found certain minerals with rates of 0.06 % Fe, 1.25 % Mg, 0.51 % Ca, 0.51 % Na, 18.08 % K, 0.01 % Cu, 0.014 % Zn and 0.16 % P. Optimum pH of enzymatic hydrolysis of paste by the digestive juice of snail *Archachatina ventricosa* was 5 while optimum temperature was 45 °C. Hydrolysis extent of gelatinized paste by the digestive juice of snail increased quickly in the earlier stage of hydrolysis. It reached 42.36 % after 40 minutes. Results of this study show the necessity of developing these young growths.

Key words: *Borassus aethiopum*, fresh paste, *Archachatina ventricosa*, physicochemical properties.

INTRODUCTION

African fan palm (*Borassus aethiopum*) is a tall palm with leathery, gray green, and huge fan-shaped leaves. This palm can reach 20 to 30 m height and is widespread in west Africa. In the areas of the center of the Côte d'Ivoire, this palm is a very significant tree for the population. It is useful in the food, building material and traditional medicinal uses. It serves also as an article of commerce in the rural areas as a form of income-generating produce for the farmers. Unfortunately, the methods of extraction of sap (palm wine) starting from the final bud are destructive. Thus there are a destruction of the palm and a threat of disappearance of this species. That could involve serious consequences not only for the population but also for ecology and the environment. It would be thus advantageous, by considering all these risks ecological, nutritional, and economic, to propose an alternative to the rural populations in order to divert their attention towards other product of this palm which would bring a plu-value. For that, the valorization of the young growths of ronier which are seedlings from 6 to 8 weeks is considered by the study of the physico-chemical properties of the fresh paste of the young growths of rônier

MATERIAL AND METHODS

Enzymes

The enzymatic source was the digestive juice of snail *Archachatina ventricosa*.

Young growths of Borassus aethiopum

They are cultivated in the center (Didievi) of the Côte d'Ivoire.

Physical characteristics

The length of the root was measured using measuring rule. The diameters and tapered ends of the root were respectively measured using a vernier caliper. The proportion of the peel with respect to the whole root was determined by weighing the peel having carried out the peeling manually.

Preparation of the fresh paste of the Young growths

The young growths of *Borassus aethiopum* were washed and grated. The fresh paste obtained was homogenized and preserved at the freezer before use.

Chemical composition

Quantitative evaluation of moisture, crude protein, lipid and ash of the fresh paste were determined using standard methods of AOAC [3].

The nitrogen content was determined by the kjeldahl method and the crude protein was estimated by multiplying the nitrogen content by 6.25.

The lipid was extracted with petroleum ether for 8 h in a soxhlet extractor.

The quantitative determination of starch was carried out according to the colorimetric method of Dubois [7]. The content of other carbohydrates in the fresh paste was determined by difference by subtracting the sum of the percentage of moisture, crude protein, lipid, ash and starch content from 100.

Amylose content

The amylose content of fresh paste was determined according the method of William et al., [20] using O.5 N KOH solution, 30 g of fresh paste, 0.1 N HCL and 0.5 mL of iodine reagent. The absorbance value measured at 625 nm with spectrophotometer. The amylase content in the fresh paste was determined using a derived standard formula:

Amylase content (%) = (85.24xA) – 13.19; where A = absorbance value.

Mineral composition

Three grams of fresh paste were subjected to dry ashing in a muffle furnace set at 550 °C. The resultant ash was dissolved in 5 mL of HNO_3/HCL/H_2O (1:2:3, v/v/v) followed by heating on ahot plate at the boiling temperature of the solution until brown fumes disappeared. 5 mL of deionized water were later added to the remaining content in the crucible and the mixture was heated until a colourless solution was obtained and was then filtered.

The concentration of the following elements Ca, Mg, Fe, Zn and Cu was the determined from the filtered solution using atomic absorption spectrophotometer, having initially prepared a standard curve for each element under investigation. The concentration of each element was calculated as mg/kg of sample (ppm).

The analysis of sodium (Na) and potassium (K) concentrations of the sample was carried out using flame photometry while the phosphorous (P) content of the filtered solution was determined by the molybdenum blue method using spectrophotometer. All determinations were in triplicates.

Extraction of digestive juice of snail *Archachatina ventricosa*

The digestive juice of the snail *Archachatina ventricosa*, was extracted from three days unfed snails. The shell was broken and the digestive tube was isolated. The digestive juice was collected in the erlenmeyer by successive pressions on the digestive tube, centrifuged (10 000 g, 30 min, 4°C) and the supernatant was conserved at 4°C with sodium azide (0.02 % : w/v) as preservative. The snails are grown in the University of Abobo-Adjame (Côte d'Ivoire).

Protein concentration assays

Protein concentration was measured with Lowry method [11] using bovine serum albumin as standard.

Amylase activity

The amylase activity was assayed by measuring the reducing sugar released during the reaction by the dinitrosalicylate (DNS) method of Bernfeld [5]. The reaction mixture (200 µl) in 0.05 M acetate buffer (pH 5.0) contained 0.1 mL of 1% fresh paste and 50µl of enzyme solution. The mixture was incubated at 37°C for 30 min. The enzymatic reaction was then stopped by the addition of 300 µl of dinitrosalicylic acid solution. After 5 min heating at 100°C for the color development, the resulted samples were chilled to room temperature and then diluted with 3.0 mL distilled water. The absorbance at 540 nm was then measured. One unit of α-amylase activity was defined as the amount (µmol) of reducing sugar released by minute under standard assay conditions.

Effect of pH on enzyme activity

The pH optimum of the enzyme was determined by varying the pH of the assay reaction mixture using the following buffers: sodium acetate buffer 100 mM, (pH 3.6-5.50); phosphate buffer 100 mM, pH (5.6-8.0); citrate buffer 100 mM, pH (3.5-8.0). The residual activity was determined as described earlier.

Effect of temperature on enzyme activity

The temperature optimum of the enzyme was evaluated by measuring the amylase activity at different temperatures (30-60 °C) in 0.1 M sodium acetate buffer pH 5.0. The residual activity was determined as described earlier.

Effect of fresh paste concentration on amylase activity

Effect of *Borassus aethiopum* fresh paste concentration on hydrolysis was studied by varying its concentration from 1 % to 10 % (w/v) in the reaction mixture (total volume of 10.0 mL) containing the digestive juice of snail *Archachatina ventricosa* by shaking at 120 rpm at 37 °C. To determine the extent of starch hydrolysis, end products were measured as described above.

Effect of gelatinization time on amylase activity

The substrate to be hydrolized was gelatinized at 100 °C during 1;2;4;6;8 and 10 minutes in the suitable buffer. After cooling, the reactional medium made up like was previously described.

Gelatinized fresh paste hydrolysis

The reaction mixture (total volume of 10.0 mL) containing 1 % of gelatinized fresh paste and 5.0 mL of enzyme solution (4.5 U) in 0.1 M sodium acetate buffer pH 5.0 was incubated by shaking at 120 rpm at 37 °C. With interval of regular time of 5 min aliquots (200 µl) were taken and the reducing sugars were quantified as describe above.

RESULTS AND DISCUSSIONS

Physical characterization of *Borassus aethiopum* roots

The physical caracteristcs of *Borassus aethiopum* root are given in table 1. The circumference of the root range of 10-21 cm while that of the tapered ends was 3-7.4 cm. The total length of the root ranged from 18.69 - 34.01 cm. The mass of root ranged from 84.24 - 148.62 g. The colour of the root was brown.

Table 1: Physical characteristics of *Borassus aethiopum* root

Parameter of the root	Observation/measurement (cm)
Colour	Brown
Circumference	10 - 21
Circumference of the tapered end	3 - 7.4
Length	18.69 - 34.01
Mass (g)	84.24 - 148.62

Chemical composition

The chemical composition of the fresh paste of *Borassus aethiopum* root was presented in table 2. The moisture content was relatively high 52 % but lower than that of the fresh cassava root [1]. This has as a consequence, to predispose the young roots of *Borassus eathiopum* with a rapid change afther harvest, such as for example, rotting [19].

The crude protein of the root was 4.62 % which is lower compared to that obtained for the gingember root [2]. The total lipid content obtained was very low 0.95 % and this is typical of most root crops such as Cassava, yam, and potato.

The starch content was 35.24 % which is higher than the content of the varieties of cassava [13]. This yield might be an indication of appreciable accumulation of starch in the young tubers for conversion to energy during the physiological development of the palm [4]. The amylose content (1.44 %) was lower than the apparent amylose range 17-30 % [16]. The amylose content of *Borassus aethiopum* fresh paste would indicate that *Borassus aethiopum* starch would be rich in amylopectine. The others carbohydrates, most likely made up of reducing and non-reducing sugars constituted about 6.47 %. The ash was about 0.72 %.

Table 2: Chemical composition of *Borassus aethiopum* fresh paste

Constituents	Composition (%)
Moisture	52 ±0.1
Crude protein	4.62 ± 0.22
Total lipids	0.95 ± 0.02
Amylose	1.44 ± 0.2
Starch	35.24 ± 2.1
Ash	0.72 ± 0.04
Other carbohydrate (by difference)	6.47 ± 0.03

Mineral composition

This study revealed the presence of certain minerals in the fresh paste of *Borassus aethiopum*. Indeed, we found 0.06 % Fe, 1.25 % Mg, 0.51 % Ca, 0.51 % Na, 18.08 % K, 0.01 % Cu, 0.014 % Zn and 0.16 % P.

Effect of pH on the hydrolysis of fresh paste by the digestive juice of snail *Archachatina ventricosa*

This study showed that the hydrolysis of the *Borassus aethiopum* fresh paste by the digestive juice of snail *Archachatina ventricosa* increase with the pH up to a value of pH 5. Hydrolysis extent then decrease gradually to pH 8. The optimum pH of hydrolysis of this substrate is thus pH 5 (Figure 1). The optimum pH of *Borassus aethiopum* fresh paste hydrolysis was in the range (pH 4-7) reported for most of amylases [10, 15].

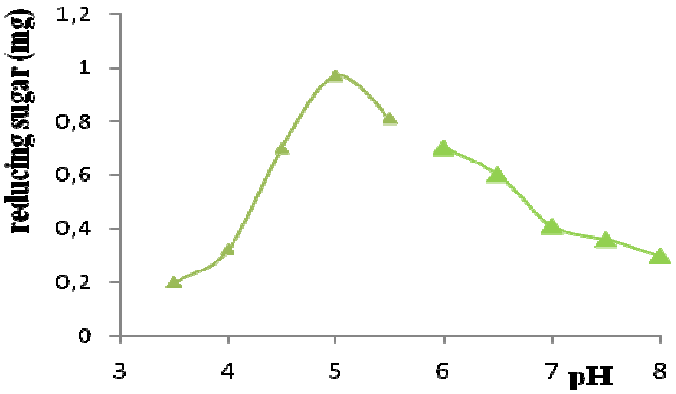

Figure 1: Effect of pH on the hydrolysis of *Borassus eathiopum* fresh paste by digestive juice of snail *Archachatina ventricosa*

Effect of temperature on the hydrolysis of *Borassus aethiopum* fresh paste by digestive juice of snail *Archachatina ventricosa*

The optimum temperature of *Borassus aethiopum* fresh paste hydrolysis by the digestive juice of snail was 45 °C (Figure 2). The digestive juice of snail has optimal temperature much lower than those of amylases of *Pyrodyctium abyssi* (100°C) [14] and of *Bacillus sp.ANT-6* (80°C) [6]. However, it optimal temperature was higher than that of *Nocardiopsis sp.7326* (35°C) [21].

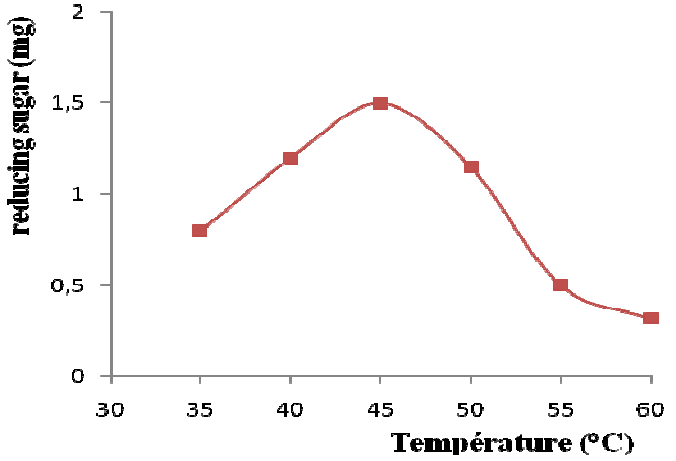

Figure 2: Effect of temperature on the hydrolysis of *Borassus* fresh paste by digestive juice of snail *Archachatina ventricosa*

Effect of fresh paste concentration on the activity of the digestive juice

It can be seen that hydrolysis extent of fresh paste by the digestive juice of snail *Archachatina ventricosa* increased from 1 % to 2.5 % then it dropped up to 10.0 % (Figure 3).

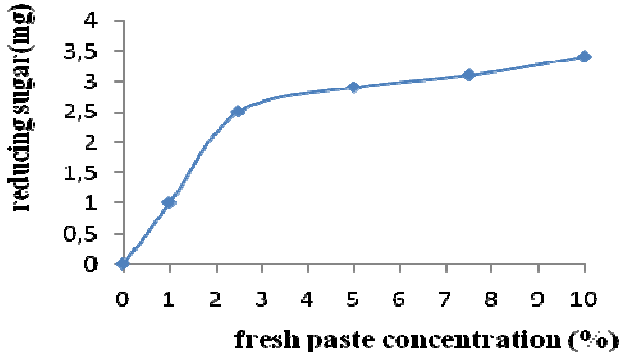

Figure 3: Effect of *Borassus aethiopum* fresh paste concentration on the activity of the digestive Juice of snail *Archachatina ventricosa*

Effect of gelatinization time of *Borassus aethiopum* fresh paste on hydrolysis

The influence of gelatinization time on the enzymatic hydrolysis of the fresh paste was represented by figure 4. The hydrolysis extent increases with the time of gelatinization up to 4 minutes then it does not vary enough whereas the duration of gelatinization is prolonged.

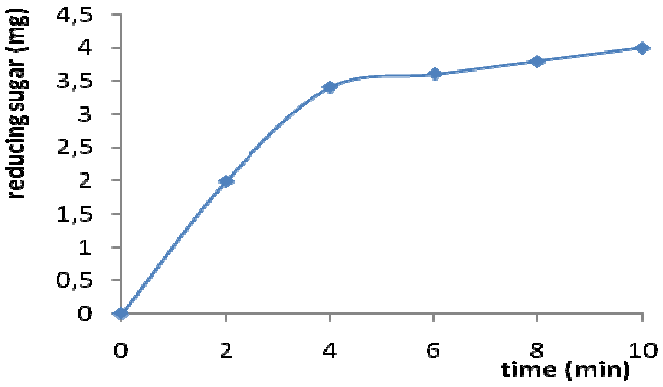

Figure 4: Effect of gelatinization time on hydrolysis of the *Borassus* fresh paste by the digestive juice of snail *Archachatina ventricosa*

Hydrolysis of gelatinized *Borassus aethiopum* fresh paste

The hydrolysis extent of *Borassus aethiopum* fresh paste by the digestive juice of snail *Archachatina ventricosa* increased quickly in the earlier stage of hydrolysis. It reached 42.36 % after 40 minutes (Figure 5).

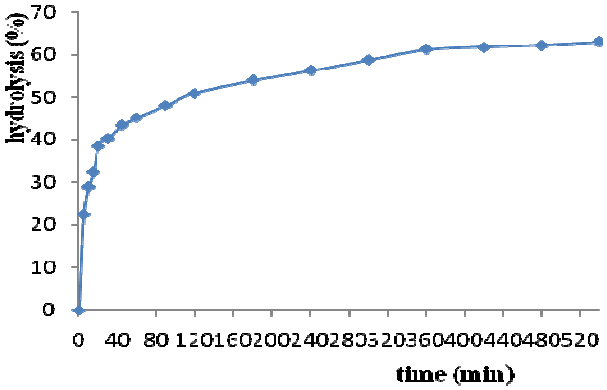

Figure 5: Hydrolysis of *Borassus aethiopum* fresh paste by the digestive juice of the snail *Archachatina ventricosa*

The potential utilization of *Borassus aethiopum* young roots was evaluated by studying the extent of hydrolysis of fresh paste. It was observed that the digestive juice of snail *Archachatine ventricosa* could efficiently hydrolyze fresh paste of *Borassus aethiopum* in a short time. This is possible because when starch is gelatinised the semi-crystalline nature of granules becomes totally amorphous and the starch becomes digestible by amylases [8, 12, 17, 18]. The gelatinisation process involves a number of stages of granule expansion when progressively heated in excess in water, the morphology of which varying between different starches, where granules hydrate progressively, double helices undo as hydrogen bonds are ruptured, crystalline regions are converted to amorphous regions. So, amylase can progressively digest starch granules more and more as they gelatinise.

CONCLUSION

After having determined the chemical composition of the fresh paste of *Borassus aethiopum* and the suitable conditions for its enzymatical conversion, it was carried out to its hydrolysis. The result indicated that much more reducing sugar was released from gelatinized fresh paste by action of the digestive juice of snail *Archachatina ventricosa* and there is also a link between gelatinization time and degradation. Thus, the *Borassus aethiopum* fresh paste would have potential applications in starch processing.

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