ISSN: 2287-6898
International
Journal of Bio-Pharma Research
Volume 9, Issue 6 (2020) pp. 2671-2677

Research Article **Open Access**

Traditional alkaline food additives 'Kola-khar' extracted from banana rhizome with reference to *Musa balbisiana* from Assam the state of India.

Aniruddha Sarma[1]*, Manish Das[1] and Tapan Dutta[2]

[1]Institutional Biotech Hub, Pandu College; Pandu, Guwahati, Assam, India.
[2]Advance Biotech Hub; J.N. College, Boko, Assam, India.

Abstract: '*Kola-khar*' a food additive, extracted from semi-dried banana plant parts viz. banana trunk, fruit peel and rhizome, is a traditional alkaline preparation use by the different communities of Assam in their diet. Because of the high alkalinity, it has commercial importance too. '*Kola-khar*' prepared only from different banana rhizomes has been investigated for its physicochemical properties and compared with traditionally used *Musa bulbisiana* rhizome extract. Physicochemical investigation shows that carbonate, chloride, calcium and magnesium is the major constituent in '*Kola-khar*' and also 'kola-khar' is used as a traditional ingredient and a popular food additive in Assam and other parts of North-East India, the studies were conducted to assess the possibilities of other than *M. bulbisiana* rhizome extract as food additives. Observations reveal that pH ranges from 10.05 - 11.95, carbonate alkalinity 6000 mg/l to 126000 mg/l, while hydroxyl alkalinity was ranging from 37000 mg/l to 222000 mg/l, the total amount of hardness ranging from 50 mg/l to 500mg/l, magnesium ranging from 0.02431 to 0.2569 mg/l, calcium ranging from 0.16032 to 0.2004 mg/l and chloride ranging from 14889 mg/l to 40413 mg/l in different experimented rhizome sample of banana.

Keywords: Banana rhizome; Food additives; Kola-khar; Physico-chemical property; Traditional alkaline preparation

Introduction

Banana is the second most-consumed fruit in the world. The plant is rhizomatous, herbaceous with a robust tree-like pseudo-stem. Various parts of banana plants are used in day-to-day life by people since time immemorial. Almost all modern edible parthenocarpic (seedless) bananas come from two wild species – *Musa acuminate* and *Musa balbisiana*. Mostly cultivated bananas are *M. acuminata*, *M. balbisiana* and for the hybrid *Musa* × *paradisiaca* and *Musa acuminata* × *M. balbisiana*, depending on their genomic constitution. Banana plant has been found to possess insecticidal, anthelminthic, anti-hyperlipidaemia, anti-allergenic, anti-microbial, anti-diabetes, anti-oxidant, as well as anti-cancer properties [1,2,3]. The plants or plant-products are used traditionally in various ways. '*Kola-khar*' is a preparative alkaline food additive obtains from whole plants or parts thereof singly. Traditionally, this alkaline food additive is used by the Assamese community in their diet since time immemorial. This highly alkaline preparation is found a high amount of alkali elements [3]. The bioactivity of '*Kola-khar*' may be attributed to its very high pH due to its metal content. Thus, this traditional food additive has potential therapeutic applications [4]. This antacid is generally made by filtering water through the ashes of different parts of dried banana plant like pseudo-stem, rhizome, and

Corresponding Author:
Dr. Aniruddha Sarma,
Pandu College, Guwahati,
Assam, India.
E-mail: aniruddhasarma@rediffmail.com

http://dx.doi.org/10.21746/ijbpr.2020.9.6.1

peel. It is used as a food additive in the cooking of various traditional food items. '*Kola-khar*' has been used to treat various ailments also [5,6]. Traditionally, it is used to normalize digestive disorders of the stomach and to prevent bacterial attacks on freshly cut injury to heal fast. Use of '*kola-khar*' as soaps and detergent for washing clothes and shampooing hair has practised in villages' generation by generations. It is also used by farmers to kill leeches as bio-pesticide, which can prevent the attack of leech while working in submerged field condition. It has also been used in curing and prevention of certain cattle diseases. The young banana pseudostem is cooked as a vegetable which is a very rich source of iron and fibres. The '*khar*' is a signature class of preparations made with a key ingredient. The traditional ingredient is made by filtering water through the ashes of the different sun-dried parts, which is then called '*Kola-khar*.' The '*khar*' is a dish, probably unique to the state of Assam, with traditional Assamese meal always contains a recipe as it believes that cleanses the stomach.

The present work aims to investigate the physi-cochemical properties of '*Kola-khar*' prepared from different varieties *viz*. *M. chinensis cv.* Chenichampa, Kechelapa; *M. acuminata cv*. Manohor, Malbhog, Kach-kol, Baratmoni, Jahaji, Bogbogi and Bogi-monohar found in Assam and compared to traditionally well known '*Kola-khar*' prepared from *M. balbisiana cv*. Bhim /Athiya kol.

Materials and Methods

Preparation of kola-khar: Ten different banana rhizome samples were taken *viz* Athiya, Chenichampa, Monohor, Kaceylapa, Malbhog, Kach-kol, Baratmoni, Jahaji, Bogbogi and Bogi-monohar from Hajo under Kamrup (R) district of Assam (geographical location: 26°15′0″ north, 91°32′0″ east) the state of India. For preparing the '*Kola-khar*', the rhizome part has been selected for extraction and cleaned by washing to remove dirt. Then the rhizomes were sliced into small pieces so that they can get dried faster in the sunlight. The smaller the pieces of slices faster the rate of getting dried. After complete drying, it was burnt into ash into an earthen pot. Each sample is prepared separately. Samples were collected for physiochemical analysis and stored in a dry earthen pot in airtight for further analysis.

Extraction of Kola-khar: The burnt ashes were first weighed 50gms and moisten with distilled water and soaked in a beaker for 24hours to get better adsorption. Then the alkaline solution was obtained by filtering with Whitman filter paper no.1 until get up to 100ml. The extracting alkaline solution was kept in a clean and dry amber bottle for further experimental purposes. The extraction process is based on a traditional method with the modification of using distilled water and filter paper.

Physiochemical parameters:

Determination of pH: pH of the sample was determined by a digital pH meter MKIV, Systronics. Before measuring pH, the alkaline solution was diluted ten times by deionised distilled water. The concentration of the alkaline solution is 20ml/g ashes.

Determination of total alkalinity: Alkalinity is a measure of the capacity of water to absorb H^+ ions without significant changes of pH. The alkalinity of '*Kola-khar*' extractant is a measure of the acid buffering capacity of water. Total alkalinity of the sample is determined volumetrically by titrating it with standard acid to a pH of 4.5 using methyl orange indicator. Alkalinity is due to the presence of OH^- (hydroxyl ion) and CO_3^{2-}(carbonate ion) or the mixture of two ions [7,9].

For the experiment, 2ml of '*Kola-khar*' (per sample) was diluted ten times with double distilled water and poured in a 250ml conical flask.

A few drops of methyl orange indicator were added to get the yellow colour of the solution. Then it is titrated against 0.02N HCl solution till the colour changes to red and Burette readings are recorded for calculation. The process is repeated several times to get concordant readings. Using the following formula, alkalinity is calculated and expressed as $CaCO_3$ equivalent.

Total alkalinity (mg/ml) = Vol. of titrant × 50 × 1000 × 0.02/Vol. of sample

Where,

50 is a constant value (as calculated).

0.02N is the Normality of HCl.

Determination of TDS (Total Dissolved solids): TDS is determined as the residues left after evaporation of the filtered sample [7]. Firstly, pre-weighted clean and dry 250ml beaker was taken along with 100ml of the alkaline sample obtained through filtering with Whitman no. 1 filter paper. The beaker, along with the sample, was evaporated to dryness on a heating plate at temperature 100^0C. After cooling the beaker, the final weight was taken. TDS was expressed as the following formula-

TDS (mg/l) = final weight - initial weight x 10^6 / vol. of the sample.

Determination of Chloride: Chloride concentration of a sample is determined using a standard method [8] (accordance to Indian stand. IS: 3025, part 32) reaffirmed 2003 and also APHA standard procedure [7]. Chloride is distributed as salts of Calcium, Sodium, and Potassium in water and wastewater. The concentration of these ions varies widely depending on the environmental conditions. Most of the water-soluble salts in a pond environment generally remain in Cl^- form and hence the amount of Cl^- in pond water indicates the total amount of soluble salts present in the ecosystem very closely. Chloride ions (Cl^-) can be conveniently estimated by titration with Silver Nitrate ($AgNO_3$) in the presence of Chromate ion. $AgNO_3$ forms Silver Chloride (AgCl) by reacting with Chromate ions (CrO_4^{--}) present in the sample. When the Chlorine in water gets exhausted, $AgNO_3$ then reacts with the CrO_4^{--} ions to show a red colour of Silver Chromate ($AgCrO_4$) indicating the completion of titration.

For the experiment, 1ml of sample is taken with 19ml of double distilled water to make up 20ml in a clean 250ml conical flask. A few drops of Potassium Chromate indicator were added to get a light yellow colour. Then the sample is titrated against Silver Nitrate solution till the colour changes from yellow to brick red, i.e. the endpoint. The volume of Silver Nitrate (titrant) used is recorded for calculation. The whole process is repeated for thrice to get concordant value using distilled water. The following formula calculates chloride in mg/l:-

Chloride (mg/l) = (V_s-V_b) x 0.2 x 35.45 x 1000/ vol. of sample

Where,

V_s- vol. of Silver Nitrate for sample.

V_b- vol. of Silver Nitrate for blank.

Normality of $AgNO_3$- 0.2N.

The equivalent weight of Chloride - 35.45.

Determination of Total Hardness: The total hardness in water substance is contributed by Calcium, Magnesium, Chloride, Sulphates, Bicarbonate ions but Magnesium and Calcium are the prime source with high concentration of these ions is considered as hard water. The total hardness is measured according to the procedure described by our Indian standard IS: 3025 (part 21) – Reaffirmed 2002 and also APHA and EPA methods are referred [7,8,9]. To determine hardness, ammonia buffer is used for maintaining pH of sample between 9 and 10. Eriochrome Black T (EBT) is used as an indicator which turns the sample to red wine in colour if Mg and Ca or other ions are present. 0.02N EDTA is used as titrant which complexes with Mg & Ca or other ions responsible for hardness.

In the experiment, 1ml of the sample with 19ml of double distilled water is measured where 2ml of ammonia buffer is poured. 20µl of EBT indicator is added in the above solution. The solution is titrated against 0.02N EDTA solution till the colour changes from wine red to blue i.e., the endpoint of the titration. The process is repeated thrice to get concordant readings. Using the following formula, total hardness is calculated – Total hardness (mg/l) as $CaCO_3$ equivalent= vol. of titrant × 0.02N × 50 × 1000/ vol. of sample taken.

Where, normality of EDTA solution= 0.02N and equivalent weight of $CaCO_3$= 50.

Determination of Calcium and Magnesium: Ca^{++} can be determined directly with EDTA using Patton and Reeder's (PR) indicator when present alone or in a mixture [10]. The required pH is 7-11 and the colour changes from red to blue as the endpoint. Mg^{++} can be determined directly at pH 10 by using Eriochrome Black T indicator when present alone in a solution. But the ions content is determined directly in the presence of Ca (II), C a(III) and Mg (II) from wine red coloured complexes with Eriochrome Black T indicator, EDTA decomposes both the indicator complex at pH-10. Hence, Mg (II) cannot be determined in the presence of Ca (II). The total amount of Ca (II) and Mg (II) in a mixture is determined using EBT as indicator. Amount of Mg (II) is calculated by subtracting by the amount from the total amount. In the experiment, 1ml of '*Kola-khar*' sample is taken to determine Ca (II) with 24ml of double distilled water and poured in a sterile 250ml conical flask. Then 4ml of 8M KOH solution was added and allowed to stand for 5 minutes with an occasional swirling motion. Then added 35mg of PR indicator mixture and titrate with standard EDTA (0.01M) solution until the colour changes from red to blue. The process was repeated for concordant results.

For calculation

1ml of 0.01M EDTA= 0.4008 mg (Ca (II)), 1ml of 0.01M EDTA= 0.2431mg (Mg (II))

Let the volume of EDTA consumed in the determination of total Mg and Ca with EBT indicator= Xml.

The volume of EDTA for Ca only with PR= Y ml; the amount of Ca = 0.4008 × Y ml and, the amount of Mg= (X-Y) × 0.2431.

Results

Determination of pH: The pH of all the alkaline samples (20ml extractant/gram ashes) were recorded in Table-1 and ranging from 10.35± 0.14 (Baratmoni and athiya varieties) to 11.60 ± 0.16 (Malbhog). Traditionally used 'athia kol' variety recorded pH value was 10.35 ± 0.15.

Determination of Total Dissolved Solid: The TDS (mg/l) of the samples were recorded in Table:1. The range of TDS 68198 mg/l (Jahaji) to 213710 mg/l (Monohor). Athya kol variant was recorded TDS 210370 mg/l.

Determination of Total Hardness: The Total Hardness (mg/l) of all the samples was recorded and ranging from 50 mg/l (Chenichampa) to 500mg/l (Monohor). Traditionally used Athya kol variants exhibits 300mg/l total hardness.

Determination of Chloride: The Chloride (mg/l) content of all the samples was ranging from 14889 mg/l (Malbhog) to 40413 mg/l (Kaceylapa). Athiya kol variant exhibits 27651mg/l chloride.

Determination of Total Alkalinity: The Total Alkalinity (mg/l) of the studied banana variants were recorded in carbonate (CO_3^{--}) and hydroxyl (OH^-) form (figure-1). Carbonate alkalinity was ranging from 6000 mg/l (Kecelepa) to 126000 mg/l (Athiya kol) while hydroxyl alkalinity was ranging from 37000 mg/l (Jahaji) to 222000 mg/l (Athiya).

Traditionally used variant 'athiya kol' exhibits higher alkalinity in terms of carbonate and hydroxyl.

Determination of Calcium and Magnesium: The Calcium and Magnesium (mg/l) content of all the samples were studied and range of calcium found 0.16032 to 0.2004 mg/l. Three variants viz. Athiya, Monohor and Bogi Monohor exhibits a higher amount of calcium than the rests. The range of magnesium contents was recorded from 0.02431 to 0.2569 mg/l (kach kol). Other than '*kach kol*' variant, rests of the banana variants exhibit approximately at par with magnesium content (figure 1 & 2).

Table 1: Physico-chemical analysis of 'Kola-khar' obtains from different Banana cultivars.

Varieties	pH	Total Hardness (mg/l)	Chloride (mg/l)	TDS (mg/l)
M. *balbisiana cv.* Athia	10.35 ± 0.15	300 ± 1.6	27651 ± 2.3	210370 ± 4.1
M. chinensis cv. Kechelepa	10.54 ± 0.14	200 ± 1.4	40413 ± 3.2	94420 ± 2.7
M. acuminata cv. Malbhog	11.60 ± 0.16	400 ± 1.8	14889 ± 21	161450 ± 3.7
M. acuminata cv. Monohar	10.60 ± 0.12	500 ± 2.0	24815 ± 2.7	213710 ± 4.2
M. chinensis cv. Chenichampa	10.45 ± 0.11	50 ± 1.0	31196 ± 3.2	201010 ± 4.0
M. acuminata cv. Kach kol	10.48 ± 0.13	250 ± 1.5	33323 ± 3.6	113360 ± 3.1
M. acuminata cv. Baratmoni	10.35 ± 0.14	50 ± 1.0	31905 ± 3.3	147120 ± 3.5
M. acuminata cv. Jahaji	10.44 ± 0.14	100 ±1.2	19143 ± 2.4	68190 ± 2.4
M. acuminata cv. Bogbogi	11.22 ± 0.15	200 ± 1.4	36159 ± 3.7	192120 ± 3.8
M. acuminata cv. Bogi Monohar	10.50 ± 0.13	250 ± 1.5	26233 ± 2.2	138730 ± 3.3

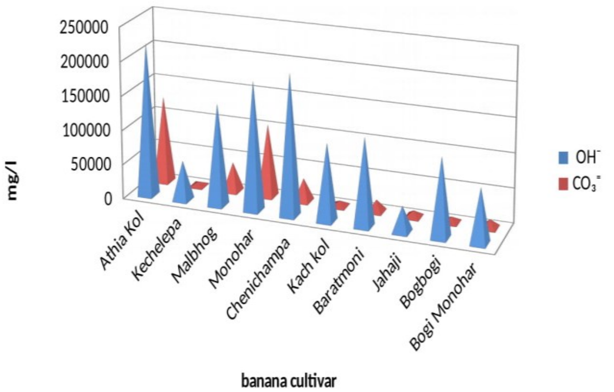

Figure 1: Total alkalinity of Kola-khar from different Banana cultivars

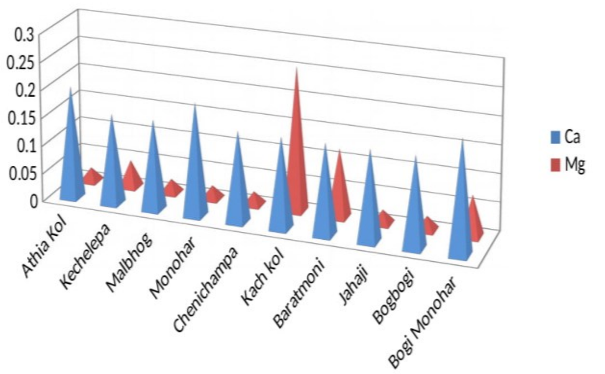

Figure 2: Calcium and Magnesium content in Kola-khar from different Banana cultivars

Discussion

Among the locally available banana varieties, *Musa bulbisiana* var. athiya/bhim, the seeded banana variety, is considered the best one for 'kola-khar' preparation by the Assamese community since time immemorial. This preparation is routinely used as a food additive in cooking and also to treat various ailments. Young banana pseudo-stem is cooked as a vegetable (locally called *posola*) which is a very rich source of iron and fibers. Rhizomatous stem exudate is used to treat dysentery, pinworm infection, as well as a sore throat. The ability of liquid exudates of banana trunk in treating infertility in males has also been reported [11]. The banana powder i.e. ashes extractant exhibited high alkaline nature and the pH ranging from 10.35-11.60 (table-1). In our study, pH of athiya kol (*M. bulbisiana*) variety was recorded 10.35. However, maximum pH 13.0 was recorded by other workers [5]. This may be due to extractant concentration. Along with the TDS, carbonate and chloride are the major constituents of 'kola-khar'. In this study, highest alkalinity, both hydroxyl (OH^-) and carbonate (CO^{2-}_3), was exhibited higher by *M. bulbisiana* than the rest. Other parameters like TDS, hardness, chloride concentration are within the moderate range for *M. bulbisiana* variety in our experiment. However, traditionally consumers preferred *M. bulbisiana* extractant as '*Kola-khar*'. Our experiments exhibited possibilities to use other types also.

Chloride content in the diet plays an essential role in high blood pressure. The excessive Chloride concentration increases the rate of corrosion of metals, high level of chloride ions may result in salty taste [8]. In the present study, chloride content (mg/l) was ranging from 14889 to 40413, and *M. bulbisiana* shows moderate (27651 mg/l). '*Kola-khar*' with a high amount of carbonate (6 to 126g/kg) in ash, is certainly an alternative, cheap and renewable source for carbonate compounds. After harvesting of banana fruits, the pseudostem or rhizomes are of no use and treat as waste. As the banana plants are annual, after harvesting, the pseudostem can be explored for a rich source of carbonate compounds as a bio-alternative. As banana plants can be grown easily and fast-growing, it will be a renewable source of carbonate compounds. Probably due to high accumulating efficiency of elements from soil and water, the extractant (*Kola-khar*) from ashes exhibits higher pH along with alkalinity and chloride values. In our experiment, *M. bulbisiana* (athia/bhim) demonstrated a higher amount of carbonate 126000 mg/l and possibilities for commercial exploration. '*Kola-khar*' is quite rich in potassium [6] and can be exploited as a cheap and renewable natural source of potassium carbonate. There are also possibilities for application of banana ashes as potassium-type fertilizers for agricultural purpose in acidic soil.

Conclusion

'*Kola-khar*', an antacid, is traditionally used by various communities of Assam, is quite rich in alkalinity and therefore it is used an antacid. Traditionally used variety *M. bulbisiana* exhibited moderate property except for alkalinity. '*Kola-khar*' prepared from *M. acuminata cv*. Malbhog has found the highest pH (pH 11.60) and followed by *M. acuminata cv*. Bogbogi which also contained a significant amount of calcium and magnesium. *M. acuminata cv*. Kach kol may be treated as good magnesium source. Moreover, *M. chinensis cv*. Kechelepa could be exploited for chloride content. The experimental findings reveal that '*kola-khar*' obtain from other cultivars may also be used like *M. bulbisiana* and possess potentiality as a source of certain chemical compounds.

Acknowledgement

The corresponding author is very thankful to DBT Govt. of India for analytical instrumental support by Institutional Biotech Hub and Principal of Pandu College for providing necessary help to carry out the work. He is also thankful to Izaz Ul Ahmed for collecting and processing the sample.

References

Singh SK, AN Kesari, PK Rai, and G Watal "Assessment of Glycemic potential of *Musa paradisiaca* stem juice." *Indian J. Clin. Biochem*. 22:2 (2007): 48-52.

Agarwal PK, A Singh, K Gaurav, S Goel, HD Khanna and RK Goel "Evaluation of wound healing activity of extracts of Plantain banana (*Musa sapientum* var. *Musa paradisiaca*) in rats." *Indian J. Exp. Biol*. 47:1(2009): 32-40

Vijaykumar S, G Presanna kumar and NR Vijaylakshmi "Antioxidant activity of banana flavonoids." *Fitoterapia*. 79:4(2008) 279-282

Phukan RK, CK Chetia, MS Ali, and J Mahanta "Nutritional cancer Role of dietary habits in the development of esophageal cancer in Assam, the north-eastern region of India." *Nutrition and Cancer.*; 39:2 (2001):204-209

Mudiar RH, VK Mane and A Bhagwat "Analysis of traditional food additive kolakhar for its physic-chemical parameters and antimicrobial activity" *European Academic Research.* 2:8 (2014): 10531-10536

Deka DC and NN Talukdar "Chemical and spectroscopic investigation of kolakhar and its commercial importance" *Indian Journal of Traditional knowledge.*; 6:1 (2007): 72-78

Clesceri LS, AE Greenberg and RR Trussell "*Standard Methods for the Examination of Water and Waste Water*", 17th edn, American Public Health Association, Washington DC, 1989.

Bureau of Indian Standard (BIS), 1998, (reaffirmed 2007) Methods of sampling and test (physical and chemical) for water and wastewater, 8th reprint' 2010. UDC 628.1/3:543.3:543.847

Environmental Protection Agency (EPA, 2003), safe drinking water act. EPA 816-F-03-016

Chattopadhay GN "Chemical analysis of fish pond Soil and water" Daya Books (1998) ISBN 81-7035-177-4.

Kalita D and B Deb "Some folk medicines used by Sonowal Kacharis Tribe of the Brahmaputra valley" *Natural product radiance.* 3:4(2004): 240-246.

Cite this article as:

Aniruddha Sarma, Manish Das and Tapan Dutta. Traditional alkaline food additives 'Kola-khar' extracted from banana rhizome with reference to Musa balbisiana from Assam the state of India. Volume 9, Issue 6 (2020) pp.2671-2677.

http://dx.doi.org/10.21746/ijbpr.2020.9.6.1

Source of support: DBT Govt. of India; **Conflict of interest:** Nil.