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ESTIMATION OF CYNOGENIC CONTENT IN EDIBLE BAMBOO SHOOTS THROUGH PICRATE PAPER METHOD

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ABSTRACT

Bamboo shoots are delicious, taste sweet, rich in carbohydrate, protein, vitamin and essential amino acids. Despite these nutrtious quality, bamboo shoots have cynogenic glycosides which releases hydrocyanic acid (HCN) on hydrolysis. Picrate paper method was found convinient and reliable protocol to estimate hydrocyanic acid content in edible bamboo shoots. Present study was done on edible shoots of three bamboo including *B. tulda* and *D. strictus* and found that tender shoots of *B. tulda* are edible and good for human health as it has lower content of hydrocyanic acid. Overall middle part of the shoots contained maximum amount of HCN content in all species.

Key words : Bamboo shoots, Picrate paper, Cynogenic gylcosides, HCN

Introduction

Cosumption of tender shoots as vegetable is one among the several documented uses of bamboos. In fact, bamboo shoots are a traditional component of Asian cuisine. Some common bamboo species like *Bambusa nutans, Bambusa tulda, Dendracalamus strictus, D. hamiltonii,* etc. produces edible shoots at varying periods of availability. Bamboo shoots are delicious, nutritious, taste sweet and keep the body cool. Edbile bamboo shoots are rich in carbohydrates, fat, protein, mineral content and amino acids which are essential for human body (Tripathi, 1998; NMBA, 2009; Satya *et al*., 2010). Bamboo shoots are also valuable in pharmaceutical and food processing industries and can be processed for beverages, medicines, additives or health foods (Park and Jhon, 2010).

Despite these merits , bamboo shoots have one major antinutrient component which is cynogenic glycosides. Amygdalin, linamarin, taxiphyllin, dhurrin etc. are some known cynogenic glycosides present in cynogenic plants (Conn, 1969; Dilleman, 1958). Among them, taxiphyllin is more frequently found in bamboo shoots (Fig.1). Taxiphyllin and Dhurin differ only in the configuration of aglycone unit (Conn, 1969). Cynogenic plants contains an enzyme system which is capable of converting the cynogenic glycoside to sugar, HCN, and an aldehyde or ketone (Fig.2).

The concentration of HCN recommonded by WHO for cassava flour is 10 ppm and a concentration of 100ppm become lethal for human (FAO/WHO, 1991). Thus, knowledge of actual HCN conc. in different edible bamboo species is essential for processing to make them suitable for human consumption. Bamboo species with extremely high HCN content should altogether be avoided as food. Thus, the present study was undertaken to estimate HCN content in different portions of young shoots of three bamboo species employing convenient picrate paper method which has been used even by farmers in abroad (Egan *et al*., 1998).

Material and Method

Two kinds of bamboo shoots (*B. tulda* and *D. strictus*) and one market bamboo shoot (Unknown species) were used in this experiment. Bamboo shoots were grown and harvested in the August-September 2012 in Chandwa, Ranchi. Processed marketed bamboo shoots was purchased from the local market, Ranchi. Cynogenic content in bamboo shoots was determined as per the pictrate paper procedure prescribed earlier (Bradbury *et al.,* 1999). Briefly, took 25mg from each tip, middle and bottom portion of bamboo shoot and ground and placed in flat bottom plastic bottel. Immediately added 0.5ml of 0.1M phosphate buffer at pH 6. After slow mixing, yellow picrate paper attached to plastic strip was placed in the bottel and closed properly. It was allowed to stand for 16-24 hours at room temperature. After this immersed the orange-brown picrate paper in 5.0 ml of distilled water for 30 min. with occasional gentle shaking. Absorbance of the solution was measured at 510nm (Spectroquant, PHARO, MERK) (Fig.2).

Statistical analysis

Three replicate trials for each experiment were performed. The data were subjected to statistical analysis, employing analysis of variance (ANOVA), `F`-test for significance at P 0.05 and computing LSD values

Tender shoots of *Bambusa tulda* having lower content of HCN are edible and good for human health as confirmed in picrate paper test.

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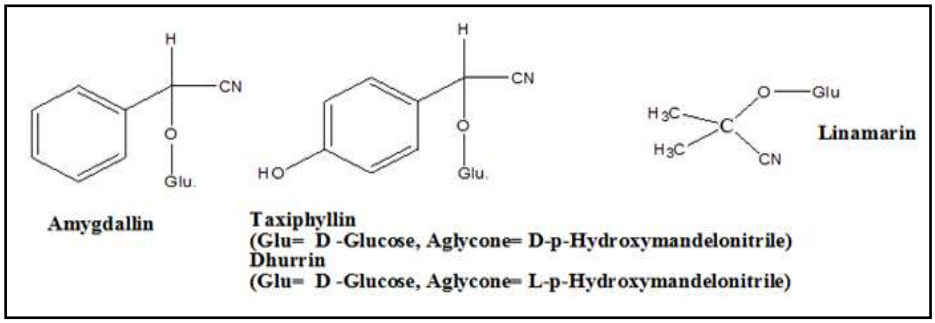

Fig.1 : Some common structures of cynogenic glycosides found in cynogenic plants (Conn, 1969 and Dilleman, 1958)

Table 1 : Cynogen content avalable in bamboo shoots by picrate paper method.

Bamboo Species	Shoots portion	Cynogen content (mg/kg)
Bambusa tulda	Tip	139
	Middle	448
	Bottom	289
Dendrocalamus strictus	Tip	350
	Middle	772
	Bottom	361
Processed marketed Bamboo shoots	Tip	255
	Middle	575
	Bottom	382
$LSD^{0.05}$		160.16

to separate means in different statistical groups using statistical software IBM SPSS version 18.

Result and Discussion

Since bamboo shoots are popular food in Jharkhand during monsoon season, commonly known as 'sandhana' in local market, hence it is equally important to know the level of cynogenic content in these shoots which is important from human safety point of view. Occurrence of taxiphyllin, a cyanogenic glycoside in raw shoots, and its side effect on human health demands for the innovate processing ways using scientific input to eliminate the toxic compound without disturbing the nutrient reserve. The biosynthetic precursors of the cyanogenic glycosides are different L-amino acids, which are hydroxylated, then the N-hydroxylamino acids are converted to aldoximes and these are converted into nitriles and hydroxylated to α-hydroxynitriles and then glycosylated to cyanogenic glycosides (Bleihert *et al.,* 1966; Conn, 1969; Chang and Hwang, 1990). All known cyanogenic glycosides are β-linked, mostly with D-glucose. Advantages of picrate method over other method is that the developed yellow-orange-brown colour of the picrate paper was stable for 48 h and the colour can be quantitaively eluted off the paper and its intensity determined spectrophotometrically (Egan *et al*., 1998). HCN content in bamboo shoots ranges from 0.3% to 0.8% out of which 0.16% of the total cyanide present in the tip portion (Haque and Bradbury, 2002). However, Chaudhary *et al*. (2010) reported that *B. tulda* has lower cyanide content in tip portion. We have also found that all three bamboo shoots contain low amount of HCN in tip portion (Table 1).

A WHO report (1993) states that the concentration of cyanide in the immature shoot tip of bamboo is 8000 mg/kg of hydrogen cyanide, whereas Ferreira *et al.* (1995) report that bamboo shoots contain as much as 1000 mg/kg of hydrogen cyanide in the apical part. The most probable reason for this observation may be some enviornmental and physiological factors. However, our findings in relation to middle and basal portion are in agreement with the previous investigations (Chaudhay *et al*., 2010, 2012), who reported that maximum HCN

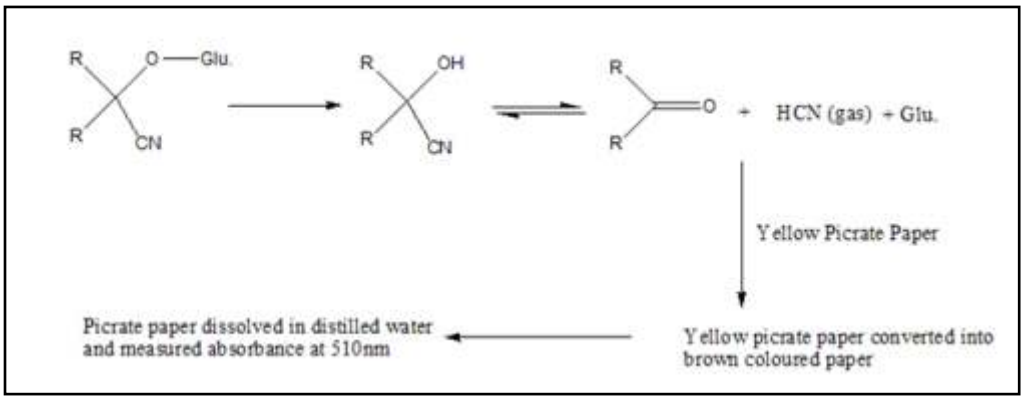

Fig. 2 : A schematic representation of the cynogenic hydrolysis and detection of HCN with Picrate paper

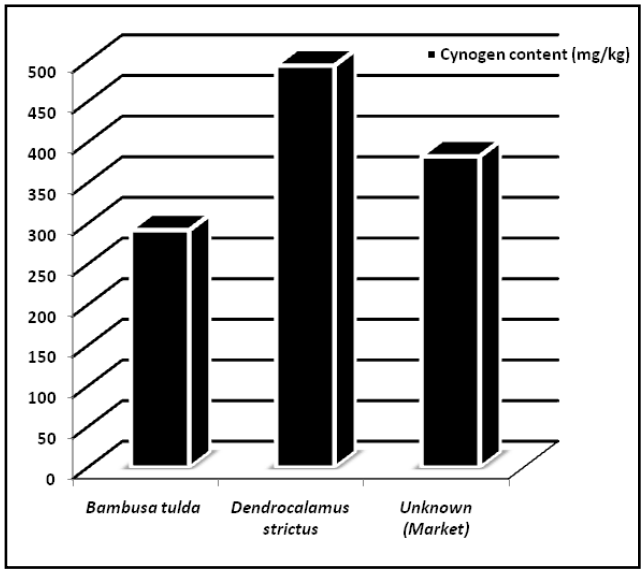

Fig. 3 : Cynogen content (mg/Kg) in three bamboo species.

content available in middle portion followed by the basal portion of the shoots (Table 1). Edible shoots from *D. strictus* have higer HCN content as compared to shoots of *B. tulda*. Our findings indicate that tender shoots of *B. tulda* are edible and good for human health as it has lower content of HCN (Fig. 3).

Fortunately taxiphyllin is unusual amongst the 60 or so known similar compounds in that it degrades readily in boiling water. Thus the normal preparation of bamboo shoots should remove any taxiphyllin problem. Further, the type of processing used can have an effect on the remaining cyanide content of the processed food. The most common indigenous methods applied by the tribal people include chopping of tender shoots into small pieces (known as '*sandhana'* in Jharkahnd), partial drying of fresh shoots, boiling in water/salt water and draining or keeping the tender shoot in hot water for 10-15min (Bhatt *et al*., 2003). Maximum reduction in HCN content was found when boling of bamboo shoots are done for 25 min (Ferrira *et al*., 1995). However, when cynogenic bamboo shoots are eaten occassionaly there may be no symptoms of cyanide poisioning (Jones, 1998). Cynogenesis is a natural phenomenon occur in plant to prevent themselves against their enemies. The new shoots are brilliant for human consumption. To the best of our knowledge there is no report of poisining and death due to cyanide intake from edible bamboo shoots.

In conclusion, the picrate paper method appeared as a viable way to have a quick and reliable estimate of HCN content in edible bamboo shoots. HCN content in studied bamboo species is comparable to other plants foods like other plant foods with values such as cassava, lima beans ranging from 660-3000mg/kg while the level associated with fatal human poisoning is 2100 - 3120 mg HCN/kg (EFSA, 2007; Gypta, 1987; Holzbecher,1984). Among these studied bamboo species, overall cynogenic content of *B. tulda* is lower indicating its suitability as food.

बांस के खाद्य योग्य वनों में पिक्रेट पेपर पद्धति से साइनोजेनिक मात्रा का आकलन

पंकज सिंह, रामेश्वर दास, संजय सिंह तथा कुमारी प्रिया

सारांश

बांस के तने स्वादिष्ट, मीठे, कार्बोहाइड्रेटयुक्त, प्रोटीन, विटामिनों और सुरभित अमीनों अम्ल से परिपूर्ण होते है। इन पोषक गुणों के बावजूद बांस के तनों में साइनोजेनिक ग्लाइकोसिड्स होता है जो हाइड्रोलेसिस पर हाइड्रोसाइनिक अम्ल छोड़ता है। भोज्य बांस तनों में हाइड्रोसाइनिक अम्ल की मात्र का आकलन करने के लिए पिक्रेट पेपर पद्धति को सरल और विश्वसनीय प्रोटोकोल माना गया। वर्तमान अध्ययन, *बी. ट्ल्डा, डी. स्ट्रिक्टस* सहित तीन बांसों के भोज्य तनों पर किया गया जिनमें हाइड्रोसाइनिक अम्ल की मात्रा कम होती है और जो मानव स्वास्थ्य के लिए उत्तम होते है। कुल मिलाकर सभी प्रजातियों के तनों के मध्य भाग में एचसीएन की मात्रा उच्चतम होती है।

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