Available online www.jocpr.com

Journal of Chemical and Pharmaceutical Research, 2017, 9(9):131-134

Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

A Dipstick to Determine the Lead Contamination in Sugarcane Juice

Ruchi D Sharma*, Suparna Ghosh, K Anita, Shweta Sharma and Sulbha Amlathe

Career College Bhopal, Barkatullah University, Bhopal, Madhya Pradesh, India

---

ABSTRACT

Sugarcane is one of the most important cash crops in the tropics and subtropics, mainly used to manufacture crystal sugar. Sugarcane juice is consumed by people, thus the human health risk was measured using the concentration of total heavy metals in sugarcane juice. To obtain high production of sugar cane; we intensively use fertilizers, effluents, sewage sludge, industrial residues, sugar mill by-products, spent wash, pesticides, and herbicides, along with the use of highly producible sugar cane varieties. All of these efforts utilize the sources that contain heavy metals and thus increase heavy metals concentration in soils where sugarcane is grown. Short term exposure may not result into any serious harm but long-term consumption may result into contamination of sugarcane juice which in turn creates serious human health issues. In particular, it is important that the concentration of heavy metals such as lead (Pb) and arsenic (As) in edible parts of the plant are below the maximum limits for heavy metals in foods. The present paper presents a dipstick to check the presence of lead in sugarcane juice. The dipstick has been prepared by immobilizing a new reagent system on TLC paper. On contact with the sugarcane juice containing lead (Pb) dark blue color spot develops. Intensity of color depends on the concentration of lead in juice. Thus, the dipstick is helpful in on spot check of presence of lead in sugarcane juice and helps in health check.

Keywords: Sugarcane; Heavy metals; Thin-layer chromatography (TLC); Dipstick

---

INTRODUCTION

Since Vedic period India is one of the largest cultivators of sugarcane. Indian writings of the period 1400 to 1000 B.C mention the proof of initial sugarcane cultivation [1]. India is widely accepted as the original home of Saccharum species. It is a plant with good photosynthetic capability that is cultivated extensively [2]. The major sugarcane production region in India consists of the states of Maharashtra, Andhra Pradesh, Tamil Nadu, Karnataka, Gujarat, Madhya Pradesh, Goa, Pondicherry and Kerala, UP, Bihar, Haryana and Punjab. In agriculture sector, sugarcane shared is about 7% of the total value of agriculture output and occupied about 2.6% of India's gross cropped area. Sugarcane provides raw material for the second largest agro-based industry after textile. The juice Sugarcane per serving (28.35 grams) contain Energy-111.13 kJ (26.56 kcal), Carbohydrates-27.51 g, Protein-0.27 g, Calcium 11.23 mg (1%), Iron 0.37 mg (3%), Potassium 41.96 mg (1%), Sodium 17.01 mg (1%) [1]. Heavy metal contamination is a serious issue for environmentalists. The food contamination due to heavy metal pollution is a worldwide problem. In polluted crop yard, heavy metal pollution often affects a wide area, but the level of pollution is sufficiently low that crops are still able to grow. However, if heavy metals accumulation in the edible parts of the crop exceeds the food safety standards, heavy metals can enter the body and pose a risk to human health [2]. The ability to absorb heavy metals differs between crop species, and several studies have shown that significant differences in the absorption of heavy metals exist between varieties of the same species [3-8]. Sugarcane juice is an important and healthy drink especially in summer. It is cheap, tasty and nutritious juice with many health benefits. A sugarcane juice consists of sucrose, fructose, and many other glucose varieties and hence, it is sweet to taste. Raw sugarcane juice has about 13 grams of dietary fibers per serving, which are essential for carrying out a lot of body

functions. Sugarcane juice is an ultimate health tonic with skin benefits as cures acne, fights against aging. It also helps in various health issues like it is an instant energy booster, it ensures safe Pregnancy, freshens breath and controls tooth decay etc. It acts as a digestive tonic, fights cancer, helpful in treating sore throat, heals wounds, and helps in strengthening body organs, elimination of toxins from the body and boosts immunity. Studies have shown the presence of heavy metals like Cd, Pb, As, Zn etc. in sugarcane juice. Consuming the sugarcane juice contaminated with any of such heavy metals can cause severe health problems. Thus, it is highly important to develop any such method or tool which could detect the presence of such toxicity. Present paper deals with the application of an analytical tool (dipstick) for detection of Pb (lead) in sugarcane juice. Paper also explains the removal of it to the possible extent and thus to safeguard the humans from the health hazards.

Experimental Work

Amlathe et al. have developed a tool called paptode on paper platform for various toxic entities [9-17]. They have developed a paptode by immobilizing KI and Starch for determination of lead [18]. The same paptode has been used as a dipstick to detect the presence of lead in sugarcane juice.

Apparatus and Software

JEOL JSM -6390 A SEM Made in Japan, JEOL JFC-1600 Sputter Coater unit. The scanner (HP-SCANJET G2410) was used for scanning the strips. Resolution of scanner: 300 dpi. MATLAB software.

Chemicals and Reagents

All reagents used were analytical grade chemicals. Double distilled water is used throughout the experiment.

KI - Potassium Iodide

10% KI Solution – It was prepared by dissolving 10 g of KI salt in 100 mL of double distilled water.

Starch Solution

4% Starch Solution, It was prepared by dissolving 4 g of starch powder in 100 mL of double distilled water. The solution was found stable for 3days but we prepared it daily for flawless analysis.

METHODOLOGY

Procedure

Preparation of paper optode:

The Dipsticks were constructed by immersing TLC strips in 10% solution of KI for few seconds and then dried in a temperature controlled oven (to speed up drying) followed by immersing in 4% solution of starch and then dried again in an oven at the same temperature but not higher than 700°C to avoid brittleness of strips. The prepared dipsticks were stored in cool and dry place and can be used for 25 days.

Mode of operation:

The paptode were dipped in the sugarcane juice samples collected from different areas of Bhopal city. The dark brown to violet coloration appears based on the concentration of lead on the immersed area. The developed color was scanned through a flatbed scanner and the scanned images were transferred to computer for digital RGB analysis to MATLAB and the intensity of color-spots was recorded. Effective intensity for the color values of developed color spots was calculated by following formulae:

$$\mathbf{A_r = -Log\ (R_s/R_b)\ \_\_\_\_(1);\ A_g = -Log\ (G_s/G_b)\ \_\_\_\_(2);\ A_b = -Log\ (B_s/B_b)\ \_\_\_\_(3)}$$

Where, A_r, A_g, A_b are effective intensities of red, green and blue color respectively R_s, G_s, B_s and R_b, G_b, B_b refer to R, G and B values of sample and blank respectively. The calibration curve is obtained by plotting effective intensities of R, G and B values vs. analytic concentration.

Where; B- blank, S- sample, a- color development in solution, b- color development on injecting various concentration of analyte.

RESULTS AND DISCUSSION

Chemical Reaction

Lead (IV) oxide get converted to lead (IV) chloride on dissolution in cold and concentrated HCl. Lead (IV) chloride reacts when reacts with KI forms lead (IV) iodide. The lead (IV) iodide being unstable breaks down to lead (II) iodide and liberate iodine. The liberated iodine binds subsequently with starch to form complex and produce a blue colored product. Lead iodide volatizes off, which has been confirmed by electron diffraction studies as no lead or lead compound peak was found. This is the reason for no coloration on strip even it contains both the reagent until lead sample is injected. It is recommended to use a minimum amount of reagents to prevent browning of strips due to environmental oxidation.

$$PbO_2 + 4HCl \rightarrow PbCl_4 + 2\,H_2O$$
$$PbCl_4 + 2KI \rightarrow PbI_4 + 2KCl$$
$$PbI_4 \rightarrow PbI_2 + I_2$$
(Volatizes off)
$$I_2 + \text{Starch} \rightarrow I_2\text{-starchcomplex}$$
(Blue violet)

Table 1: Detection of lead quantity in sugarcane juice samples

S. No.	Sample	Lead originally found	Lead added	Total lead found	% recovery
1	Sugarcane juice (Area 1)	<0.05 µg	10 µg	11 µg	110
2	Sugarcane juice (Area 2)	<0.05 µg	20 µg	20 µg	100
3	Sugarcane juice (Area 3)	Not found	30 µg	30 µg	100
4	Sugarcane juice (Area 4)	<0.05 µg	40 µg	41 µg	102.5
5	Sugarcane juice (Area 5)	Not found	50 µg	49 µg	98

The table shows that the observed samples of sugarcane juices had lead concentration below TLV thus were harmless to consume (Table 1).

CONCLUSION

Sugarcane juice is a very common and healthy drink for common man can be suspected to toxic heavy metal pollution due to farmyard contamination and thus can pose hazard to human. The developed dipsticks were successfully applied to detect the presence of lead in sugarcane juice. These can also be applied to remove the lead from the juice sample if found above the TLV.

ACKNOWLEDGEMENT

Authors are highly indebted to Department of Chemistry, UIT, BU, Bhopal and Career College, Bhopal for laboratory facilities.

REFERENCES

[1] T Chen; M Lei; Yanmei; SB Li; X Wanand; X Wang. *J Resour Ecol.* **2012**, 3(4), 373-378.
[2] Directorate of sugarcane development, Govt. of India, Ministry of Agriculture,(Department of Agriculture & Cooperation), Kendriyabhavan, Aliganj, lucknow (up), January, **2013**.
[3] H Kurz; R Schulz; V Romheld. *J Plant Nutrition Soil Sci.* **1999**, 162, 323-328.
[4] P Dominy; FB Wu; GP Zhang. *Environ Experiment Botany.* **2003**, 50, 67-78.
[5] M Tiryakioglu, Seker; Fozkutlu. *J Trace Elements Experiment Med*. **2006**, 20, 181-189.
[6] Z Luan, X Shan, Y Wang, C Zhu. *Separation Purification Technol*. **2007,** 57(1), 161-169.
[7] WT Liu; YB Su; QX Zhou. *Environment Pollution.* **2009,** 157, 1961-1967.
[8] K Kanika. Benefits of Sugarcane Juice for Skin, Hair and Health, **2016**.
[9] RD Sharma; J Smita; A Sulbha. *Anal Methods.* **2011**, 3, 452-456.
[10] RD Sharma; A Sulbha. *J Chem Pharm Res.* **2012**, 4(2), 1097-1105.
[11] RD Sharma; J Smita; A Sulbha. *IJRCE,* **2012,** 2(2), 88-95.
[12] RD Sharma; J Smita; A Sulbha. *Asian J Pharm Biol Res (AJPBR).* **2012,** 2(3), 161-168.
[13] RD Sharma; J Smita; A Sulbha. *Anal Chem Indian J* (*ACAIJ).* **2012**, 11(12), 342-346.

[14] RD Sharma; A Sulbha. *IOSR JBPS*. **2012**, 3(4), 41-48.
[15] RD Sharma; B Anita; A Sulbha. *Chem Pro Eng Res*. **2013**, 11, 32-34.
[16] D Prachi; RD Sharma; A Sulbha. *IJMERT*, **2014**, 1(2), 14-19.
[17] RD Sharma; J Smita; A Sulbha. *Res J Recent Sci*. **2012**, 1(10), 51-54.
[18] RD Sharma; J Smita; A Sulbha. *J Chem Pharm Res*. **2015,** 7(6), 27-36.