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Antioxidant and Biochemical Profile of Five Sweet Sorghum Juice Varieties

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***Abstract*: Sorghum juice is primarily used as a raw source for syrup and biofuel production. Contrarily sorghum seeds have proven to be a rich source of phytochemicals and are consumed worldwide in various forms. Proving sweet sorghum juice as a source for phytochemicals and its inclusion as a parameter for better syrup quality forms the aim of this paper. Antioxidants, total Phenols, total sugars and protein content of five sorghum juice samples was estimated by 2,2-diphenyl-1-picrylhydrazyl, Folin-Ciocalteu, Di-Nitro Salicylic acid and Bradford reagents respectively. Of the five sorghum juices analysed, all the four parameters were found to be high in E10 sample with 32.23±0.12mg/ml of sugars, 3.0 ±0.15mg/ml of protein, 0.15±0.05mg/ml AEAC of antioxidants and 2.48mg/ml GAE of phenols. The results conclude that sweet sorghum juice can also be a good source of phenols, antioxidant phytochemicals and proteins. Hence phytochemical and biochemical parameters of juice may be considered for selection of suitable cultivars for syrup production.**

Index Terms: **Antioxidants, Phenols, Proteins, Sugars and Sweet sorghum juice.**

I. INTRODUCTION

Sorghum ranks fifth among the most utilized staple foods and is also an important ancient crop for the countries of South Africa, India and China. The complete plant is used for various purposes but the most commonly used part is the seeds in various forms like flakes, seed flour as malt, rotis etc. Sorghum seeds are proven to be rich in various phytochemicals like phenolics acids, anthocyanins, flavanoids (Awika, 2004(a); Linda D, 2006). Sorghum is also one of the limited sources present for 3-deoxyanthocyanins (Awika, 2004(b)), natural photochromic pigments replacing synthetic ones like diarylethenes and spiropyrans usage industrially (Tasaki K, 2020). Another form of sorghum; Sweet sorghum is an agro-industrial crop used primarily for syrup preparation and other industrial uses like ethanol, lipids and amino acids production (Dattamazumdar, 2012; Johnston, 2018; Yanna liang, 2010). It is deemed to be economical compared to other biofuels feedstocks like sugar cane , sugar beet and corn; as it is more tolerant to biotic and abiotic stress, can be grown throughout the year in all climatic and soil conditions. It is called as "sugarcane of the desert" and ''the camel among crops'' for its drought tolerance characteristics (Vinutha, 2014; Nandini, 1987).

Similar to grain sorghum, sweet sorghum juice can also be a source for phytochemicals and proteins apart from sugars. Studies on commercially available sorghum syrups have shown that sorghum syrup have higher phenolics content compared to other syrups like high fructose corn syrup, agave, maple etc (Eggleston G, 2020). Sorghum syrups were found to be rich in phenolics acids like synapic acid, ellagic acid and protocatechuic acid (Eggleston G, 2020). It is also proved that the syrup quality is dependent on the sweet sorghum cultivar used (Abd El-Razek, 2009). But studies on bioactive composition of sorghum juice which is the raw source for syrup is not available. It is also important to consider the phytochemical and biochemical potential of juice as a parameter for syrup production along with other parameters like carbohydrate content, yield processing conditions etc. Evaluation of various sweet sorghum juice cultivars for nutritional content can give an insight into its potential usage for human health. Further sweet sorghum juice can also be considered for usage in various juice cocktails which is a current trend.

Thus the present investigation attempts to establish the phytochemical potential of sweet sorghum juice using five different cultivars.

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II. MATERIALS AND METHODS

Five sweet sorghum juice varieties E1, E2, E4, E10 and E13 were collected from ICRISAT. The collected juice was filtered to remove solids, aliquoted and stored at -20°C until further use. The juices were used to evaluate their antioxidant property, total phenolics content, total sugars and protein content.

A. *Materials*

Dpph (2,2-diphenyl-1-picrylhydrazyl), Folin-Ciocalteu reagent were procured from sigma Aldrich. Coomassie Blue G250, Dinitro salicylic acid, sodium potassium tartarate, sodium hydroxide were purchased from himedia. Phosphoric acid of analytical grade, methanol of hplc grade was procured from himedia. Ascorbic acid, glucose, bovine serum albumin and gallic acid of sigma aldrich were used as reference standards.

B. *Methodology*

Antioxidant activity was estimated using DPPH assay by free radical quenching activity as given by Maria rita (2017). The results were expressed as *Ascorbic acid* equivalent antioxidant capacity AEAC. Total phenolics content was estimated using Folin-Ciocalteau method (Singleton, 1999) using gallic acid as standard. Results were expressed as mg gallic acid equivalents per ml of juice. Total reducing sugars were estimated using DNS reagent as per the protocol of Anamaria (2012). Results are expressed as mg/ml glucose. Proteins were estimated with Bradford reagent and results expressed as mg/ml of BSA equivalents.

C. *Statistical Analysis*

All the tests were carried out in triplicates and results expressed as mean ± standard deviation.

III. RESULTS AND DISCUSSION

Sweet sorghum and sugar cane juice are used as raw materials for syrup production in many parts of globe. But data on the nutritional constituency of sweet sorghum juice is not available widely due to its limited usage both in form of juice and syrup. This may be attributed to the sour and pungent flavour of juice and syrup due to presence of aconitic acid (Ospankulova G, 2020; Rokaia R, 2020). But selection of the right variant of sorghum for syrup production can alleviate these characteristics to a certain extent. Information on phytochemical contents of juice may also help in proposing usage of sweet sorghum juice as a fresh bever similar to that of fruit juices.

Of the five sweet sorghum juice varieties studied, the phytochemical antioxidants were found to be comparatively very high in E10 sample (0.15±0.05mg/ml AEAC) as shown in Fig.1. Also the results further prove the fact that the phytochemical content is dependent on the sweet sorghum cultivar. Other varieties under study have half the phytochemical content as that

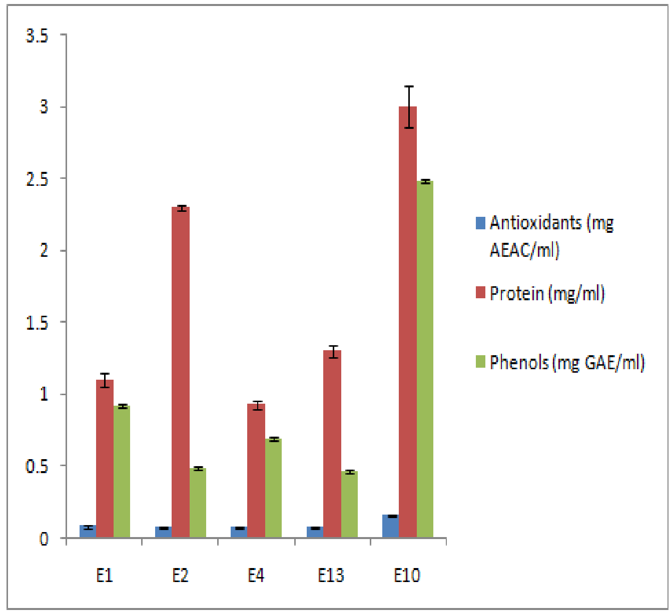

Fig. 1. Antioxidant, protein and phenolics content in five sweet sorghum varieties. Error bars represent standard deviation.

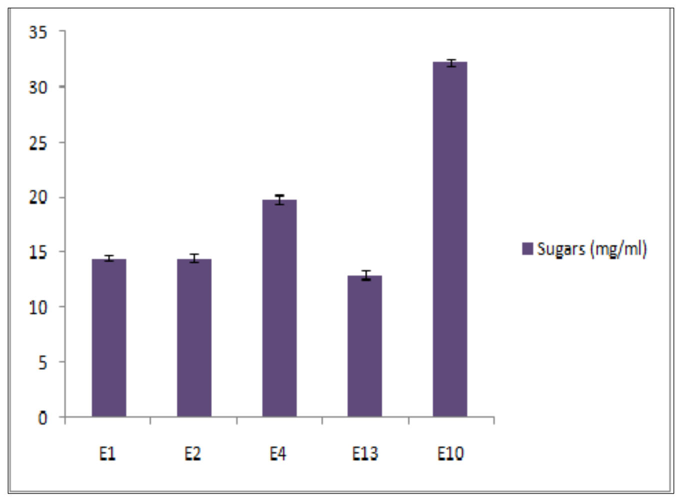

Fig. 2. Carbohydrate content in five sweet sorghum varieties. Error bars represent standard deviation.

of E10 in the range of 0.069±0.009 to 0.079±0.009. But further studies are required for establishing the nature of phytochemicals. Total phenolics content was also found to be in correlation with antioxidants with E10 showing high phenolics content (2.48±mg/ml GAE) followed by E1 (0.92 ±mg/ml GAE) [Fig 1]. These results are in accordance to that of syrup values 6471 ± 1823 mg/L given by Eggleston G (2020) as syrup is a condensed form of juice.

Sorghum is a rich source of proteins which include kafirins (Taylor, 2018). Proteins of sorghum were found to be resistant to digestion by pepsin and are known to impact the nutritional properties of sorghum. These are also thought to play a role in low glycemic index foods development (S.R Bean, 2011). Similar to antioxidants and phenols content, protein content was also found to be comparatively high in E10 sample

(3±0.15mg/ml BSAE) followed by E2 (2.3±0.02 mg/ml BSAE), E13(1.3±0.04 mg/ml BSAE), E1(1.1±0.05 mg/ml BSAE) and E4(0.93±0.03 mg/ml BSAE). Studies show Sweet Sorghum juice to be a rich source of carbohydrates like starch, glucose, fructose and sucrose. For the samples under present study reducing sugar content was also found to be high in E10 (32.23±0.12mg/ml).

Sweet sorghum cultivars like E10 which show high phytochemical, protein and carbohydrate content can be utilized as a raw source for high quality syrup. It can also be stated that it is important to consider the phytochemical and biochemical characteristics of sorghum cultivars while determining the best variety for syrup production which can influence the health benefits and promote their further utilization as a food source.

CONCLUSION

From the present study it can be concluded and recommended that evaluation of sorghum cultivars on basis of bioactive constitution is necessary in selection of cultivars during syrup preparation. However, further studies on phytochemical and biochemical changes during processing of juice to syrup may add upto the importance of these parameters consideration in selection of suitable cultivars for syrup preparation. This also helps in increasing the market value of sweet sorghum juice and syrup for consumable sources.

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