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Total phenolic, chromium contents and antioxidant activity of raw and processed sugars

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ABSTRACT

Processing improves the visual quality of food; however, the ingredient and nutritional values may alter. In present study, the sugar samples (refined, raw, gur (Jaggery/jaggeree) and molasses) were collected from 20 different agro-climatic regions of Pakistan and analyzed for the chromium concentration, total phenolic and antioxidant activity, in order to evaluate the processing effect. The concentration of Cr was determined by digestion method using atomic absorption spectrophotometer, while antioxidant activity was determined by DPPH (1,1-diphenyl-2-picrylhydrazyl) and reducing power. It was observed that chromium content in Jaggery was 74% higher than raw sugar, while molasses showed 21.27% higher concentration versus jaggery. The total phenolic contents were found considerably higher in molasses (3751 μg GAE/g) followed by Jaggery (3285 μg GAE/g), raw sugar (27.75 μg GAE/g) and refined sugar (23.81 μg GAE/g). The DPPH scavenging activity and reducing power was also found dependent to sugar type. Form results, it can be concluded that processing significantly affected the chromium contents, total phenolics and antioxidant activity.

1. Introduction

Chromium is present in all living individual and essential for the metabolism of carbohydrates and lipids [1,2] and deficiency can leads to the disorder in metabolic activities and causes diseases such as diabetes mellitus which is a global disease, increasing rapidly and has been doubled since last two decades. At present, more than 240 million people are pretentious to this disease [3]. Diabetes mellitus is a disease of metabolism abnormality due to chronic chromium deficiency and is implicated in several cardiovascular and metabolic pathologies such as non insulin dependent

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diabetes mellitus (NIDDM) [2]. Reports revealed that the chromium supply had significant beneficial effect on Glycated hemoglobin, glucose, insulin and cholesterol regarding type II diabetes [4]. Therefore, the chromium is a nutritionally essential element with a requirement in human from 10 to 60 μg/day for healthy person [5–8]. Attempts have been made to identify the chromium deficiency in diabetes patients [9,10]. Therapeutic trials with trivalent chromium gave good results and lead to significant improvement in glucose tolerance with lowering fasting glucose, plasma total cholesterol, LDL cholesterol [11] and reduction in plasma triglyceride in type 2 diabetes patients [12]. For diabetes patients, the World Health Organization [8] suggested the utilization of chromium rich sources foods, approved by National Bureau of Standards such as Brewer's yeast, Bovive liver, orchard leaves, spinach, pine needles and tomato leaves to mitigate the chromium deficiency [4,10,11]. Refined sugar is used as sweetener in beverages (juices, syrup and tea coffee) and in making desserts such as jams and cakes. According to Bratakos et al. [13], the concentration of chromium vary based on food processing methods and source which might affect the nutritional value of food. Sugars are obtained from sugarcane and sugar beet crops. In sugar industry, initially, raw sugar (brown sugar) is produced, which is a sucrose sugar with brown color due to the presence of molasses, which is an unrefined or partially refined sugar consisting of sugar crystals with some residual molasses content (natural brown sugar). Refined sugar is made from raw sugar by further processing, which removes molasses and resultantly, white crystals are obtained. Molasses also called black treacle, is a viscous by-product of refining sugarcane or sugar beets into sugar. Jaggery is a traditional non-centrifugal cane sugar, which is commonly consumed in Asia, Africa and America. The major constituents of Jaggery are 50% sucrose, 20% invert sugars, 20% moisture and remaining part contains insoluble matter (wood ash, proteins, and bagasse fibers etc.) [14–17].

The plant and plant products have been the main focus in the search for nutraceuticals to combat oxidative stress induced diseases [18]. Free radicals are generated during normal cellular metabolism and their effect is neutralized by antioxidants. However, this balance between the oxidants and antioxidants molecules is disturbed by free radicals derived from exogenous sources like ozone, exposure to UV radiations and cigarette smoke. The free radical production in cells can be significantly increased by certain toxic redox cycling compounds such as drugs and carbon tetrachloride. Importantly, the main biomolecules like DNA, lipids and proteins are vulnerable to free radical damage resulting in cell destruction. Damaged cells lead to abnormal functioning and results in oxidative stress induced diseases. A potent scavenger or quencher of free radicals may serve as a possible preventive measure for free radical mediated diseases and naturally occurring plant product are the potent source of scavenger. However, the processing of the natural product may affect the quality of food products [19,20].

Sugarcane extract has been reported to be excellent source of organic compounds i.e., phenolic compounds and minerals [21] with significant antioxidant activity [22]. However, it has been reported that processing/refining of food product can alter the food quality [23] i.e., blanching results in losses of vitamins and minerals. Also, milling and extrusion can cause the physical removal of minerals during processing. The nutritional quality of minerals in food depends on their quantity as well as their bioavailability. Moreover, the bioavailability also reported to be significantly different in processed and raw foods. The contents of food components are altered by various processing methods including milling, fermentation, extraction and thermal processing. Bioactive components are highly sensitive to the processing methods as well as the processing conditions [24].

In view of processing effect on food quality, present study was aimed to appraise the processing effect on chromium content, antioxidant activity and phenolic contents of sugars. Different products i.e., refined, raw sugar, jaggery (Gur) and molasses were collected from 20 different agro-climatic region of Pakistan and were analyzed for chromium concentration, antioxidant activity and total phenolic compounds in order to evaluate the processing effect on sugar quality.

2. Materials and methods

2.1. Chemicals and reagents

The chemical and reagents used were of analytical grade i.e., HNO_3 (70%), HCl (⩾99%), chromium standard (TraceCERT®, 1000 mg L^{-1} Cr in nitric acid), Folin–Ciocalteu reagent (F 9252), DPPH (CS0790-1KT), sodium carbonate (⩾99%), Tris–HCl buffer (99%), ethanol (99.5%), disodium hydrogen

Table 1 – The station selected for sampling of jaggery, molasses, raw and refined sugar.

Code	Station	Location	Code	Station	Location
1,21	Tandilnwala	Kanjwani/Faisalabad	11,31	Noon	Bhalwal/Sargodha
2,22	Chaudhry	Gojra/Toba Tek Singh	12,32	Pahriawali	Lalian/Jhang
3,23	Chistia	Sillanwali Chistia/Sargoda	13,33	Pattoki	Pattoki/Kasur
4,24	Crescent	Nishtabad/Faisalabad	14,34	Ramzan	Chainot/Jhang
5,25	Csk(phalia)	Phalia/Mandi Bahauddin	15,35	Shahtaj	Mandi Bahauddin
6,26	Gojra Samundri	Gojra/Faisalabad	16,36	Shakarganj Jhang	Jhang
7,27	Haseeb waqas	Nawabshah	17,37	United	Rahim Yar Khan
8,28	Hussain	Jaranwala/Faisalabad	18,38	Yousaf	Sargoda
9,29	Kamalia	Kamalia	19,39	Adam	Chistian/Jhang
10,30	National	Bhalwal/Sargodha	20,40	Shakarganj Bhone	Jhang

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