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Extraction of Dietary Fiber from Sugarcane & its Application in Foods

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Abstract: ***The present work was conducted to investigate the sugarcane residue (SR) left after the extraction of juice subjecting it to physical treatments. Sugarcane bagasse from sugarcane industry could be utilized for the extraction of dietary fiber. Among the methods the best method of extraction was identified to get maximum yield. Sugarcane bagasse is cheap as compared to other sources. The presence of extracted dietary fiber was confirmed by identification test. The yield of insoluble dietary fiber was 12% using alkali treatment. In this study, the extracted dietary fiber was introduced in bread. Bread was made up of usual ingredients with addition of extracted dietary fiber. It was used to increase ability of digestive system. By employing optimum parameters for the extraction good quality dietary fiber could be extracted successfully from bagasse. The extracted dietary fiber can be used in number of products. Though the method used for extraction of dietary fiber is time consuming, but it is economical.***

Keywords: Sugarcane Bagasse, IDF (Insoluble Dietary Fiber), Dietary Fiber (DF), Insoluble Dietary Fiber, Bread

1. Introduction

Sugarcane is several species of toll perennial true grasses of the genus *Saccharum*, tribe Andropogoneae used for sugar production. The plant is 2 - 6 meter tall. Sugarcane belongs to family Poaceae. The global demand of sugar is the primary driver of sugarcane agriculture. Sugarcane is the world's largest crop by production quantity with 1.9 billion tons produced in 2015, with Brazil accounting for 41 % of world's total. Sugarcane accounts for 79% of sugar produced most of the rest is made from sugar beets, about 70 % of the sugar produced globally comes from a species of sugarcane called *Saccharumofficinarum* & hybrids using these species. Sucrose extracted from sugarcane in specialized mill factories is either used as raw material in the food industry or fermented to produce ethanol. In some regions people use sugarcane reeds to make pens, mats, screens & thatch. Sugarcane was an ancient crop of the Austronesian & Papuan people. In 18th century AD, sugarcane plantations began in Carrabin, South American, Indian Ocean& pacific island nations & need of laborers become a major driver of large migration of people.

Saccharumofficinarum is a large, strong growing species of grass in the genus *Saccharum*. Its stout stocks are rich in sucrose, a simple sugar which accumulates in the stock internodes *Saccharumofficinarum* is one of most productive & most intensively cultivated kinds of sugarcane. it can interbreed with other sugarcane species, such as *Saccharum Sinense* & *Saccharumbarberi.* About 70 % of sugar produced globally comes from *Saccharumofficinarum*& hybrids in the species. *saccharumbarberi* was only cultivated in India after the introduction of *Saccharumofficinarum Saccharumbarberi* originated in India & has been exported to other parts of the world. *Saccharumsinese*, sugarcane is strong growing species of grass Poaceae in genus Saccharum. *Saccharumofficinarum* was first domesticated in New Guinea& the island east.

Crude fiber is a major of the quantity of indigestible cellulose, pentose's, lignin & other components of these types of present foods it was developed in 1850s. Dietary fiber is portion of plant derived food that cannot be completely broken by human digestive enzymes. Soluble fiber & insoluble fiber are two main components. Dietary fiber is found in fruits, vegetables, legumes, whole grain breads& cereals. In 2016 ruling, the FDA the increase the daily reference value (DRV) for dietary fiber from 25 g per day to 28 g per day. In 2018, the British nutrition foundation issued a statement to define dietary fiber and enlist potential health benefits & increasing yields recommended daily intake to 30 g.

Many molecules that are considered to be 'dietary fiber' are so because humans lack the necessary enzymes to split the glycosidic bond and they reach the large intestine. Dietary fiber has distinct physiochemical properties. Food polymers may be soluble in/or plasticized by water. Water is the most important plasticizer, particularly in biological systems hereby changing mechanical properties. Dietary fiber may act on each phase of ingestion, digestion, absorption, and excretion to effect cholesterol metabolism. All important action of some fibers is to reduce the reabsorption of bilec acids in the ileum and hence the amount of and type of bilec acid & fats reaching the colon.

The fibers are the most effective in influencing sterol metabolism (e. g. Pectin) are fermented in colon. Other fibers e. g. Gum arabic acts as stabilizers & cause significant decrease in serum cholesterol without increasing fecal bile acid excretion. Feces consist of plasticine like material, made up of water, bacteria lipids, sterols, mucus & fiber. Feces are 75% water, bacteria make a large contribution to dry weight residue being unfermented and excreted compounds only dietary fibers increases fecal weight. The fermentation of some fibers results in an increase in bacterial content & possibly fecal weight. the proximate composition of sugarcane dietary fiber & the most important physical & chemical properties (pH, alkalinity, color, oil & water absorption ability) were also evaluated.

2. Materials & methods

Sample preparation
Previously sugarcane species co - 86032 & co - 10001 are collected & rinsed with distilled water to remove any surface contaminants such as dust, soil, fertilizers and pesticides. Cutting of sugarcane and rising with distilled water was carried out. After that grinding and juice extraction must done. Drying of Sugarcane bagasse must carried out by methods of hot air oven in college laboratory. Before drying of sugarcane bagasse the bagasse should be washed properly by using clear water. Moisture removal was carried out and packed in polyethylene bags and stored at room temperature for further use. Removal of fat from bagasse was done by using Soxhlet extraction method.

Chemical composition of extracted dietary fiber
Moisture, carbohydrates, ash, fat, protein determinations of dietary fibers where determined according to AOAC procedures. The alkalinity of defatted fiber was analyzed. The moisture content of dietary fiber was calculated based on weight loss after the sample was heated in oven at 100C until weight becomes constant. Non - reducing sugar was determined by Fehling's method. Pectin test and iodine test were also determined. Fat content was determined by extraction with petroleum ether in a Soxhlet apparatus. the total protein content from defatted & dried fiber was determined by micro jheldhal method, using 6.25 as a conversion factor. The ash content of dry fiber was determined by incineration in the muffle furnace at 550^{o}c at 5 hrs.

Extraction with cold & hot water:
The defatted fiber samples were extracted with cold, slightly alkaline water (pH 7 - 7.5) for 2 hours at 20 ^{o}c. after that the residue were washed with hot water containing 24 % KOH & 2 % boric acid solution. The washed residue was dried & kept for further analysis. These residues were called insoluble dietary fiber (IDF).

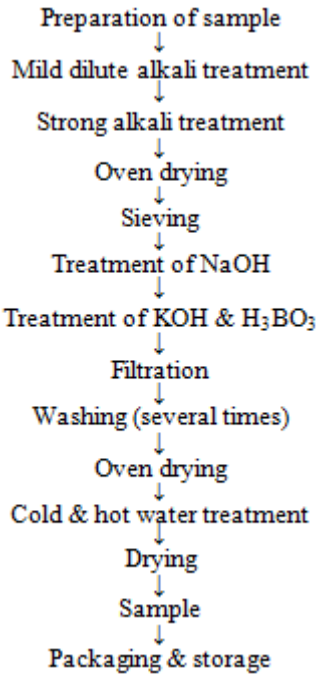

Figure: Extraction & fractionation of fiber

Application
The dietary fiber can be used in various foods. In this study, the extracted dietary fiber was introduced in bread. The bread was made up of usual ingredients like refined wheat flour, sugar, salt, oil & yeast. Dietary fiber was used to increase ability of digestive system. There were three samples of bread. Each sample was with different concentrations of dietary fiber. Sample A contains 2%, sample B contains 2% & sample C contains 3% concentration of dietary fiber. The sensory analysis was performed for all samples for texture. The taste of all sample were same, the difference is only in concentration of dietary fiber. Most of the panel members prepared sample C which contains 3 % concentration of dietary fiber.

3. Result & Discussion

1) Dietary fiber content
The insoluble DF was the major fraction in sugarcane bagasse. Insoluble DF is important to intestinal regulation, whereas the soluble fraction s involved in reduction of both blood cholesterol & intestinal glucose absorption. Insoluble DF was 36.50% of total DF content. This is a relatively high value in comparison with other fruit & vegetable processing byproducts.

2) Water & oil absorption ability
The water absorption ability of sugarcane DF was higher than oil absorption ability.

3) Proximate composition
The moisture of DF depends primarily on the intensity of the slurry dehydration during the processing of DF. The carbohydrate content of the sugarcane DF was high due to increased sugar concentration. The protein (7.2%) & lowest mineral content (1.14%) were found in sugarcane DF.

4) Color
Sugarcane IDF presented an off white color.

5) pH & alkalinity
The IDF from sugarcane bagasse of species CO - 86032 & CO - 10001 had a similar pH (7). The alkalinity was 0.

6) Identification test
Contact test, chew test, cook test, were carried out.

7) Sensory evaluation
Sensory evaluation was carried out by using 9 point hedonic scale rating.

Sr. no.	Sample	Rating
1	Sample A	Like slightly
2	Sample B	Like moderately
3	Sample C	Like very much

4. Conclusion

On the basis of present study bagasse from the sugarcane industry could be utilized for the extraction of dietary fiber. Among the methods the best method of extraction was identified to get maximum yield. By employing optimum parameters for the extraction good quality dietary fiber could

be extracted successfully from bagasse. The extracted dietary fiber can be used in number of products. Though the method used for extraction of dietary fiber is time consuming, it is economical. From the study it can be concluded that the sugarcane bagasse is cheap as compared to other sources. The presence of extracted dietary fiber was confirmed by identification test. Chemical analysis of fibers indicated that the moisture content of the sample was 11.32 which is less than other sources of dietary fiber. The Ash content in dietary fiber sample was in the range of1.14%. The protein content of extracted dietary fiber was found to be 7.3% and very less fat content of 7%. The extracted dietary fiber was used in the preparation of bread to make high fiber bread. The sensory analysis of high fiber bread was carried out. Swelling capacity water absorption and oil absorption) was carried out for dietary fiber. The yield of extracted Dietary fiber is 12.05%. This study therefore suggests that the methods provide reliable fractions for further characterization. Standard procedures for fractionations are needed to study various sources of fibers through the diversity of composition & properties of fiber; fiber rich ingredients can enhance the nutritional & functional properties of various foods. However, it is necessary to adapt the formulation & the processing of fiber enriched foods. Further improve sustainability of sugarcane industry. We can conclude that regular consumption of dietary fiber may help to control the cholesterol level in the body, lowers risk of heart diseases, relieves, constipation, reduces risk of cancer and diabetes.

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