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Original Research Article

SUPPRESSION OF GLYCATION ACTIVITY AND OXIDATIVE STRESS IN DIABETES MELLITUS- A NUTRITIONAL ASSESSMENT

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Abstract

Nutrition/Diet remains a key player in Diabetes Mellitus prevention and management, and rightly so, healthy eating proves to be a essential factor in prevention of complications. Cereals that are edible to eat by Indian people and showing antioxidant and antiglycation activity which can be helpful in decreasing glucose levels. Different sources of methods are used to check the activity of free radicals, their oxidative stress, antiglycation property and phenolic content. Phenolic content excellently shown by the oat meal and pigmented rice bran as well as antioxidant capacity by barley, determined by 3-ethylbenzothiazoline-6-sulphonic acid (ABTS). About minerals zinc, copper, potassium, calcium are analyzed by inductively couple plasma atomic emission spectrometry and these are present in most concentrated form in barley. Unsaturated lipids (oleic acid and linoleic acid) are 76% more in sorghum than in rye. Scavenging activity is weaker in ready to eat whole cereal where as in oat meal showed higher capacity to do scavenging activity. Barley have a lower fat content than sorghum and millet. Rye and Barley is a great source of soluble dietary fibre and higher levels of insoluble dietary fibre are present in barley and sorghum than millet and rye. Beta-glucan is the great source in barley; about 22% compositions of pentosan, lignin and resistance starch.

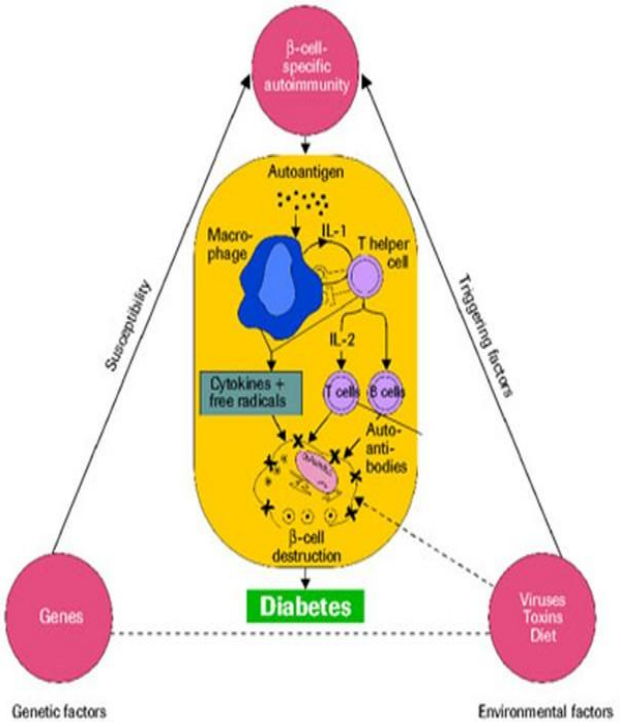
Keywords: ABTS, glucan, spectrometry, antiglycation, oxidative stress

Introduction

In world, diabetes are rising day by day and all over the world. Seconday complications can occur when it meets with highly sugar levels for a longer time which results in multiple organ failure[1] **(Dee Zeeuw D et al. 2008)**. Reasons that leads to severe complications in diabetics are due to multiple reactions between aldehyde group of sugars and amino group of proteins[2] **(Wu JW et al. 2009)**. Due to excess glycation rate in diabetes it changes the structure and modifies the proteins. Different three stages from which glycation passes are beginning, middle and backward[3] **(Baker JR et al. 1985)**. Proteins that form Schiff bases with their amino groups can react easily at the beginning stage with reducing sugars. By the end, there is formation of different advanced glycation end products which are insoluble, fluorescent in nature. Healthy individuals with lower levels of Oxygen Species and Vitamin C serum levels have decreased level of various antioxidant enzymes[4] **(Goh SY et al. 2008).** Formation of intermediate product and inhibition shown by identified compounds could be an approach for generation of new therapeutics and thereby vascular diseases could be prevented in diabetes. Inhibition reaction occurs in AGEs which has a main role in diabetes and ageing process; can control the diabetes difficulties and slow down aging process.[5] **(Xi M et al. 2008).**

Diabetes mellitus can be treated by regular screening of new compounds that have potential antiglycation and antioxidant properties[6] **(Dai J et al. 2010)**. It is well known that plants which possess antioxidative and pharmacological properties are related to the presence of phenolic compounds, especially phenolic acids and flavonoids[7] **(Ignat I et al. 2011)**. Antioxidant properties have been seen in the extraction done from medical plants invitro and it becomes an area of research in medical field. Risk of obesity, diabetes can also be prevented by polyphenols present in source material. Plants that are used as antioxidant possess a phenolic compounds especially flavonoids and anthocynanis[7] **(Ignat I et al. 2011)**

Role of damaged erythrocytes in pathogenicity and progression of complications related to diabetes mellitus has been clinically and experimentally proved[8] **(Brown CD et al. 2005).** Inflammation occurs in the blood streams and kidney due to oxidative stress caused by glycated albumin and also due to higher glycemic index in erythrocytes. Evaluating effect of therapies is necessary in treating dysfunction caused by erythrocytes.



Products shows antiglycation and antioxidants

1. Fruits ***(****Spondias purpurea****)***
2. Cereals (*Barley, Rice, Oats, Dahlia*)
3. Medicinal plants *(Azardica Indica, Emblica officinalis, Syzygium cumini and Terminalia bellrica)*
4. Culinary plants (*Cinnamomum burmannii, Coriandrum sativum*)

Cereals role in antiglycation and antioxidant properties

Rice bran

The inhibitory enzyme activity shown by extracts of red varieties collected from 35 SriLankan traditional, have significantly higher level than white varieties. Phenolic compounds is specifically rich in pigmented rice[9] **(Sompong R et al. 2011).** Amylase activity got inhibited resulting in easy management of Type 2 diabetes by phenolic compounds.[10] **(McCue P et al.2004)**. In previous study, to check the anti-glycation, reverse glycating process, reduction of amylase levels is checked through giving doses of rice grain abstracts and some of them successfully got results.

Complications that occurred in diabetes, cardiovascular disease, cancers, all involved free radicals. It has also been reported that foods having antioxidant properties could increase human diseases. Radical activity is determined by biochemical methods such as DPPH (diphenypicrylhydrazyl) and ABTS (3-ethylbenzothiazoline-6-sulphonic acid). **Farrar JL et al. 2008**[11] studied the antiglycation activity of brans of rice, oat, wheat and sorghum where as wheat bran didn't show antiglycation activity. Solubility of molecules in alcohol is shown by DPPH where as solubility of molecules in water by ABTS.

Sorghum grain

Sorghum grain is a stable cereal and it is found some parts of India, Africa, China[12] **(O'kennedy MM et al. 2006).** In drought effected countries with semi-arid areas, sorghum and millets develop easily[13] **(Awika JM et al. 2004)**. Sorghum can be filled into two categories- phenolic acid and flavonoids. The phenolic acids are benzoic or cinnanic acid derivatives and where as flavonoids are larger tannins and anthocynanins[13,14]**(Awika JM et al. 2004; Dykes L et al. 2007)**. Sorghum lipids consist of lots of fatty acids, oleic acids and linoleic acids[15] (**Pomeranz H et al.1981).** ABTS activity can be purely seen in Sorghum where as it is lower in Rye.

Oats

Quaker ready-to-eat cereal have higher phenolic content but not so higher than oat meal and easily direct DPPH radicals as compared to the whole cereal wheat using Folin-Ciocalteu agent**. Zielinski L et al. 2000** [16] found that porridge show longest range of phenolic compounds comparatively to other pre-packaged foods and also shows no relationship from trying different grain specimen and response to phenols is low.

Oxidative damage is in weakest form in cereals comparatively to the fat soluble vitamins, ascorbate, a lipophilic organic compound. Cereals satisfy radical polymerization about 64%, 53% and 27% in Corn meal boiled with water, rolled oats, flakes that are frosted, results cause to be visible in similar conditions. Comparision of cereals with others vitamins and also some chemical compounds satisfy the radicals activity is in different percentages 86%, 94%, 85% on exposure of quite similar conditions. Scavenging activity is weaker in ready to eat whole cereal where as oat meal showed higher capacity to do ABTS activity.

Barley

Barley various value added products are used as a food in India, China, West Asia, North Africa [17] **(Bhatty RS. 1999).** Barley have a lower fat content than sorghum and millet. Rye and Barley is a great source of soluble dietary fibre and higher levels of insoluble dietary fibre are present in barley and sorghum than millet and rye. Excess amount of varieties of minerals such as copper, zinc, potassium, calcium are present in barley where as sorghum had a poor number of minerals. These minerals can be analyzed by using inductively coupled plasma atomic emission spectrometry.

Table 1: Minerals contain in whole grain in higher level than wheat grain due to kernels present

Minerals	Hard wheat	Soft wheat	Barley	Rye	Millet	Sorghum
P	3498	977.6	45.70	3620	2879	349.0
K	826.2	1225	4572	3570	2798	2399
Mg	301.2	306.5	1971	1328	1488	187.7
Ca	159.5	202.2	736.2	348.7	508.6	27.3
Na	46.0	38.4	238.4	30.6	60.89	4.6
Zn	30.8	7.6	74.2	30.6	65.9	3.1
Fe	13.2	13.9	128.4	44.0	199.8	10.6
Mn	5.2	8.1	9.2	24.4	8.1	1.2
Cu	1.4	1.6	5.7	2.9	3.4	0.2
Ca	0.1	0.001	0.9	0.7	7.7	0.8

Higher insoluble dietary fibers are present in Barley and Sorghum than in millet and rye. Amount of minerals such as zinc, copper, potassium, calcium are more in barley. Barley and Rye is more concentrated with all minerals than sorghum which has poor quality minerals. Barley extract has great potential of antioxidant activity than rye. Beta-Glucan is the core component of barley which makes it an efficient dietary product with high content of fatty acids, pentason, resistance starch[17] **(Bhatty RS. 1999)**.

Nutrition facts

Oats

Oats are the most nutritious that are used as human food. Oats whole grain contains the germ, endosperm and is rich in nutrients. It acts mostly as a dietary fibre, and has good crude fat, vitamins, minerals content.

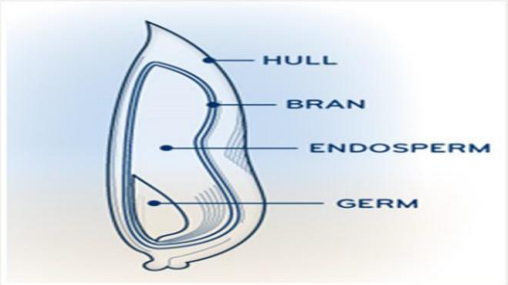


Figure 1: Structure of oats grains (Quckeroats.com)

Components of a molecule that contain one hydroxy group are - phosphatide, sterol alcohols, gangliosides and these are present in triglycerides. Presence of oat starch will suppress the level of starch retrogradation in oats[18] **(Gudmunsson M et al. 1989).**

Table 2: Nourishment formation of broken grain oat and processed oats[19].(Usman S et al. 2010)

Nutrients	Whole grain oat	Oat bran
Protein	15-17%	15-18%
Starch and sugars	59-70%	10-50%
Fat	4.5%	6.5%
Total dietary fibre	12%	14.15%
Ash	3.5%	2.4%
Beta-Glucan	2-6%	5-20%
Cellulose	14%	2.5%
Lignin	2.4%	4.5%

Barley

Fiber, selenium, vitamin B complex, copper, chromium, phosphorus, magnesium, and niacin are ranging more in barley. When compared to other grains or ancient grains, barley shows some possible effect on diabetes, cardiovascular disease. Lower calories and easy fat digestion property make this cereal more efficient. Least kilocalories are present in one serving spoon of common barley whereas other grains such as sorghum, brown rice, quinea, millet has less fibre content.

Figure 5: Label of mark details in one bowl of nutrient barley https://draxe.com/nutrition/barley-nutrition/

Manganese	20 % DV (Daily Value)
Selenium	19% DV
Niacin	16% DV
Iron	12% DV
Manganese	9% DV
Zinc	9% DV
Thiamin	9% DV
Folate	9% DV
Phosphorous	8% DV
Copper	8% DV

Sorghum

Sorghum bicolor is the fifth most important cereal in world, being most popular in United States. It contains higher content of phenolic and antioxidants which helps to get rid of various health diseases such as cardiovascular disease, diabetes, fatigue, diarrohea and some other serious health problems. It has been also used as a livestock in U.S. It has also several health benefits, serves as antioxidant, rich in vitamins and minerals, prevents heart disease and improves immunity. Sorghum can be used as staple foods for poor people and rural areas South Africa , Central America and South Asia. Eco-friendly nature of sorghum may be used for sustainable energy.

Conclusion

Cereals with great amount of minerals such as copper, zinc, potassium and calcium could be a great potential of antioxidation, thereby reducing oxidative damage and thus being beneficial in various human health diseases. Antiglycation properties present in cereals is a potential

treatment for diabetes, cardiovascular diseases. Many researchers are still working on different cereals and their mixtures which will be showing some possible results in upcoming days. New research is going to increase on cereals which will have an important role in the food industries, pharmaceutical industries, ayurveda and livestock. In future, gaining a new information regarding cereals and using biotechnology formula we will definitely make use in food industry.

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