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Effect of *Citrus sinensis* peel on the blood sugar level in Diabetic White Rat

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ABSTRACT

Citrus sinensis is a citrus orange belonging to the family Rutaceae. The peel contains fibre, Vitamin C, polyphenols, provisional A, folate, riboflavin, thiamine, Vitamin B6 and calcium. The peel extract was given to twenty white rats weighing between 140-200g. They were divided into four groups. Group 1 was control whereas the experimental rats (groups 2 to 4) received 10mg/kg, 20mg/kg, 30mg/kg doses of *Citrus sinensis*peel extract, group 2 rats treated with alloxan monohydrate to induce Diabetes mellitus. Fasting blood sugar levels were obtained and compared between groups. A significant difference ($p<0.05$) in relative blood sugar level among groups (control, medium dose and high dose) was absen except in low dose group. A statistically significant difference was observed for blood sugar levels across the groups compared to control. Thus, consumption of *Citrus sinensis peel* extract caused a dose dependent effect on blood sugar level in white rats.

Introduction

The orange is a citrus fruit originated in a region comprising Southern China, North east India and Myanmar. Orange trees are widely grown in tropical and sub-tropical climate for their sweet fruit. The fruit of the orange tree can be eaten fresh or processed for its juice or fragrant peel. As of 2012, sweet oranges accounted for approximately 70% of citrus production. 73 million tons of oranges were grown worldwide, with Brazil producing 24% of the world total, followed by China and India.

Orange peel, which is the primary waste fraction in the production of orange juice, contains flavonoids associated with antioxidant activity (Kanaze et. al. 2008). The glycosides hesperidin and naringin are mainly responsible for the purported antioxidant activity of citrus peel extract.

The citrus peel extract, polymethoxylatedfl avones (PMFs) has been reported to have beneficial effects on cholesterol level. The

PMF restores insulin sensitivity. PMF are similar to other plant pigments found in citrus fruits that has been increasingly linked to health benefits, including protection against cancer, heart disease and inflammation. The main PMF in the extract are tangeretin and nobiletin as well as small amount of synephrine.

The major ingredients of the orange peels are flavonoids, that mainly consists of terpenoid such as limolene, linalool and other volatile oils. The peels contain a large amount of Vitamin C. Besides it also provides Vitamin A and B complex and minerals such as Calcium, Magnesium, Selenium and Zinc (Morton 1987).

Diabetes mellitus is a metabolic disorder that has caused significant morbidity and mortality (Patel et. al. 2012). This is a chronic disease caused when either the body can not use the insulin effectively produced by the body or when the pancreas does not produce enough insulin. This disease prevents the body from properly using the energy from the food taken. The blood vessels and the blood are the highways that transports sugar from where it is either taken in (the stomach) or manufactured (in the liver) to the cells where it is stored (Fat). The pancreas releases insulin into the blood which serves as the helper, or the "key" that lets sugar into the cells for use as energy. When sugar enter the cells, the blood sugar level is lowered. Without insulin the sugar cannot get into the body cells for use as energy. This causes a rise in the blood sugar level. Too much sugar in the blood is called "Hyperglycemia" or commonly known as 'High Blood Sugar'. The orange peelsarea source of health promoting carbohydrates. Orange peel and pulp contain hesperidin, a flavonoid that helps to lower cholesterol and triglyterides. Orange peel being rich in pectin which is a natural fibre helps to reduce cholesterol levels (Youssef, et. al. 2013) also.

Present study aimed to evaluate the effect of sweet orange peels on the blood glucose level in diabetic rats.

Materials and methods

Materials

Orange Peels:

The *Citrussinensis* is the variety of orange used. The peels were obtained from fresh orange. The peels were cleaned and washed with tap water. Then air drier oven was used to dry the peels. The oven was set at 45 degree Celsius for 48 hours. A Multi Mill apparatus was used, and the peels were passed through fine mesh sieve and fine powder was obtained.

Rats:

Twenty healthy adult male albino rats 140-200 grams were taken for the research work.They were kept in single wire cages with wire bottoms under hygienic conditions and controlled laboratory condition of temperature (26 degree Celsius), lighting and ventilation.

Food and tap water were provided and checked daily.

Diet:

The vitamin mixtures and salt mixtures were prepared according to (AIN, 1977).

Experimental Design:

The adult male albino rats were fed on standard diet for 10 days for adaptation with the environment. They were then divided into four groups (n=5). The first group (1) was given standard diet only and served as control group. The remaining three groups i.e. group 2, group 3 and group 4 were the diabetic groups. Diabetes was induced in the normal healthy rat by injecting alloxanmonohydrate in the dose 150 mg per Kg body weight according to the method described by Desai &Bhide (1985). Six hours after the injection of the alloxan monohydrate, fasting blood samples were obtained by retro-orbital method to estimate the fasting serum glucose. When the fasting serum glucose was more than 200 mg per dl, the rats were considered to be diabetic (NDDG, 1994). The groups 2, 3 and 4 were given basal diet plus 10 mg per kg, 20 mg per kg, and, 30 mg per kg orange peel extract respectively and replaced by equal amount of starch for 60 days. At the end of the experiment period, the animals were sacrificed after being fasted (overnight) under anesthetized condition. The blood samples were collected from the hepatic portal vein in dry centrifugetubes. The serum was separated by centrifugation of the blood at room temperature in a centrifuge machine by revolving at a speed of 4000 rpm (revolutions per minute) for 20 minutes and kept in plastic vial at -20 degree Celsius till analysis.

Method

Chemical Analysis of Peels

The crude protein, fibre, fat and ash content were determined by following the method described by (AOAC, 1995).

Biochemical Parameters

The enzymatic calorimetric method was used to determine the serum glucose level according to Kaplan (1984).

Statistical Analysis

The data were expressed as mean $\pm$ standard deviation (mean $\pm$ SD). The one-way analysis of variance (ANOVA) ($P<0.05$) was used for testing all variables for normal distribution. When the group showed significant differences, Turkey's multiple comparison test was performed with Snedecor and Cochran (1972).

Results and discussions

The data in Table 1, indicated that the fibre was 9.35 gram per 100gram dried orange peels represents approximately one third of the recommended daily intake. The dietary fibre is fundamental and remains intact in fibre-rich food (example fruit, vegetables, legumes, whole grains) is widely known to have

beneficial effects on the health, when consumed at recommended levels (25 grams per day for adult women and 38 grams per day for adult men) (According to Mc Rorie 2015). The risk of cardiovascular disease can be prevented by intake of high dietary fibre (Johanssan et. al.).

The Table2 showed that the blood glucose level gradually decreased in diabetic rats after 2 months (as an experimental period) with the increase of supplement dose. These results are in agreement with those reported by Youssef et. al. (2013) who reported that, the orange peels marked protection and it brought down the level of blood sugar. Chifai et. al. (2003) suggested that, glucose lowering effects are most often associated with the *viscous* fibre that lies in the soluble dietary fibre content of peels. Spandana et. al. (2016) found that orange peel and orange peel extract can provide benefits to diabetic patients and may reduce overeating, which were in accordance with the result. This mainly occurs due to the presence of natural fibre in the orange peels as a natural source of pectin, which helps in reducing blood sugar.

Table 1 Chemical composition of dried orange peels (g%)

Constituent Material	**Protein (g)**	**Fat (g)**	**Fibre (g)**	**Ash (g)**	**T. Carb. (g)**	**Total (g)**
Orange Peels	1.43	2.0	9.35	6.75	80.47	100

Table 2 Effect of feeding of different doses of orange peels on glucose level in diabetic rats (mg per dl)

Group Item	**Group 1**	**D.Group**	**Group 2**	**Group 3**	**Group 4**
Blood Glucose Level	89.80 ± 0.87	389.20 ± 4.50	289.40 ± 3.50	258.90 ± 1.70	218.50 ± 3.50

Data are expressed as mean ± SD. Values within a row having different superscript are significantly different ($P \leq 0.05$).

Conclusion

From this study we came to a conclusion that the orange peels are a rich source of fibre that is intrinsic and intact in whole food and antioxidant as active components. This study observed a significant reduction in the blood glucose level after high dose intake of orange peels.

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