

# Effect of Ginger (*Zingiber Officinale*) Extracts on Blood Glucose in Normal and Streptozotocin--Induced Diabetic Rats

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Received June 16, 2014; Revised June 26, 2014; Accepted July 02, 2014

**Abstract** The increasing global prevalence of diabetes mellitus requires a holistic approach which is easy and cheap to apply for acceptability and affordability by all categories of people, hence, the use of spices to combat this social ill needs to be explored. In view of this, this study aimed at determining the effect of raw and cooked ginger juice on blood glucose in normal and streptozotocin-induced diabetic rats as a first phase of experimental study of its possible use as an anti diabetic food adjunct in human subjects. Male Albino rats (70) of weight range 143-180 g were divided into 7 groups and were treated thus: NT1S- normal control, NT1R- normal rats given 4 ml/kg body weight raw ginger juice, NT1Co- normal rats given cooked ginger juice, T1S- diabetic control, T1R- diabetic rats given raw ginger juice, T1Co- diabetic rats given cooked ginger juice and T1D- diabetic rats given glibenclamide (5 mg/kg body weight). Fasting blood glucose (FBG) was taken from overnight fasted rats before and after diabetes was induced (with 60 mg/kg body weight intra peritoneal injection) and at the end of the second and fourth weeks of ginger administration using ACCUCHEK Active Glucometer, Roche, Germany. ANOVA and Least Significant Difference were used for statistical analyses. The FBG was reduced to normal by raw and cooked ginger extracts and glibenclamide ( $p < 0.05$ ) in diabetic rats while it was significantly lower than normal ( $p < 0.05$ ) in normal rats given ginger extracts. There was no significant difference ( $p < 0.05$ ) between FBG in normal rats given raw ginger and cooked ginger extracts. It can be inferred from this study that the active hypoglycemic component of ginger was not affected by heat, hence, the consumption of ginger in raw and cooked forms in different cuisines may be an effective regimen in the management of diabetes. Also, consumption of ginger by normal subjects may not cause hypoglycemia but further study is recommended in this area.

**Keywords:** Raw ginger, cooked ginger, blood glucose, diabetes

**Cite This Article:** ADENIYI Paulina Oludoyin, and SANUSI Rasaki Adegoke, "Effect of Ginger (*Zingiber Officinale*) Extracts on Blood Glucose in Normal and Streptozotocin--Induced Diabetic Rats." *International Journal of Clinical Nutrition*, vol. 2, no. 2 (2014): 32-35. doi: 10.12691/ijcn-2-2-2.

## 1. Introduction

The combat against diabetes mellitus must be made a matter of top priority by all due to the continual increase in the global prevalence of this social ill. Globally the prevalence was estimated to increase in year 2000 to 2010 from 14.2 million to 17.5 million in North America, 15.6 million to 22.5 million in South America, 26.5 million to 32.9 million in Europe, 9.4 million to 14.1 million in Africa, 84.5 million to 132.2 million in Asia and 1.0 million to 1.3 million in Australia giving a total global increase in prevalence from 151 million people in 2000 to 221 million people in 2010 [1]. This was projected to 324 million by 2025 [2] and 366 million 2030 [3]. In 2013, 382 million people had diabetes mellitus worldwide and this is expected to rise to 592 million by 2035 [4]. This shows clearly that the prevalence is increasing more than

it was projected or expected hence, the need to overcome this disease cannot be over emphasized.

Spices are food adjunct commonly added to food to improve the sensory properties but many spices have been observed to exert medicinal effects. Some spices which have been reported to exert hypoglycemic effect both in laboratory animals and human subjects are: Fenugreek seeds (*Trigonella foenumgraecum*), garlic (*Allium sativum*), Onion (*Allium cepa*), turmeric (*Curcuma longa*), cumin seeds (*Curminum cyminum*), ginger (*Zingiber officinale*), mustard (*Brassica nigra*), curry leaves (*Murraya koenigi*) and coriander (*Coriandum sativum*) [5].

Ginger is a perennial plant with narrow, bright green, grass-like leaves. It is cultivated in the tropics for its edible rhizomes and has been found to be useful for both culinary and medicinal purposes [6,7]. For culinary purposes ginger is suitable for all dishes both sweet (such as drinks, puddings, apple pie, cakes, breads, candies etc) and savory (such as soups, sauces, stews, savory puddings,

grills, roasts, etc). Similarly, the medicinal uses of ginger are enormous. The spice had been reported to exert anti microbial, anti nausea [8], anti pyretic [9] analgesic, anti-inflammatory, hypoglycemic [10,11] anti ulcer, antiemetic, [12] cardio tonic, anti-hypertensive [13], hypolipidemic [14], anti-platelet aggregation [15] effects in both laboratory animals and human subjects.

Several studies have reported the hypoglycemic effect of different forms of ginger in both animals and human subjects. Among the fairly recent reports are: Arablou et al., [16] used ginger powder in Type 2 diabetic patients; Mozaffari-Khosravi et al., [17] used ginger powder in diabetic patients; Son et al., [18] used 6-gingerol isolated from ginger in obese diabetic mice; Mahluji et al., [19] used ginger powder in diabetic patients; Sukalingam et al., [20] used 6-gingerol in STZ-induced diabetic rats; Abdulrazaq et al., [21] used aqueous ginger extract STZ-induced diabetic rats; while Jafri et al., [22] used aqueous extract in alloxan-induced diabetic rats. Very limited studies have reported the hypoglycemic effect of ginger juice while there is abject scarcity of scientific findings on hypoglycemic effect of cooked ginger extract. which is highly needed since the spice is mostly consumed in cooked forms in various cuisines. Hence, the objective of this study is to determine the hypoglycemic effect of raw and cooked ginger juice in normal and STZ-induced diabetic rats.

## 2. Materials and Method.

### 2.1. Ginger Extracts Preparation

Fresh ginger rhizomes (*Zingiber officinale* Roscoe) was purchased from Bodija market in Ibadan, Nigeria The raw extract was prepared according to the method used by Elshater *et al.*, [23] with slight modification. Ginger rhizomes was washed, weighed, peeled, weighed and wet-milled using plate attrition mill (Amuda Plate mill, India). The smooth paste (without addition of water) was sieved using cheese cloth the raw extract was stored in plastic jars at 2°C until use.

Cooked ginger was prepared by boiling the raw ginger extract for 1 hour on the medium burner of a 3-burner Haier Thermocool gas cooker, India. This was allowed to cool and stored in a plastic jar at 2°C until use.

### 2.2. Collection of Rats

Male albino rats (70) of weight range 140-170 g were purchased from the Experimental Animals Unit of the Department of Veterinary Physiology, University of Ibadan, Ibadan, Nigeria. These were acclimatized for two weeks and were fed rats pellets and tap water ad libitum.. These were grouped according to weight in seven plastic cages with 10 rats in each group. The animals were treated in accordance with the study protocol as approved by the University of Ibadan/ University College Hospital Ethical Review Committee (Number- NHREC/05/01/2008a).

### 2.3. Experimental Protocol

The seven groups of rats were designated thus: NT1S-normal control group, NT1R- normal rats given raw ginger extract (daily single oral dose-4 ml/kg body weight

for 4 weeks), NT1Co- normal rats given cooked ginger extract, T1S- diabetic control group, T1R- diabetic rats given raw ginger extract, T1Co- diabetic rats given cooked ginger extract and T1D- diabetic rats given glibenclamide (5 mg/kg body weight), The control groups were given distilled water instead of ginger extract.

Diabetes was induced by intra peritoneal injection of streptozotocin (Sigma Aldrich, Germany) at 60 mg/kg body weight as used by Al-Amin et al, [14] and fasting blood glucose (FBG) was monitored until stable hyperglycemia was confirmed using the Glucometer.

### 2.4. Blood Samples

Blood samples were taken from overnight fasted rats via the tail end before and after diabetes induction and at the end of the 2<sup>nd</sup> and 4<sup>th</sup> week of ginger extracts administration. The FBG was measured using ACCUCHEK Active Glucometer, Roche, Germany. The animals were sacrificed after experimentation by cervical dislocation.

### 2.5. Statistical Analysis

Analysis of Variance was used to compare the groups of data while Least Significant Difference was used to compare mean values of one group and another ( $p < 0.05$ ).

## 3. Results and Discussion

### 3.1. Fasting Blood Glucose.

Raw and cooked ginger extracts reduced FBG in normal rats to 72.92 and 74.71% respectively at the end of 4 weeks extracts administration. This reduction observed at 2 weeks was similar to these, hence ginger consumption by normal rats may not reduced FBG beyond these values (Table 1) and may predispose the animals to undesired hypoglycemia since the long and short term consumption produced similar reduction effects.

**Table 1. Effect of ginger extracts on FBG in normal and STZ-induced diabetic rats**

Groups	B FBG (mg/dl)	S FBG (mg/dl)	2 FBG (mg/dl)	4 FBG (mg/dl).
NT1S	110.30 ± 5.59	110.10 ± 4.93	112.4 ± 3.98	111.90 ± 3.98
NT1R	110.90 ± 6.74	111.4 ± 2.63	83.00 ± 1.58	81.60 ± 1.58
NT1Co	109.40 ± 5.64	111.50 ± 3.47	83.60 ± 2.99	83.60 ± 2.41
T1S	111.50 ± 4.83	372.40 ± 11.81	399.00 ± 7.84	426.29 ± 7.84
T1R	111.00 ± 4.37	369.70 ± 13.17	179.20 ± 2.56	115.10 ± 2.56
T1Co	109.20 ± 5.80	369.7 ± 13.17	176.80 ± 4.83	111.30 ± 4.85
T1D	109.80 ± 6.84	375.30 ± 11.84	164.86 ± 9.41	115.90 ± 4.95

B FBG- FBG before the induction of diabetes.

S FBG- FBG after the induction of diabetes before extracts administration.

2 FBG- FBG at the end of 2 weeks ginger extracts administration

4 FBG- FBG at the end of 4 weeks ginger extracts administration.

There was no significant difference ( $p, 0.05$ ) in the FBG values between all the groups before the induction of

diabetes. After diabetes induction the values in the normal groups were similar and significantly different from that of the diabetic groups ( $p < 0.05$ ). This shows clearly that intra peritoneal injection of streptozotocin at 60 mg/kg body weight increased the FBG by 334% as can be inferred from Table 1 which satisfied a diabetic state in the rat species ( $\text{FBG} \geq 170 \text{ mg/dl}$  -).

Both extracts lowered FBG in normal and diabetic rats significantly ( $p < 0.05$ ) by 25 and 55% respectively but glibenclamide lowered it more (57%) in diabetic rats at the end of 2 weeks oral administration. The FBG was similar in the 2 different groups (normal and diabetic) that were given the extracts..

At 4 weeks extracts administration there was no significant difference ( $p < 0.05$ ) in FBG in normal control group and the diabetic groups that were given extracts and the anti diabetic drug. This shows that the ginger extracts were as effective as the drug in normalizing blood glucose in diabetic rats and this may also be the effect if applied to human subjects. This report differs from that of Elshater et al. [23] who reported a reduction in fasting blood glucose from 370 mg/dl in diabetic control group to 240 mg/dl in diabetic rats given raw ginger extract (4 ml/kg body weight) for 6 weeks in alloxan-induced diabetic rats while the FBG of the normal group was 120 mg/dl. The low effectiveness of the same dose of this extract may be as a result of variation in the drugs used for diabetes induction

More still it can be deduced that heat at cooking temperature did not deactivate or affect the active hypoglycemic component in ginger (gingerol). There was no significant difference between the normal groups that were given the extracts at the end of 2<sup>nd</sup> and 4<sup>th</sup> weeks hence it is possible that the FBG may not reduce lower than these values even at longer term consumption of the spice nevertheless more study is recommended in this area.

#### 4. Conclusion and Recommendation

Ginger extracts, both raw and cooked, reduced fasting blood glucose to normal as effectively as the anti diabetic drug, glibenclamide, hence, the consumption of this spice in both raw (ginger drink) and cooked forms (stews, soups, sauces, sweet and savory puddings, grills, roasts etc) in different cuisines may be a very effective cheap and easy way of combating this disease globally towards the achievement of the 6<sup>th</sup> Millennium Development Goal. The hypoglycemic component in ginger is heat labile and could withstand cooking temperature without losing its activity. More still the consumption of ginger by normal subjects may not predispose the body to hypoglycemia with increase in time of consumption because the fasting blood glucose remained constant after medium and long term consumption of the spice in rats. It is good a point to note here that ginger is safe for consumption by all and should be included in the diet management regimen for diabetics to improve their quality of life at very little cost.

#### Acknowledgment

We jointly appreciate the financial support of the Oyo State Scholarship Board under the leadership of the state governor, Senator Isiak Abiola Ajimobi, without which

this study would not have had a timely commencement as well as the financial support of the management of the Institute of Agricultural Research and Training, Apata, Ibadan without which this research would not have had a timely completion.

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