

## Research Article

# Investigation of therapeutic efficacy of *Linum usitatissimum* and *Salvia hispanica* against hyperglycemia

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### Citation

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### Abstract

Hyperglycemia is a metabolic issue rising mortality and bleakness around the world. The point of efficacy study was to explore the impact of flaxseeds and chia seeds on type 2 diabetes mellitus in light of the fact that they are financially savvy and gives a great deal of medicinal advantages and are attainable to low and middle salary populace. Both comprise of many vital substances like omega-3 and omega-6, dissolvable dietary fiber, and phytochemicals. To produce the desired results of flaxseeds and chia seeds fortified yogurt to reduce hyperglycemia an efficacy study design was carried out. Fifteen healthy rodents weighing 150-280g, 2-3 months old were utilized for the examination. Rats which tested were nourished high sucrose diet for diabetes induction for roughly 15 days. Following 15 days, with the assistance of glucometer blood glucose level was checked to ratify hyperglycemia. Fifteen healthy rodents were distributed into three groups having five rodents in each. The group 1 was controlled and nourished 15ml yogurt (controlled). Group 2 including diabetic rodents was treated with 15ml yogurt invigorated with 1.5g of flaxseeds and group 3 including diabetic rodents was treated with 15ml yogurt braced with 1.5g of chia seeds for a period of 45 days. Physiological and biological tests were carried out after the completion of trials and attained results were statistically analyzed. Conclusively even with the resemblance in nutritional conformation, chia seeds seems to take the capability to alter glucose into a slow release sugar and mark satiety to a better level than flaxseeds.

**Keywords:** Flaxseeds; Hyperglycemia; Diabetes; Yogurt

## Introduction

Type 2 diabetes, an overall network wellbeing disaster cause genuine dangers to the economies all countries, especially developing nations. Type 2 diabetes a non-insulin dependent diabetes is a group of metabolic conditions because of lack or wrong activity of insulin in the body, predominantly described by a persistent hyperglycemia. A distinctive pathophysiological point of type 2 diabetes is ineffectual activity of insulin, insulin obstruction in main body part, for example, muscles and liver. It causes decline in transport of glucose in cells causing hyperglycemia. Hyperglycemia (high blood glucose), hypoglycemia (low blood glucose) are intense intricacies, although diabetic retinopathy, kidney disorder, macrovascular and diabetic neuropathy issues stand whole deal messes of diabetes [1].

World Health Organization evaluated that in surplus of 382 million individuals worldwide have diabetes mellitus. This number is probably going to dramatically increase by 2030 with no mediation. The requirements of diabetic patients are constrained to satisfactory glycemic control as well as having avoiding estimating like: smart dieting, being physically dynamic, checking of glucose, great critical thinking abilities, sound adapting aptitudes and hazard decrease practices. This metabolic syndrome is quickly overwhelming in making states and Pakistan stands situated as the seventh greatest country with diabetic peoples and assessed to be the fourth greatest 2030 continuously. Now Pakistan the recurrence of this syndrome is unimaginable reaching out from 7.6% - 11%. The outcomes of poor glycemic control and high degrees of complexities due to expanding rats of this syndrome in Pakistan that grounds threat to the quality and economy existence of people [2].

High blood glucose is a noteworthy issue in endocrine framework. It causes when there is a mistake happen in the working of insulin and its discharge in blood. There are two categories of diabetes such as diabetes 1 plus diabetes 2. It causes visual impairment, stroke and kidney disappointment. A large number of individuals influenced by this ailment universally. Diabetes is among the real essential drivers of constant infections related issue. Including being overweight and heftiness the factor that responsible for progress of kind of diabetes 2 is diverse lifestyle, muscle to fat extent, excess muscle to fat proportion proportions, nonappearance of physical development, horrible eating schedule, apprehension and expansion [3]. Flaxseed having been developed since the start of human advancement, is one of the most seasoned yield. *Linum usitatissimum* is the Latin name of flaxseeds, which signifies "very useful". Over the most recent two decades, flaxseed because of the potential medicinal advantages related with a portion of its organically dynamic parts, has been the focal point of expanded enthusiasm for the field of eating routine and illness obtain. Flaxseeds have healthful qualities and amusing wellspring of alpha-linolenic acid (ALA): omega-3 unsaturated fat, dissolvable and insoluble fiber, short chain polyunsaturated fatty acids (PUFA), naturally occurring lignans, a variety of cancer prevention agents and proteins. Flaxseeds developing prominence is because of permitting wellbeing benefits in cardiovascular illnesses declining, fading the threat of malignant growth, diabetes, hypercholesterol, exclusively of the prostate and mammary organ, mitigating action, diuretic influence, osteoporosis and facilitate menopausal side effects [4]. Flaxseed bioactive segments are utilized as dietary wellbeing animating micronutrients and as nutraceutical specialists in the infirmity of various unending sicknesses like

malignant growth, atherosclerosis, diabetes, kidney issue and lupus nephritis. Flaxseed and flaxseed arrangements (like chutney) have been devoured in India from hundreds of years because of its solid sustenance profile and advantageous recuperating properties. Complete cholesterol and LDL cholesterol levels decrease, decrease in ingestion of postprandial glucose and in some provocative markers and improve serum omega-unsaturated fats levels have been seen with the utilization of flaxseed. Flaxseed lignin and fiber apply lipid-bringing down impacts and there is no distinction in cholesterol-bringing down impacts of defatted and entire flaxseed. Flaxseed sans gluten protein and fiber improve cancer prevention agent, antimicrobial exercises [5]. Pakistan from a long time has been used flaxseed as a standard sweet. Past survey of writing has demonstrated that flaxseed has expanded restorative noteworthiness and elevate an inclination to research remedial and in various sustenance things dietary utilization of flaxseed [6]. For controlling type II diabetes and for resistance of insulin the yogurt and flaxseed acts as common therapeutic administrator. The objective of this study is to examine the proximate analysis of flaxseeds plus chia seeds and to examine the comparative hypoglycemic effects of flaxseeds and chia seeds.

## Materials and Methods

An efficacy study was led in the National Institute of Food, Science and Technology (NIFSAT), University of Agriculture Faisalabad (UAF) to develop functional yogurt for type 2 diabetes patients by utilizing same levels of flaxseed and chia seed. Both flaxseeds and chia seeds were examined for proximate analysis.

### Procurement of material and sample preparation

Flaxseeds and chia seeds were obtained from the local market of Faisalabad. They were carried in polyethylene pack. The flaxseeds and chia seeds were cleaned so as to remove dust, stones and straws. Then the flaxseeds and chia seeds were finely ground in a grinder.

### Proximate analysis

Flaxseed and chia seed powder was exposed to proximate examination. Three samples of each were taken for getting results with more exactness, the samples were investigated for various proximate examination like moisture content, crude fiber, unrefined protein, unrefined fat just as ash content using the following techniques [7].

### Determination of moisture content

The percent moisture was resolved by strategy as portrayed in AACC (2000), technique No.44-15 and determined by the accompanying articulation.

$$\text{Moisture content (\%)} = \frac{\text{weight of sample (g)} - \text{weight of dried sample (g)}}{\text{weight of sample (g)}} \times 100$$

Note: For further analysis, moisture free samples were used.

### Determination of ash

Ash content was resolved as all out inorganic matter by technique given in AACC (2000),

strategy No.08-01 and determined by accompanying formula [8].

$$\text{Ash content (\%)} = \frac{\text{weight Of Ash (g)}}{\text{weight Of sample (g)}} \times 100$$

### Determination of fat

The unrefined fat was evaluated by the methodology as laid out in AACC (2000),

technique No. 30-25. The level of rough fat was resolved by the articulation given underneath [8].

$$\text{Crude fat (\%)} = \frac{\text{weight Of sample (g)} - \text{weight Of fat free sample(g)}}{\text{weight Of sample (g)}} \times 100$$

### Determination of crude protein

The protein content of each sample was determine by utilizing kjehdhal technique as depicted in [9].

$$\text{Crude fiber (\%)} = \frac{\text{weight loss on igenition (g)}}{\text{weight Of sample (g)}} \times 100$$

### Efficacy study

Fifteen healthy rats weighing 150-280g, 2-3 months old were used for this study. All experiments were led by the moral rules of the International Association and standard guidelines for animal use. The study continued for about 45 days. Rats were kept in separate cages in controlled, systematic environment of light, temperature and humidity. Water and feed was accessible. Animals to be tested were fed high sucrose diet for diabetes induction for around 15 days. Followed 15 days, with the assistance of glucometer blood glucose level was checked to confirm hyperglycemia. Animals with blood glucose level higher than 150mg/dl were picked for the study. After diabetes induction each group of rats was fed on allotted diet for a month. Fifteen normal and healthy rats were distributed into 3 groups having 5 rats in each. The group 1 was kept controlled and fed 15ml yogurt (controlled). Group 2 including diabetic rats was treated with 15ml yogurt fortified with 1.5g of flaxseeds and group 3 including diabetic rats was treated with 15ml yogurt fortified with 1.5g chia seeds for the period of a month. At the end blood samples were occupied by puncture of tail by surgical

blade. The plasma blood glucose levels were determined by using glucometer [11].

### Physical parameters

#### Body weight gain

To examine the outcome of standard and nutraceutical diet on weight the increasing body weight of rodents was measured weekly from all treated groups throughout the study time rendering to the technique monitored by [12].

#### Body length measurement

By the use of measuring tape the length of body was measured of all rats.

#### Body mass index

After every one-week body mass index was measured to examine the standard outcome and nutraceutical diet on body weight, the increasing body weight of rodents and rise in BMI was noted. Body mass index was framed conferring to the way followed by [13].

### Biochemical parameters

#### Blood sampling

Blood samples were squeezed from all rats then investigated for biochemical contemplations for example fasting blood glucose besides random blood glucose.

### Glucose test

Glucose test was done by glucometer. This is the best advance technique to evaluate the blood glucose level.

### Insulin levels

The level of insulin was estimated by the procedure of [14].

### Statistical analysis

The resultant data from different analyses was analyzed statistically.

## Results and Discussion

### Proximate analysis

#### Moisture content

Results with respect to moisture content in present examination demonstrated that flaxseed powder showed 7.69% of moisture content and chia seeds have 11.33% of moisture (Fig. 1). Present investigate discoveries are similar with the consequences of [15] who perceived that flaxseed moisture is 7.7%. Results were additionally contrasted with [16] who documented the moisture content from 4 to 7%. Chia seeds worth was near the consequences of [17] who expressed that chia seeds have moisture 10 to 13.4%.

#### Protein content in crude form

Information examination with respect to protein substance of flaxseeds and chia seeds powder is displayed in (Fig. 1), demonstrating that the protein content of flaxseeds powder showed 22.76% of protein content and chia seeds have 18.73% of protein content.

By following the exploration of [18] he examined the proximate arrangement of flaxseed powder and expressed the estimation of protein is 21.23%. The outcomes were additionally thought about by [19] who revealed that flaxseeds powder contains 23 to 34% protein. Chia seeds protein substance outcomes are in contracted with examination of Ullah *et al.*, (2016) inferred that chia seeds display 15 to 25% protein content. Results additionally related with [20] uncovered that chia seeds contain 16 to 26% protein content.

### Fat content

The fats are among the most significant parts of food as huge job in our eating regimen. These are the primary wellspring of vitality and supply fundamental fats supplements. Fats assume significant job to decide the physical qualities like surface, appearance and mouth-feel of nourishment stuffs. The negligible fat substance acquired for the samples could be noteworthy, as fat assumes a crucial job in the assurance of timeframe of realistic usability of food [21].

Fat content consequences of flaxseeds and chia seeds were 41.10% and 30.24% separately and are exhibited in (Fig. 1). The discovering pertinent to fat substance of flaxseeds were near the finding of [22] he originated the fat substance of flaxseed and documented normal fat substance around 38.97%. [23] evaluated proximate arrangement of flaxseed and announced fat substance 39% in flaxseed powder. Also, chia seeds fat qualities were helped by [24] their investigation results demonstrated that chia seeds have 20 to 34% fat substance. [25] portrayed that chia seeds have 30 to 36% fat content range.

### Fiber content

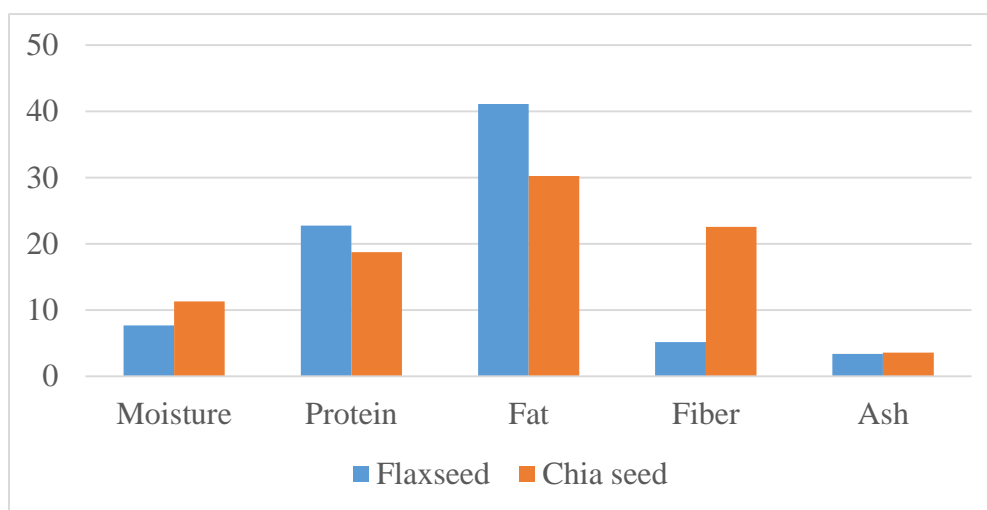
Dietary fiber is a multifaceted mixture of various segments, it could possibly incorporate the fibrous structure. Unrefined fiber, instead, is a term used to depict the fibrous nourishment buildup that is left over after it has been broken down in the lab with certain unforgiving substance solvents, for example, sulfuric acid and sodium hydroxide. It has low nourishment esteem yet it has properties to offer bilk to the sustenance and to manage physiological capacities. Fiber examination of flaxseeds powder demonstrated that it contains 5.18% fiber content and fiber of chia seeds was estimated as 22.54% (Fig. 1). The outcomes are in a joint effort with the results of [26] expressed that the usual unrefined fiber substance of flaxseed range is 4.16 to 5.14% and [27]

noticed that chia seeds have 18 to 30% fiber content. Results additionally shut to the discoveries of [27] which expressed that chia seeds have 23 to 41% fiber content.

#### Ash content

Results in regard to ash content in present investigation demonstrated that flaxseeds powder have 3.39% of ash content and chia seeds have 3.6% of fiery debris content (Fig. 1). Current and flow research results esteems

are close-by to the result readings of the investigation of [28] who discovered ash content in the scope of 3.38%. The outcome are additionally similar with [29] who decided the proximate structure of flaxseed powder and revealed that the normal estimation of ash is 3.50%. As indicated by the investigation of [22] the ash content of chia seeds run from 4 to 5%.



**Figure 1. Proximate analysis of flaxseeds and chia seeds powder**

#### Efficacy study

The plasma blood glucose levels were determined by using single touch glucometer. The outcomes of all studied parameters in different examinations are discussed collectively.

#### Water and feed intake

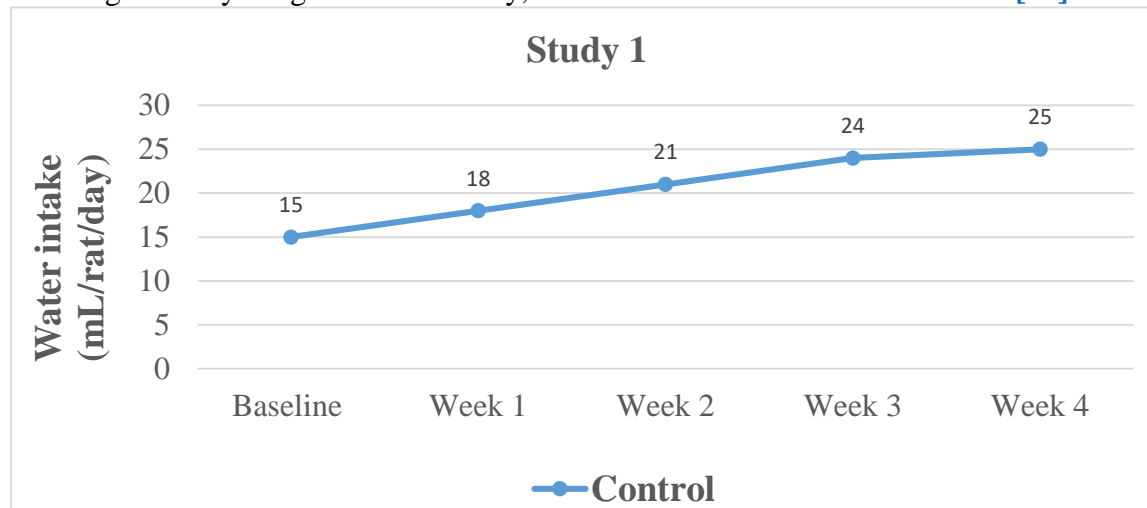
(Fig. 2) demonstrated the water consumption of study I during the entire investigation. Water admission improved from first to last week in control group. (Fig. 3) demonstrated a similar pattern in study II flaxseed treated group. In group III water admission of chia seed treated rodents demonstrated comparable pattern from begin and mid to finish of the investigation (Fig. 4). The correlation of all examinations done in (Fig. 5). The feed consumption of all groups demonstrated various patterns and variations in feed consumption. Group 1 indicated

progressive increment in feed consumption (Fig. 6). Group II indicated variations in feed admission (Fig. 7). Group III demonstrated steady decline in feed consumption (Fig. 8). (Fig. 9) demonstrated outcomes relatively. So it tends to be presumed that flaxseed was all around accepted by the rodents as there was no significant decrease in water consumption when treatment and saw that group treated with flaxseed hold lower estimations of body weight gain when contrasted with non-treated group like [29] verified. Chia seeds are 40% fiber by weight, making them a champion among the best wellsprings of fiber on earth. The absorbable carb substance is only a solitary gram for every ounce (28 grams), which is outstandingly low. This makes chia a low carb pleasing sustenance. In perspective on its high dissolvable fiber content, chia seeds can hold moving around

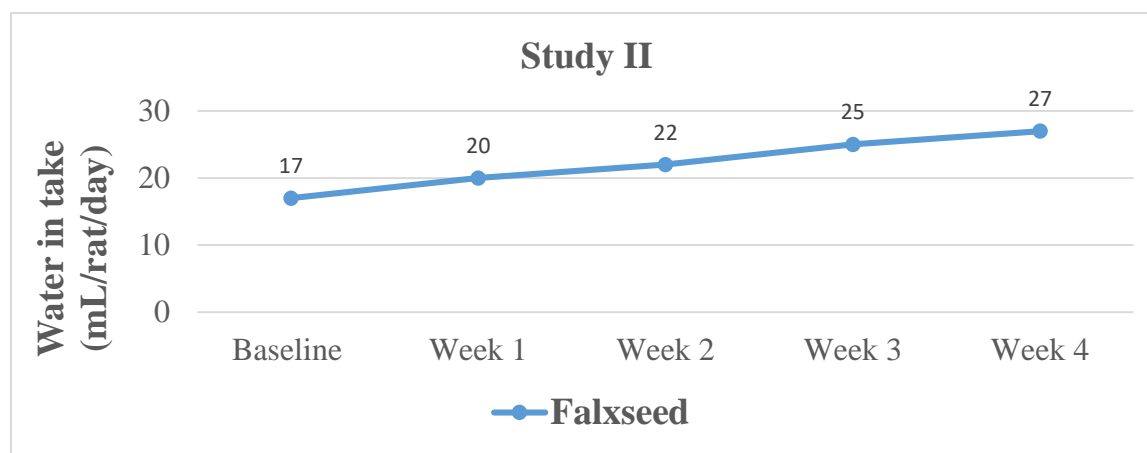


10–numerous whiles their load in water, getting the chance to be similar gel and reaching out in your gut. Theoretically, this

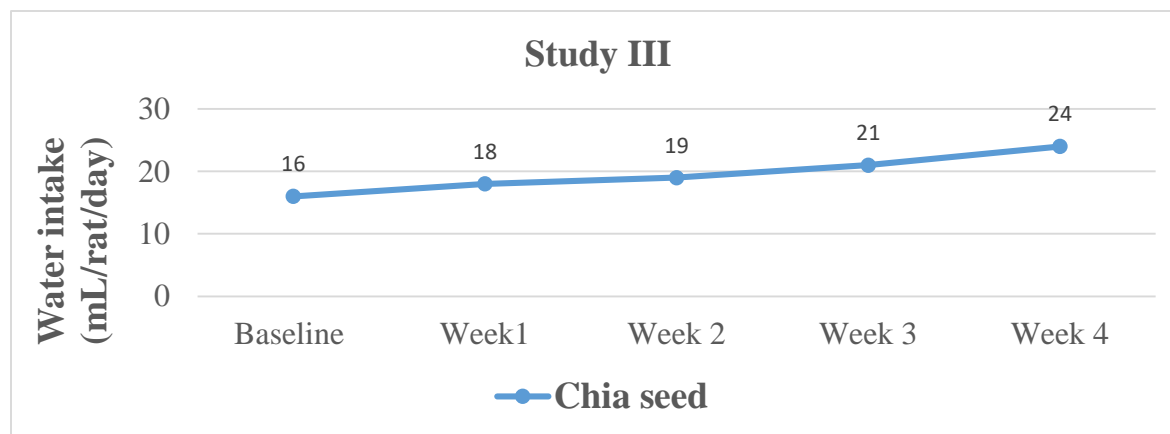
ought to grow culmination, moderate maintenance of your sustenance and help you therefore eat less calories [28].



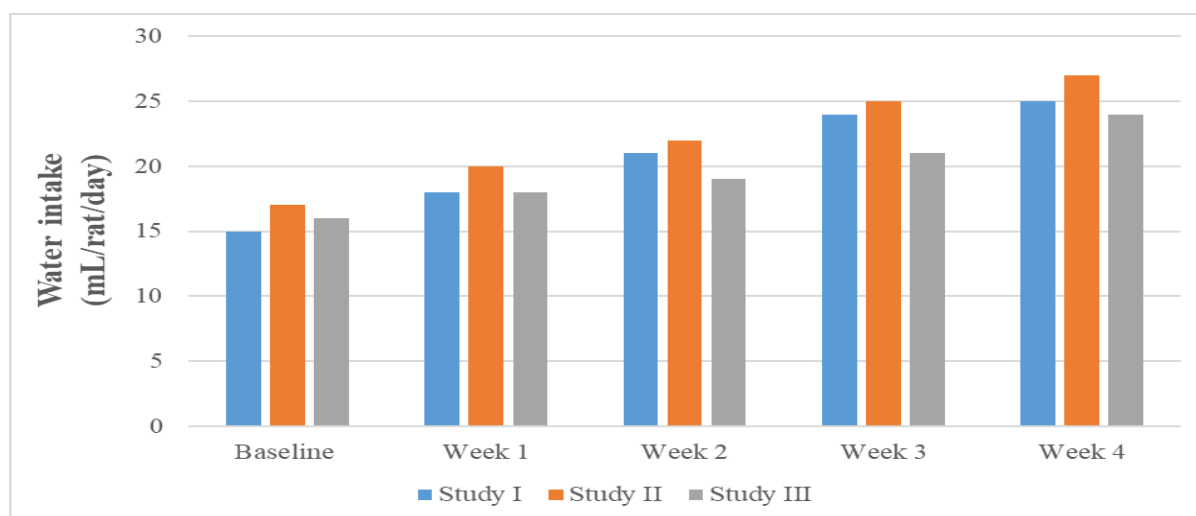
**Figure 2. Water intake (mL/rat /day) of control group**



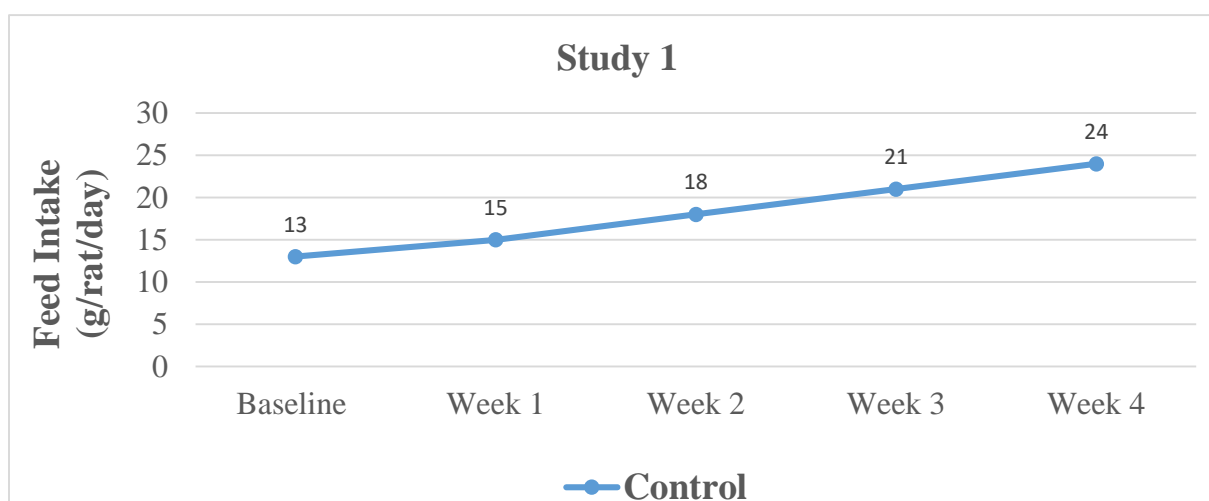
**Figure 3. Water intake (mL/rat/day) of group 2 flaxseed treated**



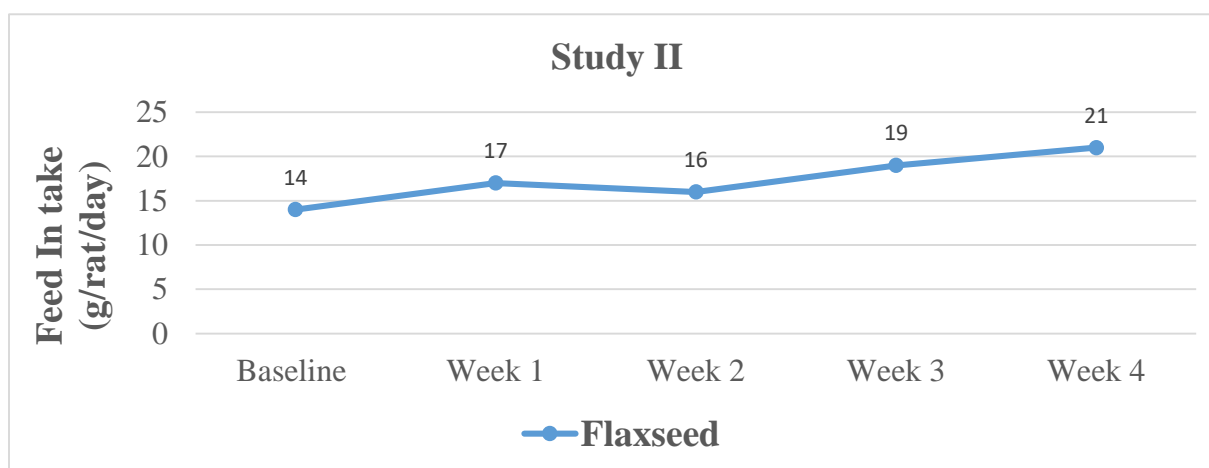
**Figure 4. Water intake (ml/rat/day) of group 3 chia seed treated**



**Figure 5. Water intake exploring the therapeutic effects of seeds on hyperglycemic rats**

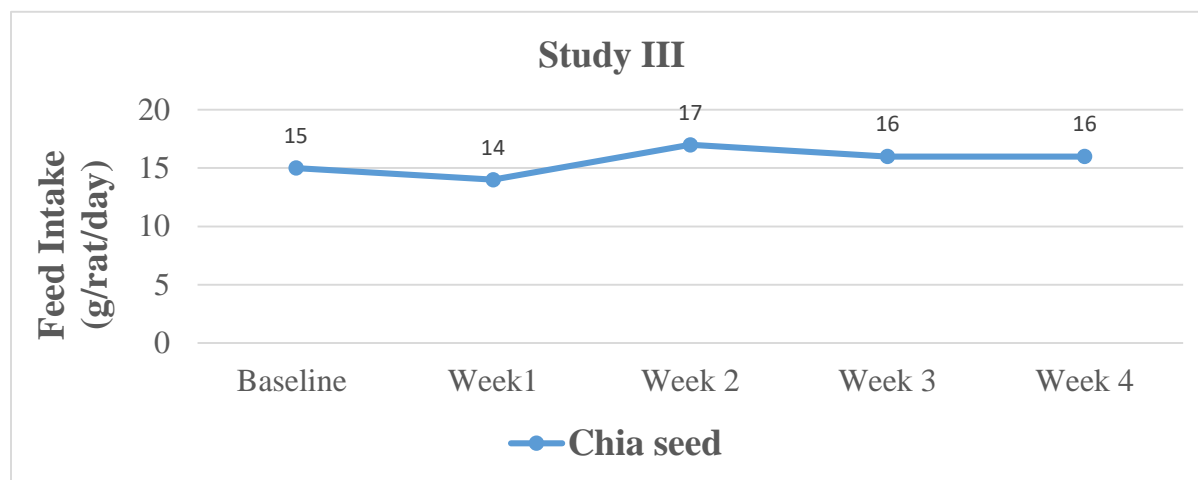


**Figure 6. Feed intake (g/rat /day) of control group**

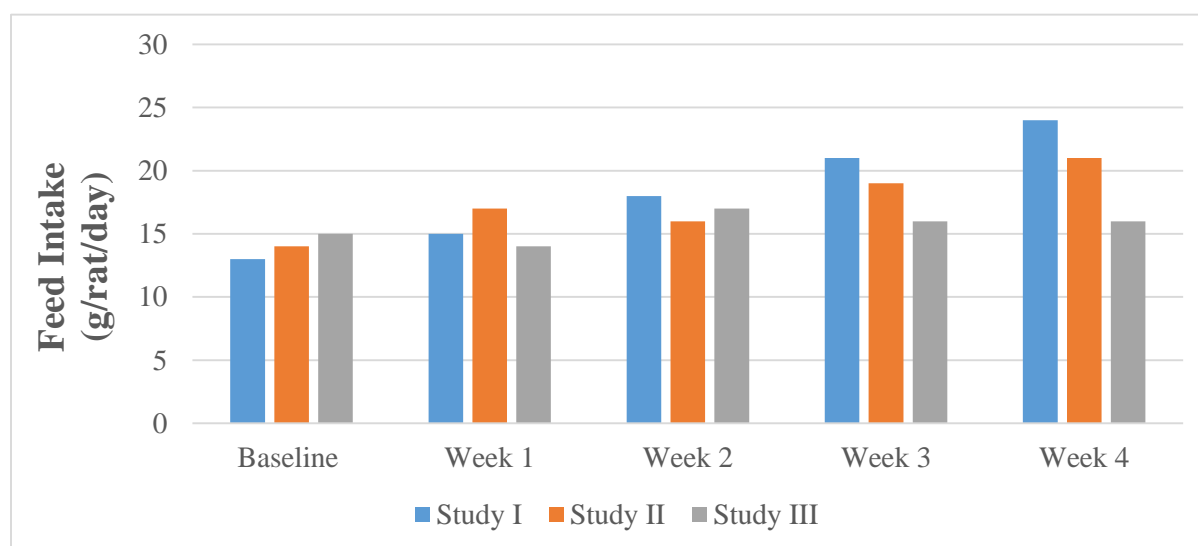


**Figure 7. Feed intake (g/rat/day) of group 2 flaxseed treated**





**Figure 8. Feed intake (g/rat/day) of group 3 chia seed treated**



**Figure 9. Feed intake exploring the therapeutic effects of seeds on hyperglycemic rats**

### Body weight

During the entire investigation, the impact of control and treatment diet on the weight of rodents was watched. The rodents of study 1 (control) demonstrated weight gain in pattern from begin to finish of the investigation (Fig. 10). In study II the weight increase was less with treatment nourished diet as contrast with control group (Fig. 11). In group III watched the sound weight gain and keep up all through the efficacy study (Fig. 12). The maximum weight gain was viewed for the control group

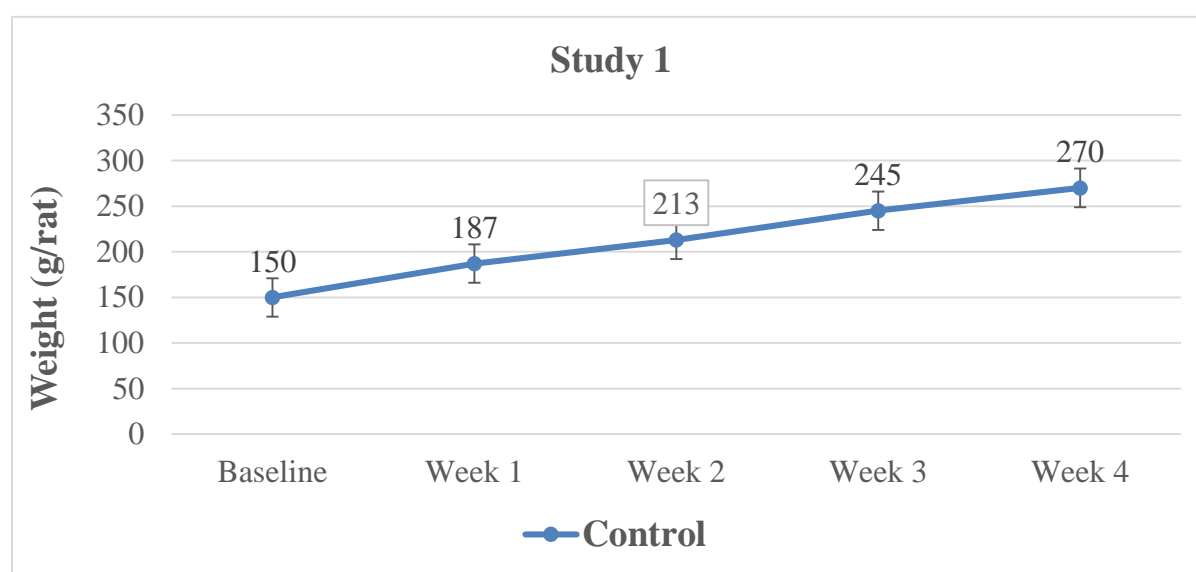
whereas the minimum weight increase was noted for the treatment groups (Fig. 13).

[20] examined the utilitarian properties of flaxseed. In ongoing examination 60 subjects of type 2 diabetes were nourished an everyday nourishment for three months, alongside 6 FS gum (5g) containing wheat flour chapattis, according to the proposals of the American Diabetic Association. Controlled group (sixty people) expended an indistinguishable eating routine however without gum chapattis. The natural blood chemistry outlines checked earlier beginning

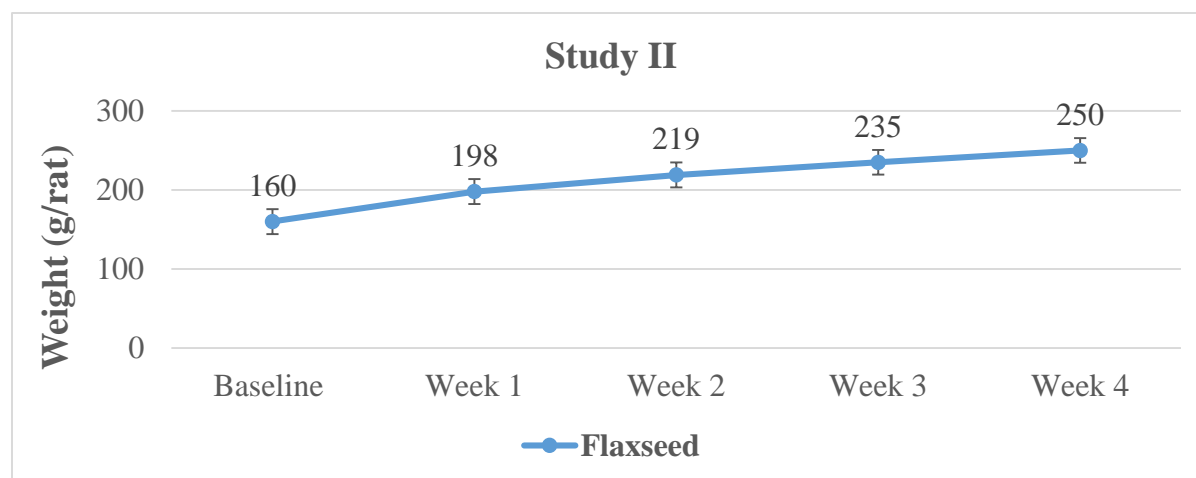
the examination and at month to month interims demonstrated fasting glucose in the exploratory group diminished 18% while the cholesterol decreased by 19%. Outcomes demonstrated a decline in LDL cholesterol by 18.5%. The investigation exhibited the viability of flaxseed gum in the blood organic chemistry outlines of hyperglycemia.

[30] directed a controlled single visually impaired preliminary to evaluate the adequacy of chia seed consumption in advancing weight reduction, adjusting body

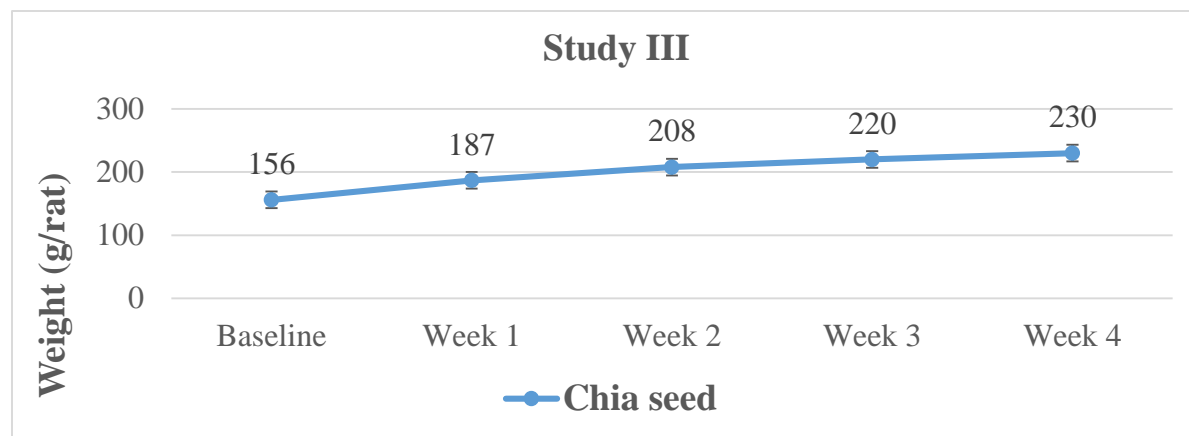
synthesis, diminishing blood lipids, besides altering incendiary pointers. The subjects associated with the investigation were overweight and fat people (n=85) between the ages of 20 and 70. Subjects stayed randomized to acquire either 45g everyday of chia seeds. Likewise, the underlying foundations of chia seeds were utilized in old occasions to treat an assortment of maladies in China. These customary uses are as yet utilized in China, just as in other states [31].



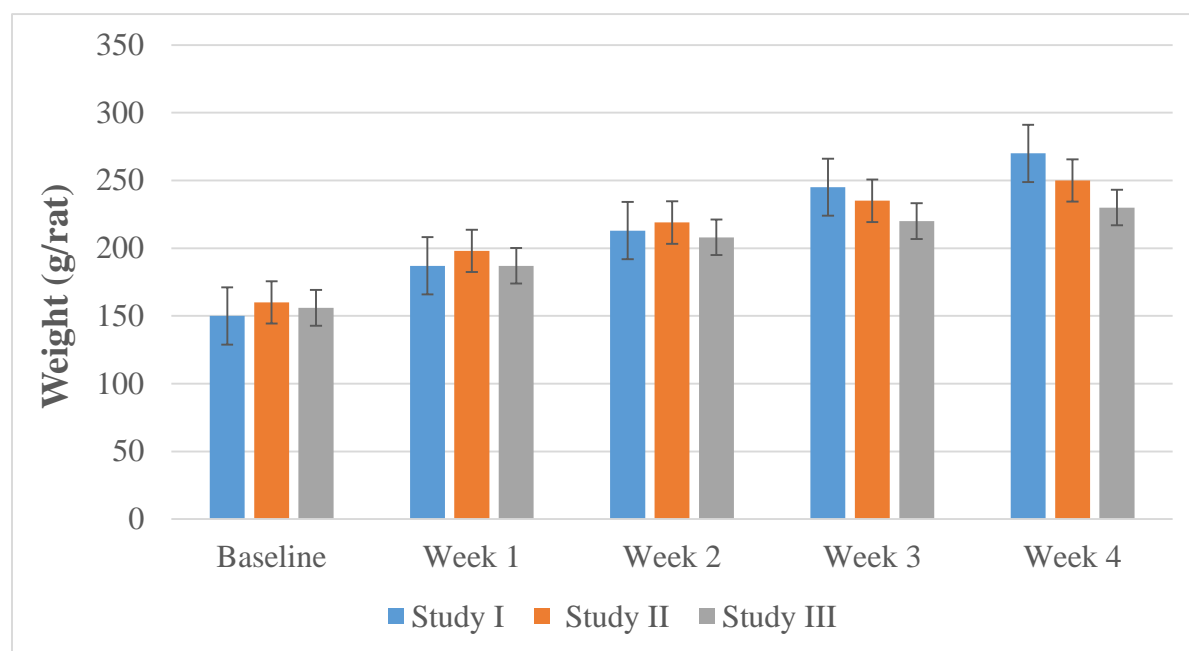
**Figure 10. Weight (g/rat) of group 1 (control)**



**Figure 11. Weight (g/rat) of Group II flaxseed treated**



**Figure 12. Weight (g/rat) of Group III Chia seed treated**



**Figure 13. Mean values of weight exploring the therapeutic effect of seeds on hyperglycemic rats**

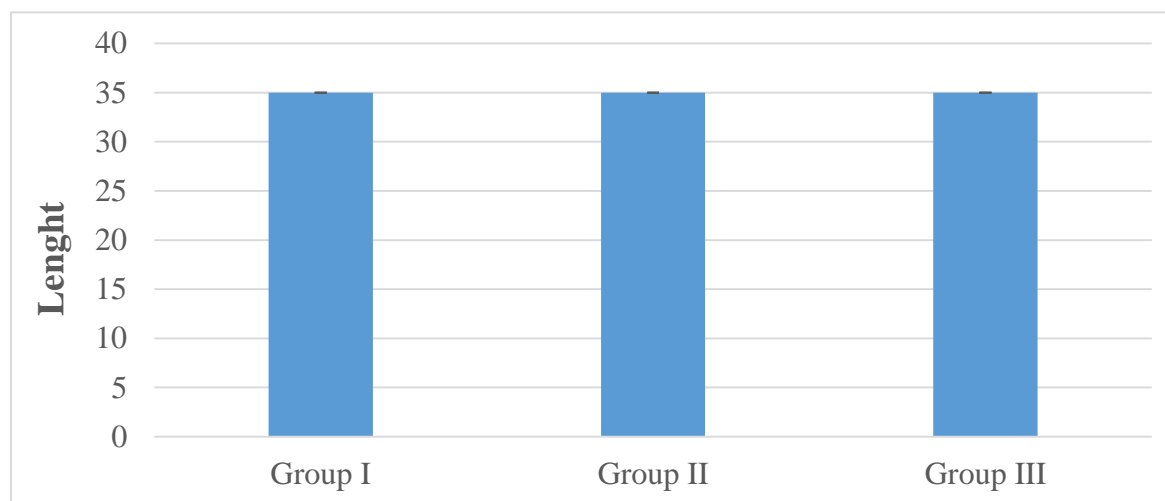
### Body length

Examination of length to investigating the helpful impact of flaxseed and chia seeds in hyperglycemic rodents has been introduced in (Table 1). Mean estimations of body length of rodents were recorded in every one of the group. The mean qualities recorded were most noteworthy in the third group pursued

by second and first group. The smallest and most extreme length can be found in the table that demonstrated greatest length in third group pursued by second and first group. Length was recorded for the figuring (Fig. 14) of body mass index that is the body weight gain ratio.

**Table 1. Mean values of length of different treatments in hyperglycemic rats**

Group	Mean values	Minimum	Maximum
1 <sup>st</sup>	35.10	33	37
2 <sup>nd</sup>	34.60	32	38
3 <sup>rd</sup>	37.50	34	40

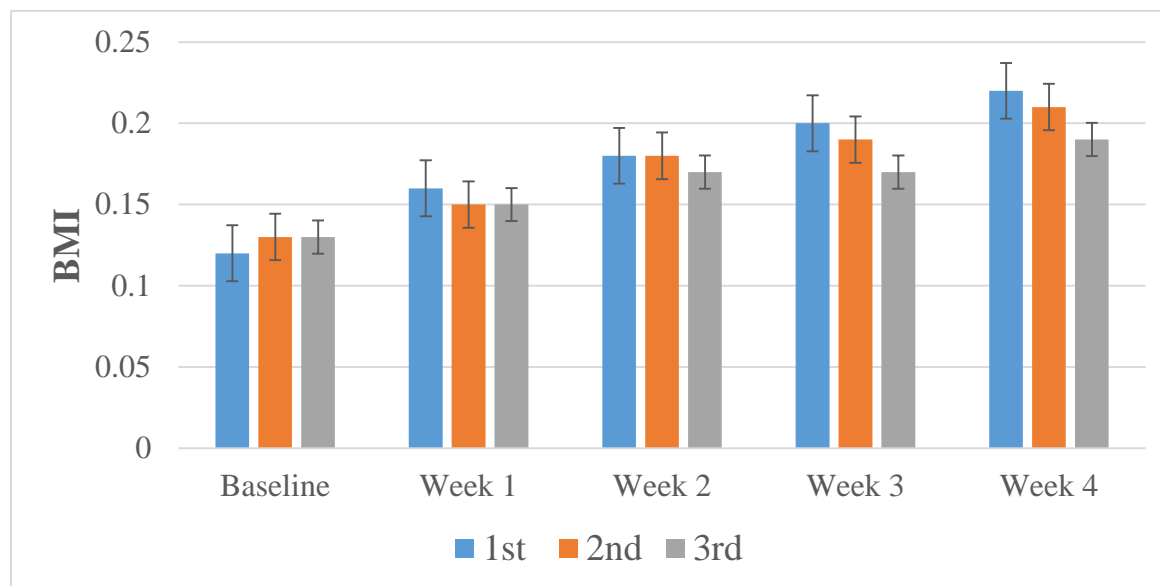
**Figure 14. Mean Length of Different Treatment in Hyperglycemic Rats****Body mass index**

Investigation of BMI to investigating the remedial impact of various medications in hyperglycemic rodents has been introduced in (Table 2). Body mass index recorded most noteworthy in control group. Generally, mean values demonstrate that control group has most elevated body weight gain

proportion and henceforth high BMI and it steadily expanded from beginning of the first week till end of the investigation in all groups. The BMI in third group somewhere in the range of second and third week demonstrated no change and after that expanded in the fourth week (Fig. 15).

**Table 2. Mean BMI values exploring the therapeutic effects of different treatment in hyperglycemic rats**

Group	Baseline Reading	1st Week	2 <sup>nd</sup> Week	3 <sup>d</sup> Week	4 <sup>th</sup> Week
1 <sup>st</sup>	0.12	0.16	0.18	0.20	0.22
2 <sup>nd</sup>	0.13	0.15	0.18	0.19	0.21
3 <sup>rd</sup>	0.13	0.15	0.17	0.17	0.19



**Figure 15. Mean BMI values exploring the therapeutic effects of different treatment in hyperglycemic rats**

### Body Glucose

The impact of medications and intervals on fasting and random blood glucose level of diabetic rodents is exceptionally huge as appeared in the (Table 3). The information acquired from this examination show that, both flaxseed and chia seeds displayed a huge antidiabetic impact in diabetic rodents (Table 4). As found in the table the more prominent decrease in fasting blood glucose levels was realized with the days. There was most extreme decrease in blood glucose means blood glucose levels diminished toward the finish of the examination when contrasted with day 0. Control group has least decrease in blood glucose level while significant decrease was seen in other two treatment groups. It was seen that yogurt with chia seeds is increasingly successful in diminishing blood glucose levels of diabetic rodents than basic yogurt that was the control group and yogurt with flaxseed. Comparative mean values of groups on fasting glucose level in (Fig. 16).

The probiotic yogurt is valuable in lessening the glucose level and counteracting the

danger of diabetes. [32] detailed noteworthy decrease in serum glucose levels and glycosylate hemoglobin levels of sort 2 diabetes patients with multi week utilization of probiotic yogurt. The present examination showed a critical hypoglycemic impact by the admission of flaxseed invigorated utilitarian yogurt. The decrease in blood glucose levels have been accounted for because of essence of SDG in flaxseed. It was accounted for in the investigation of [33] that there was 80% less shot of glucosuria in female rodents on glucosuria counts calories with SDG when contrasted with 100% possibility of rodents nourishing glucosuria eats less with no SDG. An investigation by [34] have likewise revealed huge decrease in glucose level in diabetic rodents following a month of encouraging with flaxseed extract. A randomized controlled trial led to evaluate the adequacy of chia seed consumption in advancing weight reduction, adjusting body synthesis, diminishing blood lipids, besides altering incendiary pointers. The subjects associated with the investigation were overweight and fat people (n=85) between

the ages of 20 and 70. Subjects stayed randomized to acquire either 45g everyday of chia seeds [32]. Likewise, the underlying foundations of chia seeds were utilized in old

occasions to treat an assortment of maladies in China. These customary uses are as yet utilized in China, just as in other states [34].

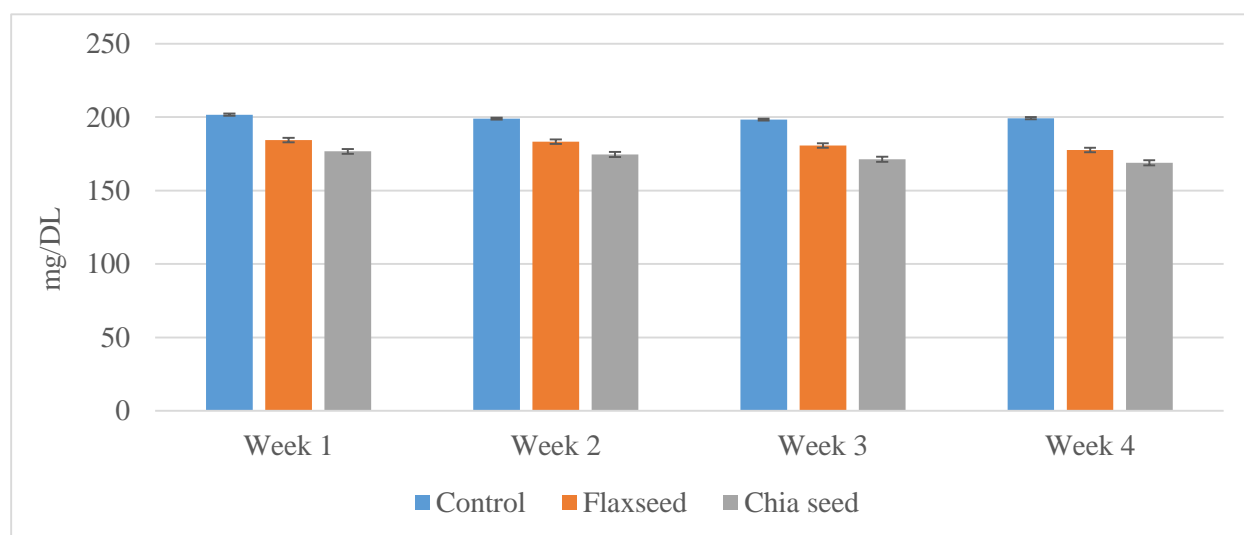
**Table 3. Analysis of variance of days and treatments on fasting blood glucose**

SOV	DF	SS	MS	F
Days	3	760.4	253.45	21.58*
Treatments	2	8609.4	4304.72	366.55**
Error	174	2043.4	11.74	
Total	179	11413.2		

\*\*=Highly Significant: \*=Significant: NS=Non-Significant

**Table 4. Comparative analysis and mean values of days and treatments on fasting glucose**

Days	Treatments		
	To	T1	T2
Day 0	201.667±1	184.333±0.57	176.667±0.57
Day 15	199±1.52	183.333±1.52	174.667±0.57
Day 30	198.333±3.51	180.667±0.57	171.333±1.52
Day 45	199.333±2.08	177.667±2.51	169±1



**Figure 16. Comparative mean values of groups on fasting glucose level**

The (Table 5) demonstrated the random blood glucose level of diabetic rodents. As found in the table the more prominent decrease in blood glucose levels was seen with the days. There was greatest decrease in random blood glucose means blood glucose levels decline toward the finish of the examination when contrasted with day 0.

Control group has least decrease in blood glucose level while huge decrease was seen in other two treatment groups. It was seen that yogurt with chia seeds is increasingly compelling in lessening blood glucose levels of diabetic rodents than simple yogurt that was the control group and yogurt with flaxseed (Table 6). Comparative Mean

Values of groups on Random Glucose Level in (Fig. 17).

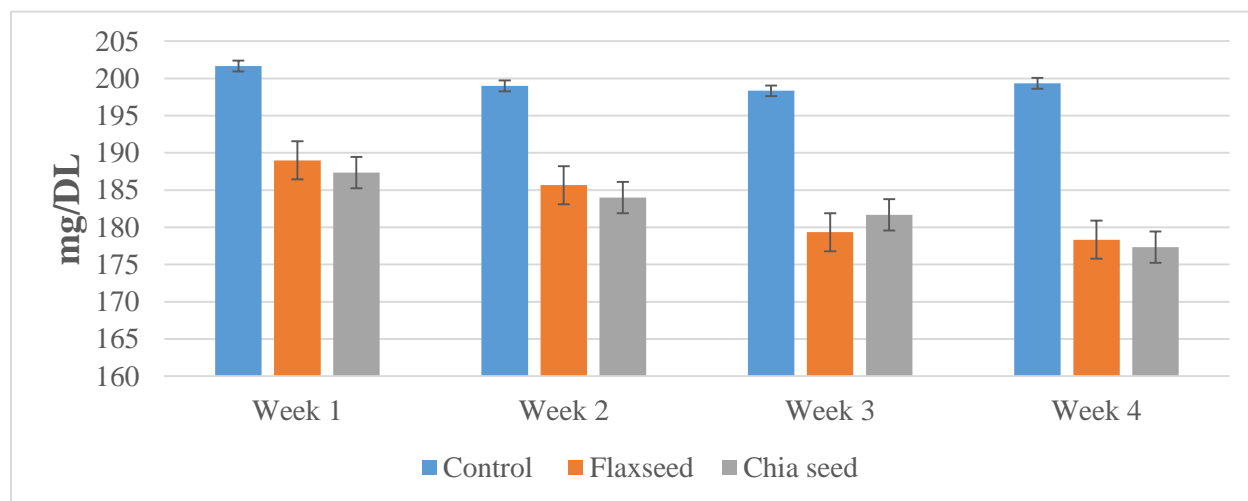
**Table 5. Comparative analysis and mean values of days and treatments on random glucose**

Days	Treatments		
	To	T1	T2
Day 0	201.667±1.52	189±1	187.333±0.57
Day 15	199±1.73	185.667±1.53	184±1.73
Day 30	198.333±0.57	179.333±0.57	181.667±1.52
Day 45	199.333±2.08	178.333±1.52	177.333±1.52

**Table 6. Analysis of variance of days and treatments on random blood glucose**

SOV	DF	SS	MS	F
Days	3	333.0	111.01	2.288*
Treatments	2	11487.2	5743.62	118.40**
Error	174	8440.5	48.51	
Total	179	20260.8		

\*\*=Highly Significant: \*=Significant: NS=Non-Significant



**Figure 17. Comparative Mean Values of groups on Random Glucose Level**

### Insulin Level

The present examination has indicated significant impact of treatment and days on serum insulin level of diabetic rodents. In the examination incredible improvement were found in the serum insulin level was seen in group III followed by group II and control group. Both flaxseed and chia seed show huge impacts of treatment and days on insulin level of diabetic rodents as contrast with control group. As indicated by mean qualities

for insulin group III show increasingly significant outcomes pursued by group 2 and control (Table 7).

The consequences of the present investigation were as per the finding of [23] who detailed in his examination noteworthy changes in insulin fixation in diabetic patients by utilization of probiotic yogurt. [30] additionally announced in his investigation huge changes in fasting glucose and insulin levels of sort 2 diabetic patients



by multi week flaxseed inferred lignan supplement utilization. Anyway slight decrease in insulin fixation were seen which show improved insulin affectability. Decrease in insulin focus were watched more in T2 gathering and T1 bunch than straightforward yogurt. Reduction in insulin

levels were because of flaxseed SDG which likewise shows improved insulin affectability past investigations additionally detailed improved insulin affectability by utilization of flaxseed and furthermore yogurt (Table 8). Comparative Mean Values of Groups on Insulin Level in (Fig. 18).

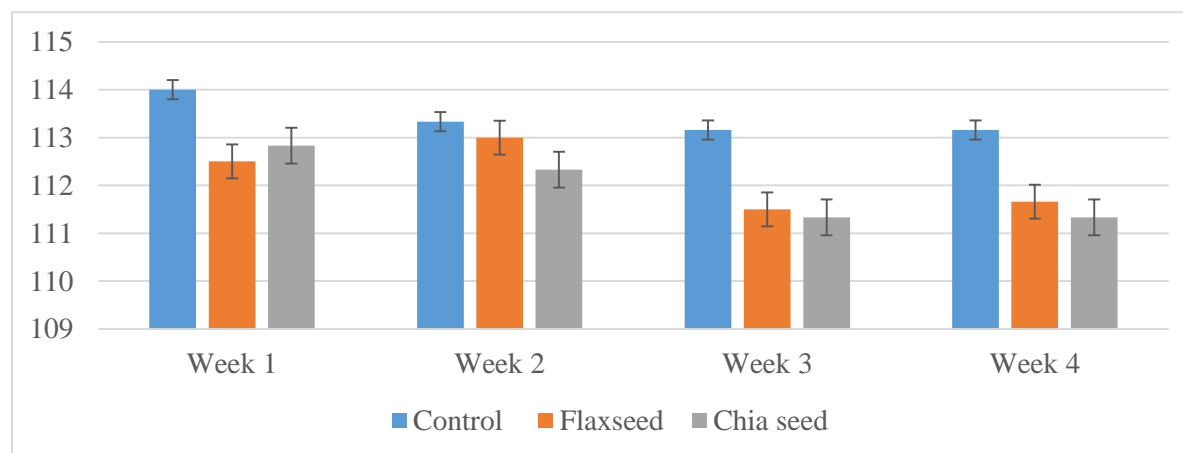
**Table 7. Comparative analysis and mean values of days and treatments on insulin levels**

Days	Treatments		
	To	T1	T2
Day 0	14±0.707	12.5±0.707	12.83±1.060
Day 15	13.33±0.353	13±1.060	12.33±0.707
Day 30	13.16±0.353	11.5±0.353	11.33±0.353
Day 45	13.16±0.353	11.66±0.353	11.33±0.353

**Table 8. Analysis of variance of days and treatments on insulin level**

SOV	DF	SS	MS	F
Days	3	99.934	24.984	14.24*
Treatments	2	551.811	275.906	157.34**
Error	174	308.633	1.754	
Total	179			

\*\*=Highly Significant: \*=Significant: NS=Non-Significant



**Figure 18. Comparative Mean Values of Groups on Insulin Level**

### Conclusion

Even with the resemblance in nutritional conformation, chia seeds seem to take the capability to alter glucose into a slow discharge carbohydrate besides mark satiety to a better level than flaxseeds, feasibly because of the greater fiber thickness. Absorption of either flaxseeds or chia seeds

into the diet may be favorable, while the consumption of chia seeds can provide bonus advantage.

### Authors' contributions

Conceived and designed the experiments: S Aslam & A Ali, Performed the experiments: MU Tariq & J Ali, Analyzed the data: H Nasir & H Manzoor, Contributed materials/

analysis/ tools: MA Jalali, Wrote the paper: N Zafar.

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