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Original Article

Effect of Moringa Olifera Leaves on Intraocular Pressure and Blood Pressure

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ABSTRACT

Moringa exhibits many antioxidant, antihypertensive, and anticancer effects. A significant source of therapeutic medicines for reducing ocular and systemic hypertension is herbal remedies. **Objectives:** To assess the impact of moringa on blood pressure and intraocular pressure and to evaluate various moringa doses that affect IOP and BP. **Methods:** Quasi Experimental study was conducted at MTH, Faisalabad from September 2022 to April 2023. Sampling technique was non-probability purposive sampling. Emmetropes, age 20-35 years, IOP range 11-22 mmHg, BP 120/80 mmHg was included. After comprehensive eye exam, 60 subjects were divided into two groups. IOP and BP were evaluated before and after intake at 30, 60, 90, and 120 minutes. Data were analyzed with SPSS software. Repeated Measure ANOVA was used for statistical analysis. **Results:** Out of 60 subjects, mean age was 22.5 ± 1.31. Baseline IOP in group 1 was 19.40 ± 3.19 and BP 113.67 ± 9.27/81.00 ± 8.03 while in group 2 IOP 19.42 ± 4.11 and BP 116.33 ± 10.08/83.17 ± 8.75. There was significant Change in IOP at 90minutes and BP at 60minutes. IOP was 18.54 ± 3.19 and 17.56 ± 4.25 in group 1, 2 respectively. BP was 101.33 ± 7.76/72.67 ± 8.97 and 101.50 ± 9.92/72.50 ± 8.68 in both groups respectively. There were significant Changes as compared to 30, 60, 120minutes. IOP and BP return to its baseline at 120 minutes. **Conclusions:** Moringa Oleifera has significant effect on lowering IOP and BP. Effect of dose on the reduction rate was directly proportional to the amount of dose administered.

INTRODUCTION

The pressure that the interior of the eyeball experiences is known as intraocular pressure, or IOP. Fundamentally, IOP is kept at a normal level by a dynamic equilibrium between aqueous humour production, aqueous humor outflow, and episcleral venous pressure [1, 2]. The average IOP that a healthy eye can tolerate over time without endangering its integrity or causing glaucomatous damage is known as normal IOP [3, 4]. The typical human intraocular pressure ranges from 11 to 21 mmHg. Glaucoma, a condition marked by elevated intraocular pressure, is also linked to optic disc cupping and loss of visual field [5, 6]. In light of the positive correlation between IOP and systemic blood pressure, found that IOP increased in direct proportion to blood pressure (BP), with no relationship to sex, age, height, or hemoglobin [7, 8]. Only when the systemic blood pressure is high enough to exceed a set threshold for the BP/IOP ratio will an elevated IOP cause visual field loss [9]. Most persons who develop hypertension do so in their middle years, and it may also be hereditary or genetic. A prolonged rise in blood pressure is referred to as "systemic hypertension" [10]. If a person's systolic and diastolic pressures are both higher than 135 mmHg, they are said to have hypertension. The tension that the blood creates on the blood vessel walls is known as blood pressure [11–13]. In most cases, the expression refers to arterial blood pressure, or the pressure in the big arteries like the brachial artery (in the arm). The usual unit of measurement for pressure measurements is millimeters of mercury (mmHg) [14]. Two separate parameters are taken into consideration while calculating blood pressure. The maximum pressure in the

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arteries during a cardiac cycle or when the ventricles contract is called systolic pressure, which is the first value. The suggested systolic pressure is 120 mmHg. Ranges lie between 110 to 135 mmHg. The relaxation phase of the cardiac cycle, or when the volume of the heart's ventricles is at its lowest, is when the diastolic pressure, or blood pressure, is at its lowest. The diastolic pressure is typically 80 mmHg. [15-17]. There is a pressure of between 60 and 80 mmHg. A significant source of therapeutic medicines for reducing ocular and systemic hypertension is medicinal plants [18]. The highly prized medical shrub Moringa oleifera is found throughout many tropical and subtropical nations. It has a wide variety of medical applications and a high nutritional value [19, 20]. The tropics are home to a large population of Moringa Oleifera (MO), one of around fourteen species in the Moringacea family. Researchers have found that MO has hypoglycemic and hypotensive effects in addition to anti-cancer, anti-inflammatory, and thyroid status regulator efficacies [21, 22]. Omolaso *et al.*, examined systemic blood pressure and blood glucose levels in healthy adults after oral administration of 75 mg/kg of Moringa oleifera dissolved in 250 ml of water. After two hours (p 0.05), and four hours (p 0.05), moringa oleifera was shown to significantly lower blood pressure and blood sugar, respectively [23]. It was examined how MOLAE affected intraocular pressure and blood pressure among individuals with normotension because various parts of this plant, including the leaf, root, seed, bark, fruit, flower, and immature pod, act as cardiac and circulatory stimulants, a -inflammatory, a hypertensive, a hypoglycemic, and an oxidant [24–26].

METHODS

A Quasi Experimental study design was conducted at Madinah Teaching Hospital, Faisalabad. The duration of study was 8 months from September 2022 to April 2023. The sample of this study was 60 subjects Data were collected through Non-probability Purposive Sampling Technique. Inclusion Criteria of this study was emmetropes, age 20-35 years, intraocular pressure range 11-21 mmHg, blood pressure range 120/80 mmHg, body mass index (Normal healthy individuals). Those individuals who have refractive errors, ocular diseases, using any systemic and ocular medications, history of past ocular surgery and any past systemic diseases were excluded from the study. The Moringa Oleifera leaves powder that was used in this study was organic and was collected from the tree that were harvested in the Southwestern part of Punjab D.G. Khan, Pakistan. Leaves were collected and air-dried at room temperature for 120 hours afterwards was grinded into the powder form. The sample was verified and doses were remeasured through the organic lab of Department of Pharmacognosy, The University of Faisalabad, by using standardized method of dose measurement. After obtaining the subject's informed consent, the data were collected. The objective of the research was also informed to the subject verbally. The collection of data were gathered through a self-structured proforma. For the selection of only emmetropes visual acuity of subjects was taken through Log MAR Chart (HUVITZ-VELORUM). The room was well-illuminated and the distance visual acuity was measured by placing Log MAR Chart at 4 meters and by occluding one eye after another, subject having 0.00 LogMAR visual acuity was selected for the further proceedings of the data collection. For the comprehensive eye examination slit lamp examination (Shin-Nippon SL-203) was performed. Weight Measuring Machine (Camry) was used to calculate BMI, height and weight of the subject was calculated and then those values were used to measure Body Mass Index by using body mass calculator only healthy weight range (18.5 to <25) subjects were selected. For the selection of normotensive blood pressure subjects, BP Apparatus (Certeza) was used. After the subject adjustment according prerequisite of the blood pressure the measurements were taken. Moreover, the Intraocular pressure was measured through Canon Air Puff Tonometer for assessing the pre dose intraocular pressure. Weight Measuring scale (Generic electronic kitchen digital weighing scale) was used for the measurement of Moringa Oleifera dose. The dose measurement was taken in carts units which was then converted into mg as 0.285 carts is equal to 57mg and 0.430 carts is equal to 85.7 mg. Two doses 57mg and 85.7 mg of Moringa Oleifera was measured through conversion (carats into mg) and was administered to two subsequent groups. Group 1 given the 57mg dose of Moringa Oleifera and 85.7 mg dose was administered to Group 2. The intraocular pressure and blood pressure were measured after a time interval of 30, 60, 90 and 120 minutes. Data were analyzed through SPSS software version-20. Descriptive statistics was applied to analyze age and gender distribution. Independent t-test was implemented to compare the IOP between two groups. Repeated measure ANOVA was used to compare IOP variation at baseline and at 30, 60, 90 and 120 minutes.

RESULTS

60 healthy emmetrope male and female subjects aged between 20-35 years old were included in this study. Blood pressure and intraocular pressure was assessed in selected subjects. Afterwards, doses of Moringa Oleifera i.e., group 1 (53mg) group 2(75.5 mg) were administered and again variations in blood pressure and intraocular was measured following the time interval of 30, 60, 90 and 120 minutes. The selected age range was 18-35 which was

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further grouped into 18-25 and 26-35. The age group of 18-25 included 36 (60%) of subjects. From 26-35 age groups the included subjects were 24 (40%) (Table1). Descriptive statistics was used to investigate the gender distribution among 60 subjects. The gender distribution reveals that there were 25(41.7%) males and 35(58.3%) females were selected(n=60).

Table 1: Age Distribution

Age Distribution	N	Minimum	Maximum	Mean ± SD
	60	18	35	22.5 ± 1.31

As per the analysis of the results it is summarized that the variation of intraocular pressure in group 1 with dose 57mg and group 2 with dose 85.7mg the results showed variation form baseline value to the follow-up values. The peak effect of dose on intraocular pressure was monitored at 90 minutes. After that the effect reaches nearly to its baseline value. However, the effect was dose-dependent as in group 2 the effect was greater as compared to group 1. Mean value of IOP 19.40 ± 3.19 was recorded before taking dose of Moringa Oleifera in group 1. After the dose intake the mean value and standard deviation of IOP at 30, 60, 90 and 120 minutes was (M=19.55 ± 3.16), (M=19.11 ± 3.22), (M=18.54 ± 3.19), (M=25.70 ± 4.02) respectively. IOP showed a significant decrease in mean value after successive time intervals. Repeated measure ANOVA result indicated a significant time effect (p=0.00). Mean value of IOP 19.42 ± 4.11 was recorded before taking dose of Moringa Oleifera in group 2. After the dose intake the mean value and standard deviation of IOP at 30, 60, 90 and 120 minutes was (M=19.44 ± 4.59), (M=18.88 ± 4.30), (M=17.56 ± 4.25), (M=18.61 ± 4.29) respectively. IOP showed a significant decrease in mean value after successive time intervals. Repeated measure ANOVA result indicated a significant time effect (p=0.00). Thus, there is significant evidence to reject the null hypothesis. Hence it is concluded that Moringa Oleifera causes reduction in intraocular pressure (Table 2).

Table 2: Comparison of Baseline and Follow-up Intraocular Pressure of Group 1&2

Variables	Group 1		Group 2	
IOP	Mean ± SD	p-value	Mean ± SD	p-value
Baseline	19.40 ± 3.19	0.00	19.42 ± 4.11	0.00
30 Minutes	19.55 ± 3.16		19.44 ± 4.59	
60 Minutes	19.11 ± 3.22		18.88 ± 4.30	
90 Minutes	18.54 ± 3.19		17.56 ± 4.25	
120 Minutes	20.70 ± 4.02		18.61 ± 4.29	

As per the analysis of the results it is summarized that the variation of blood pressure in group 1 with dose 57mg and group 2 with dose 85.7mg the results showed variation form baseline value to the follow-up values. The peak effect of dose on blood pressure was monitored at 60 minutes. After that the effect reaches nearly to its baseline value. Mean value of systolic BP 113.67 ± 9.27 was recorded before taking dose of Moringa Oleifera in group 1. After the dose intake the mean value and standard deviation of systolic BP at 30, 60, 90 and 120 minutes was (M=111.17 ± 6.65), (M=101.33 ± 7.76), (M=105.00 ± 11.44), (M=109.67 ± 20.12) respectively. BP showed a significant decrease in mean value after successive time intervals. Repeated measure ANOVA result indicated a significant time effect (p=0.02). However, the effect was dose-dependent as in group 2 the effect was greater as compared to group 1. After that the effect reaches nearly to its baseline value. Mean value of systolic BP 116.33 ±10.080 was recorded before taking dose of Moringa Oleifera in group 1. After the dose intake the mean value and standard deviation of systolic BP at 30, 60, 90 and 120 minutes was (M=107.17 ± 9.16), (M=101.50 ± 9.92), (M=104.33 ± 9.35), (M=112.50 ± 8.97) respectively. IOP showed a significant decrease in mean value after successive time intervals. Repeated measure ANOVA result indicated a significant time effect p=0.00. Thus, there is significant evidence to reject the null hypothesis. Hence it is concluded that Moringa Oleifera cause reduction in blood pressure (Table 3).

Table 3: Comparison of Baseline and Follow-up Systolic Blood Pressure of Group 1&2

Variables	Group 1		Group 2	
Systolic BP	Mean ± SD	p-value	Mean ± SD	p-value
Baseline	113.67 ± 9.27	0.02	116.33 ± 10.08	0.00
30 Minutes	111.17 ± 6.65		107.17 ± 9.16	
60 Minutes	101.33 ± 7.76		101.50 ± 9.92	
90 Minutes	105.00 ± 11.44		104.33 ± 9.35	
120 Minutes	109.67 ± 20.12		112.50 ± 8.97	

Mean value of diastolic BP 81.00 mmHg with ± 8.03 was recorded before taking dose of Moringa Oleifera in group 1. After the dose intake the mean value and standard deviation of diastolic BP at 30, 60, 90 and 120 minutes was (M=75.00 ± 9.91), (M=72.67 ± 8.97), (M=72.50 ± 14.48), (M=82.30 ± 7.66) respectively. IOP showed a significant decrease in mean value after successive time intervals. Repeated measure ANOVA result indicated a significant time effect (p=0.00). Mean value of diastolic BP 83.17±8.75 was recorded before taking dose of Moringa Oleifera in group 2. After the dose intake the mean value and standard deviation of diastolic BP at 30, 60, 90 and 120 minutes was (M=79.50 ± 9.59), (M=72.50 ± 8.68), (M=76.33 ± 7.64), (M=82.83 ± 5.03) respectively. BP showed a significant decrease in mean value after successive time intervals. Repeated measure ANOVA result indicated a significant time effect, p=0.00. Thus, there is significant evidence to reject the null hypothesis. Hence it is concluded that Moringa Oleifera causes reduction in blood pressure (Table 4).

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Table 4: Comparison of Baseline and Follow-up Diastolic Blood Pressure of Group 1&2

Variables	Group 1		Group 2	
Diastolic BP	Mean ± SD	p-value	Mean ± SD	p-value
Baseline	81.00 ± 8.03	0.02	83.17 ± 8.75	0.00
30 Minutes	75.00 ± 9.91		79.50 ± 9.59	
60 Minutes	72.67 ± 8.97		72.50 ± 8.68	
90 Minutes	72.50 ± 14.48		76.33 ± 7.64	
120 Minutes	82.30 ± 7.66		82.83 ± 5.03	

An independent t test was conducted to compare the IOP for group 1 (dose 57mg) and group 2 (dose 87.5mg). Mean value for group 1 (mean=18.54 ± 3.19) and for group 2 (mean=17.56 ± 4.25). The results were significant (p=0.01). Hence, alternate hypothesis is accepted (Table 5).

Table 5: Comparison of Intraocular Pressure of Both Groups at 90min Interval

	Groups	Mean ± SD	p-value
IOP 90 minutes	Group 1(57mg)	18.195 ± 3.19	0.01
	Group 2 (87.5mg)	14.56 ± 1.25	

An independent t test was conducted to compare the BP for group 1 (dose 57mg) and group 2 (dose 87.5mg) at 60 minutes interval. Mean value for group 1 (mean=101.33 /72.67 ± 7.76) for group 2 (mean=101.50 /72.50 ± 9.92). The results were significant less than 0.05. Hence, H_1 is significant (Table 6).

Table 6: Comparison of Blood Pressure of Both Groups at 60min Interval

	Groups	Mean ± SD	p-value
BP 60 minutes	Group 1(57mg)	101.33/72.67 ± 7.76	0.02
	Group 2 (87.5mg)	101.50/72.50 ± 9.92	

Present study findings illustrated that Moringa Oleifera has peak effect on blood pressure at 60 minutes and on intraocular pressure at 90 minutes.

DISCUSSION

The two normotensive participant groups' lower intraocular pressure and blood pressure levels supported the hypotensive effects of the Moringa Oleifera leaf aqueous extract. Although several theories have been advanced, the processes responsible have not yet been found. Many of the theories link dietary calcium to altered vascular tone and calcium metabolism in vascular smooth muscle [27]. In people with low dietary intakes of potassium, supplements have a small blood pressure-lowering impact. Further demonstrating the significance of potassium for maintaining healthy blood pressure in the general population. Therefore, the high potassium and calcium content of the Moringa Oleifera leaf aqueous extract may have contributed to decreasing blood pressure. The elevated level of sodium in the blood is thought to be the primary cause of hypertension. Hypertension, often known as high blood pressure, results from an increase in sodium absorption as the level of potassium in the blood decreases [28]. One of the best sources of potassium is the leaf of the Moringa Oleifera plant. It was discovered that Moringa oleifera leaf has a high potassium content from the phytochemical and electrolytes analysis performed in Marlet Environmental Research Laboratory, Benin City using AAS model-solar 969 unicum series (acetylene flame) [29]. Potassium is known to prevent the excessive absorption of sodium, thereby lowering blood pressure. Clinical investigations indicate that potassium is a vital blood pressure regulator. Potassium chloride lowers blood pressure and increases salt excretion in hypertensive patients. The natriuretic caused by potassium may have an impact on blood pressure. This justifies the finding of present study results. George study results concluded that statistically significant ($p<0.05$) decrease in IOP after taking Moringa Oleifera dose orally in all three experimental groups. The maximum mean difference in IOP of right eye after taking 3 doses 28.5mg/kg, 57.0mg/kg and 85.7mg/kg were 2.20 ± 0.20 mmHg, 2.90 ± 0.35 mmHg, 3.70 ± 0.31 mmHg respectively with statistically significant p-values (p=0.00). While on the other hand the maximum mean difference in IOP of left eye after taking 3 doses 28.5mg/kg, 57.0mg/kg and 85.7mg/kg were 2.10 ± 0.25 mmHg, 2.80 ± 0.36 mmHg and 3.50 ± 0.18 mmHg respectively with statistically significant p-values (p=0.00) (24). Current study showed that significant decrease in IOP at time interval of 90 minutes. The mean value of IOP of group 1 at baseline was 19.40 ± 3.19 mmHg and at 90 minutes 18.54 ± 3.19 mmHg (p=0.00) while mean value of IOP of group 2 at baseline was 19.42 ± 4.11 mmHg and at 90 minutes 17.56 ± 4.25 mmHg (p=0.00). So, both studies correlate with each other as they show significant reduction in IOP ($p<0.05$). George *et al.*, study who took oral doses of Moringa Oleifera experienced a significant decrease in B.P ($p<0.05$) [24]. After taking three doses 28.5mg/kg, 57.0mg/kg and 85.7mg/kg the highest mean difference in systolic blood pressure (SBP) was 5.80 ± 0.37 mmHg, 6.10 ± 0.98 mmHg and 6.60 ± 0.24 mmHg respectively with statistically significant p-values (p=0.000) and the maximum mean difference in diastolic blood pressure (DBP) after taking 3 doses 28.5mg/kg, 57.0mg/kg and 85.7mg/kg were 5.80 ± 0.37 mmHg, 6.10 ± 0.98 mmHg and 6.60 ± 0.24 mmHg respectively with p-values (p=0.000) [24]. Present study showed significantly decreased in BP from the baseline value at time intervals of 60 minutes. At baseline the mean value of systolic BP of group 1 was 113.67 ± 9.27 mmHg and at 60 minutes it was 101.33 ± 7.76 mmHg with statistically significant p-values (p=0.02) and the mean value of diastolic BP of group 1 at baseline was 81.00 ± 8.03 mmHg and at 60 minutes it was 72.67 ± 8.97 mmHg with statistically significant p-values (p=0.00). On the other hand, the at baseline the mean value

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of systolic BP of group 2 was 116.33 ±10.08 mmHg and at 60 minutes it was 101.50 ± 9.92 mmHg with statistically significant p-values (p=0.00) and the mean value of diastolic BP of group 2 at baseline was 83.17 ± 8.75 mmHg and at 60 minutes it was 72.50 ± 8.68 mmHg with statistically significant p-values (p=0.00). As both studies provide substantial outcomes, they, therefore, correlate with one another. There is a strong direct link between changes in intraocular pressure and changes in systemic blood pressure, according to studies performed on both humans and animals [30]. Because an increase in aqueous outflow may have resulted from a decrease in episcleral venous pressure, the peak fall in blood pressure happened before the greatest decrease in intraocular pressure [2]. Therefore, it is thought that a drop in blood pressure results in a subsequent drop in intraocular pressure, but more research is required in this area to pinpoint the precise process by which this happens.

CONCLUSIONS

Study concluded that after the intake of Moringa Oleifera, there was significant reduction in blood pressure at the interval of 60 minutes and intraocular pressure at the time interval of 90 minutes. In the two comparative groups it was observed that the reduction in group 2 with dose (85.7mg) was more than in group 1 with dose (57mg) it is concluded that the effect of dose on the reduction rate was directly proportional to the amount of dose administered, greater the amount of dose greater was the reduction in intraocular pressure and blood pressure and vice versa. With additional studies, Moringa Oleifera may be used as an adjuvant therapy for regulating blood pressure and intraocular pressure.

Authors Contribution

Conceptualization: MJ, HN
Methodology: UA
Formal analysis: HN, HS
Writing-review and editing: ZM, HS, UA

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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