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Research Article

Effects of Corn Silk (*Zea mays Linn*) Extract on Intraocular Pressure and Blood Pressure in Normotensive Young Adults in Abia State University, Nigeria

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Abstract

Purpose: To determine the therapeutic effect of Corn silk (*Zea mays Linn)* on intraocular pressure and blood pressure.

Methods: 75 subjects (29 males and 46 females) within the ages of 16 - 30 years, with mean age of 21 ± 3.19years were used. The baseline readings of intraocular pressure and blood pressure were taken and recorded prior to the administration of corn silk extract (100 mls). The intraocular pressure and blood pressure were measured and recorded 90 minutes, 120 minutes, 150 minutes, 180 minutes and 210minutes post administration of corn silk extract.

Results: The mean baseline intraocular pressure (IOP) was 14.8 ± 2.0 mmHg and decreased to 10.5 ± 1.8 mmHg at 150 minutes post administration and increased towards baseline at 210 minutes to 14.1 ± 1.8 mmHg. The mean baseline blood pressure (SBP/DBP) was 111.3 ± 7.8/71.5 ± 7.7 and decreased to 94.3 ± 11.8/61.8 ± 7.0 at 150 minutes but did not increase towards baseline values at 210 minutes rather remained reduced at 94.3 ± 12.3/62.1 ± 7.3.

Conclusion: Corn silk aqueous extract reduces IOP and BP although its effect on IOP is not sustained thus it can be used as supplement in the management of ocular hypertension and hypertension especially due to the fact that it being a waste material in many kitchens is relatively inexpensive and easy to access.

Keywords: *Corn Silk (Zea mays Linn); Intraocular Pressure; Blood Pressure*

Introduction

Intraocular pressure is the pressure created by the continuous renewal of fluids within the eye. It is the tissue pressure of the intraocular contents. Normal intraocular pressure (IOP) defines a state of dynamic equilibrium between production and drainage of aqueous humour [1]. A normal IOP has been defined as the average pressure which the normal eye can tolerate over a period of time without compromise to the integrity of the eye [2]. The range of normal human IOP is 11 - 21 mmHg [3]. IOP is found to be high when the balance between the rates of production is high relative to drainage. When the balance is shifted away from production in the direction of increased drainage IOP is found to be low [1]. Measurement of IOP is done using a tonometer and recorded in Millimeters of Mercury (mmHg). Raised IOP has been implicated as one of the clinical triad of both primary and secondary glaucoma with others being visual field loss and excavated optic disc [4]. Glaucoma is a blinding disease that causes vision loss by damaging the retinal nerve fibers extending through the optic nerve head along the visual pathway and the most significant diagnostic parameter of glaucoma is IOP variation. Studies have shown that several factors including diurnal variations i.e. fluctuation of IOP during the day and night, can affect IOP. A study by Gunner.,

et al. [5] showed a correlation between exercise and elevated IOP. These studies show that there may be other factors that could reduce IOP thereby assisting in reduction of vision loss due to glaucoma.

Blood pressure refers to the forces exerted by circulating blood on the walls of the blood vessels. It refers to arterial blood pressure which is the lateral pressure exerted by the contained column of blood on the walls of the arteries, it is usually expressed in terms of systolic blood pressure (maximum during one heart beat) and diastolic blood pressure (minimum between two heart beats) [6]. Normal resting blood pressure in an adult is approximately 120/80mmHg, 120 being systolic and 80 being diastolic [7]. It is one of the vital signs along with respiration rate, heart rate, oxygen saturation and body temperature. Blood pressure varies depending on the activity and disease state of the individual. It is regulated by baroreceptors, which act via the brain to influence the endocrine systems. Blood pressure that is low due to a diseased state is called hypotension and blood pressure that is continuously high is called hypertension. These two conditions have many causes which range from mild to severe, both may be of sudden onset or of long term duration. Hypertension that is long term is a risk factor for many diseases including kidney failure, heart disease and stroke [7]. Factors such as age and sex affect blood pressure. Chiolero [8] stated that blood pressure in the elderly tends to be above the normal range largely due to reduced flexibility of arteries. Catriona., *et al*. [9] carried out a study on the sex differences in blood pressure of human subjects. They reported that girls demonstrated lower systolic and diastolic blood pressure than boys, with the difference being determined mainly by lower stroke volume during physical challenges and by lower total peripheral resistance during mental challenges. Another study by Sulivan [10], reported that increase in blood pressure occurs more rapidly in men than in women until they reach menopause. This effect was attributed to the fact that males have too many highly reactive and potentially damaging free radicals, where there are too many it creates oxidative stress which is a contributor to increased blood pressure.

Corn silk *(Zea mays linn)* which is the stigma of maize is a soft silk thread-like waste material 10 - 20 cm long commonly found on the corn they end up in the trash in most kitchens but are the most interesting part of the plant to the herbalist. When fresh they are like silk threads of light green or yellow colour and when dry they resemble fine, dark brown crinkled hairs [11]. The silk emerges from the ear shoot of the plant and they are the functional stigmas of the female flowers of the corn plant [12]. It is harvested by simply pulling the golden green strands off the ears and spreading them out on a plate or paper towel to dry. It is best used fresh or freshly dried, it can be put in an airtight container and stored in a fridge, and this lasts a few weeks. Studies carried out on corn silk are scanty but a few studies has reported it to have medicinal and health benefits which includes treatment of urinary tract infections, prevention of kidney stones, regulation of blood sugar levels, treatment of skin pigmentation issues such as vitiligo, recovery from edema etc. Zeringue [13] demonstrated that corn silk has antifungal activity against *Aspergillus flavus* and Habtemariam [14] also discovered its anti-inflammatory activity. The result of a phytochemical study of aqueous corn silk extract by Owoyele., *et al*. [15] showed that it contains phenols, flavonoids, alkaloids and steroids. A similar study by Lui., *et al*. [16] stated that corn silk is rich in phenolic compounds particularly flavonoids. Flavonoids are a widely distributed group of plant phenolic compounds which are effective as antioxidants [17].

A study demonstrated that oral administration of aqueous corn silk extract in a concentration of 5% induced a significant increase in urinary excretion of water, also a significantly increase in urinary excretion of osmotically active electrolyte was seen along with a distinct decrease in Na^+ and Cl^- plasma levels [18]. Essentially, herbal drugs with diuretic activity are not considered diuretics but aquaretics, usually containing essential oils, flavonoids, saponins and/or tannins [19]. Nutritional composition (moisture, protein, lipid and ash) of corn silk was determined according to AOAC [20], from the study, it showed that the moisture content of immature corn silks (89.34%) was significantly higher than mature silks (84.42%). Lipid content of immature corn silk was 1.27% and dropped to 0.66% in the mature silks, meanwhile the protein content of immature silks (12.96%) was also higher than its mature counterpart (8.95%). Immature silks was obtained from non-pollinated cob while mature silks was taken from fully ripen and developed corn fruit [21]. Immature silks also had significantly higher flavonoid content than mature silk shown by ethanol and water extract respectively [22]. Another study carried out by Pearson., *et al*. [23], immunomodulatory activity of maysin isolated from corn silk was evaluated using the murine macrophage.

The result of the study showed that maysin, a major flavonoid isolated from corn silk activates macrophages and positively the immune response. The stimulation of immune response is regarded as one of the important strategies to enhance the body's defense mechanisms especially in the elderly and in cancer patient.

It was shown a study carried out by Guo., *et al*. [24], that corn silk extract markedly reduced hyperglycemia in alloxan-induced diabetic mice. Thus, corn silk extract may be used in modern pharmacological study. Min., *et al*. [25] performed a study to investigate the effects and mechanism of action o high maysin corn silk extract on body weight and fat deposition in experimental animals. The result showed that high maysin corn silk extract inhibits expression of genes involved in adipocyte differentiation, fat accumulation and fat synthesis as well as promotes expression of genes involved in lipolysis and fat oxidation, further inhibiting body fat accumulation and body weight elevation in experimental animals.

Aim of the Study

The aim of this work is to determine the effect of corn silk aqueous extract on intraocular pressure and blood pressure.

Materials and Methods

Materials

Novesine 1.4% and fluorescein strips were purchased from Alcon pharmaceuticals. Corn silks from a cultivated farm in Achara village uturu Abia state were harvested fresh from their corn combs when the combs were still seedless because at this stage, the silks are non-pollinated. The method of Velaquez., *et al*. [11] was adopted in the preparation of corn silk aqueous extract. The moisture content of the silk was removed by air drying at room temperature for 24 hours, extracts were prepared by measuring out 500g of corn silk using a weighing scale and adding it to 5liters of boiling water, heat was turned off after 20 minutes and solution filtered and allowed to cool. Aqueous extract was now stored in the refrigerator.

Study design

The study was designed to be a prospective research comprising of human subjects (45 healthy females and 30 healthy males whose ages range from 16 - 30) who served as their own control after informed consent was sought and obtained from each of them. The study was carried out in Abia State University Optometry clinic, this locale was chosen strictly based on convenience, availability of highly sophisticated research instruments accompanied with high patient patronage. Subjects were screened and those who passed the test were properly educated about the procedure.

A drop of local anesthetic (Novesine) was instilled into the right eye, after 2 minutes fluorescein sodium paper strip was applied to the lower fornix. After the eye has been sufficiently stained, the strip was removed and subjects asked to blink repeatedly. The baseline IOP was determined using Perkins handheld applanation tonometer and recorded in millimeters mercury (mmHg), the blood pressure (baseline) was also measured using Reister mercury sphygmomanometer and stethoscope and also recorded in mmHg. Following the baseline intraocular pressure and blood pressure measurement, each subject was orally administered 100ml of corn silk aqueous extract, an effective dosage per day to be ingested, and the IOP and BP was subsequently measured and recorded after 90, 120, 150,180 and 210 minutes respectively. This is because it takes corn silk extract 90 minutes to digest [26]. The study lasted for 7 days between the hours of 8.00 am and 12.00 pm, this is due to diurnal variations whereby IOP is highest during morning hours and will give us optimum values [27].

Data analysis

Analysis of data was done using appropriate statistical packages including mean, variance, standard deviation and percentage. The Z test was used to determine the level of significance of the values.

Result

Figure 1 showed a decrease in the intraocular pressure at all time intervals after ingestion of corn silk aqueous extract with peak reduction at 150 minutes, after which there was an increase towards baseline values.

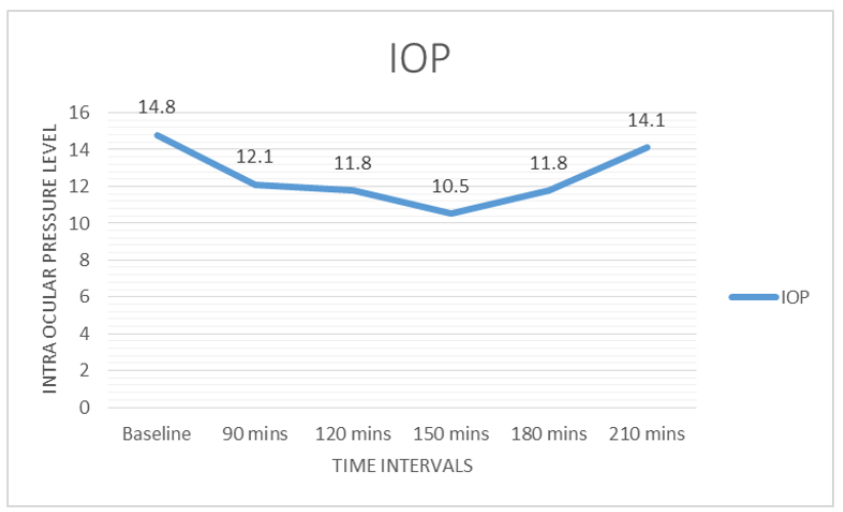

Figure 1: *Intraocular pressure levels at different time intervals.*

Figure 2 shows that male subjects had higher intraocular pressure than female subjects at all time intervals but the highest point of reduction for both males (11.3 ± 1.8) and female (9.9 ± 1.7) was observed at 150 minutes after ingestion.

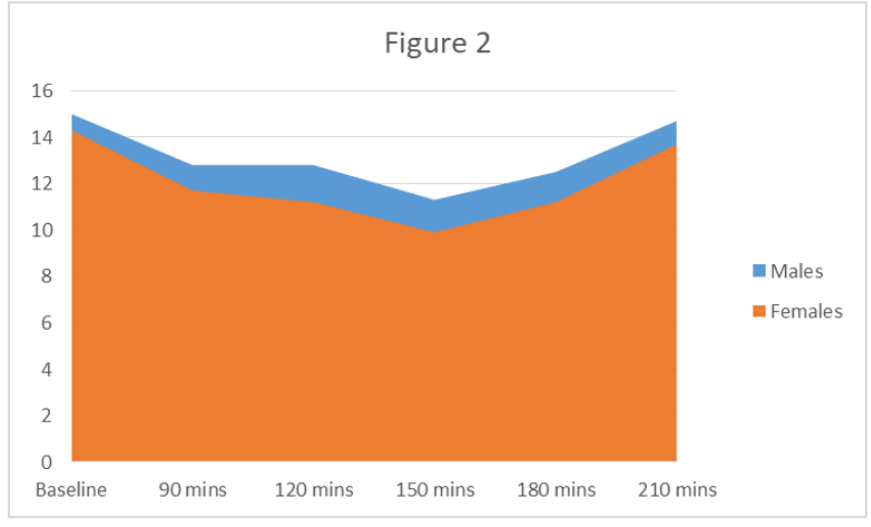

Figure 2: *IOP of at different time intervals of both males and females.*

Figure 3 shows a decrease in blood pressure (SBP/DBP) from baseline at all time intervals, while the lowest points in blood pressure reduction were at 150, 180 and 210 minutes after intake with no increase towards baseline values.

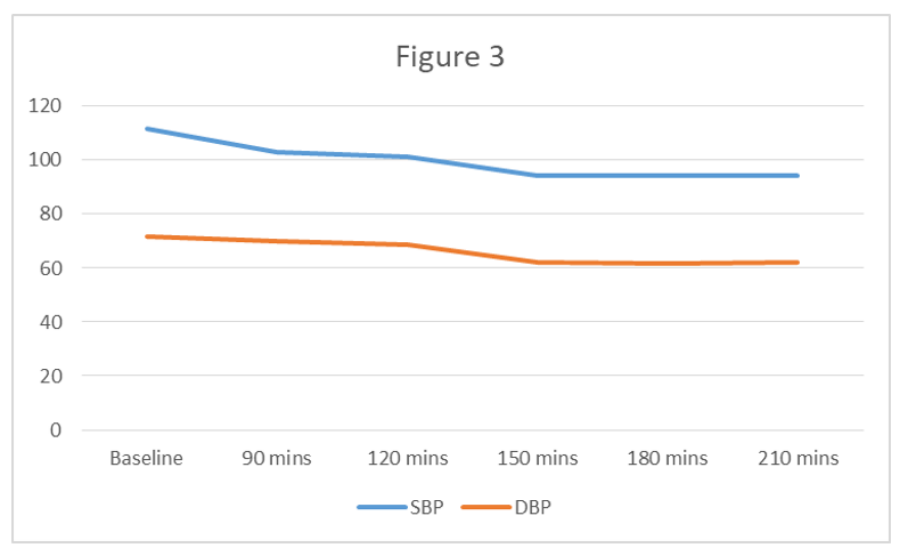

Figure 3: *Variation in blood pressure at different time intervals.*

Discussion

The results of this research work using Z test showed that a statistically significant relationship exists between the intake of corn silk aqueous extract and intraocular and blood pressure reduction. From figure 1 and 3, it was seen that after ingestion of 100mls of corn silk extract IOP and BP values of the subjects reduced from baseline values at 90, 120, 150 minutes and increased again towards baseline 3 hours post administration, while that of BP remained reduced at all time intervals. The results from figure 1 and 3 indicate that corn silk aqueous extract significantly reduces both intraocular pressure and blood pressure, because the Z calculated value for blood pressure and intraocular pressure doesn't lie within +1.98 and -1.98 which is in line with the decision rule for Z test analysis.

In a study by George and Idu [28], corn silk aqueous extract had a lowering effect on intraocular pressure in systemic and non-systemic hypertensive subjects. This may have resulted due to potassium induced diuresis caused by the high potassium content in high doses of corn silk extract. This thus supports the findings of this research work.

The result of this study showed that corn silk extract possess diuretic properties which agrees with the study carried out by Haloui., *et al*. [16] it was reported that corn silk aqueous extract led to significant increase in urine pH values and the influence of the extract on urinary secretion was statistically significant thereby leading to diuresis and reducing blood pressure.

Tucakor [29] suggested that corn silk aqueous extract increases glomerular filtration rate this direct influence on glomerular filtration rate along with simultaneous inhibition of sodium and chloride reabsorption should be considered the basic mechanism of diuretic activity of corn silk extract which leads to a decrease in blood pressure.

Czernichoro., *et al*. [30] also reported that there is an association between dietary intake of herbs on blood pressure. This is due to the presence of antioxidants. This thus supports the findings of this research work based on the antioxidant activity of corn silk.

A similar study by Montezano and Touyz [31] concluded that there is a relationship between the pathogenesis of hypertension and oxidative stress. Thus, corn silk having large variety of antioxidants leads to the reduction of hypertension.

Studies have confirmed that there is an association between blood pressure and intraocular pressure. Vajanen., *et al*. [32] evaluated the relationship between blood pressure and intraocular pressure, results showed a positive relationship. Castejon., *et al*. [33] also studied the effect of acute increase in blood pressure on intraocular pressure in humans and found a linear relationship between BP and IOP variations. Therefore, the reduction of IOP on ingestion of corn silk extract maybe as a result of a fall in blood pressure.

The results from figure 2 shows that the intraocular pressure of males were higher than females at all-time intervals and this agreed with a study carried out by Sullivan [10] it was reported that males have too many highly reactive and potentially damaging free radicals and this creates oxidative stress which is a contributor to increased blood pressure, thereby leading to increased intraocular pressure.

Conclusion

Corn silk aqueous extract can be used in treatment of hypertensive and ocular hypertensive patients although its effect on intraocular pressure is not sustained. Due to its relatively cheap and accessible nature, as it is a waste product in many homes, it can be available to the poor masses therefore helping in reducing the prevalence of blindness due to glaucoma which is predisposed by increase in intraocular pressure, it can also help in reduction of blindness resulting from hypertensive retinopathy.

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