Original Research Article

EFFECT OF RAW QUAIL EGG ON INTRAOCULAR PRESSURE AND BLOOD PRESSURE OF HYPERTENSIVE SUBJECTS

ABSTRACT

This study investigated the effect of raw quail egg on intraocular pressure and blood pressure of hypertensive and normal subjects in a Nigerian population. A total of one hundred and fifty subjects who met the inclusion criteria were recruited from the screening exercise carried out at the University of Benin Optometry Clinic. Intraocular pressure and Blood pressure were measured and recorded before oral administration of 0.6ml/kg body weight of raw quail egg and at 30 minutes interval for 90 minutes after oral administration of 0.6ml/kg body weight of raw quail egg to each subject in the three study groups. Results showed that 0.6ml/kg body weight of raw quail egg lowered intraocular pressure and blood pressure significantly ($p<0.05$) within 90 minutes of administration. The peak effect on peak effect on intraocular pressure occurred at 90 minutes and this was preceded by the effect on blood pressure which occurred after 60 minutes in the three study groups. In conclusion, raw quail egg has hypotensive effect on blood pressure and intraocular pressure that requires further investigation to determine the therapeutic dose in the management of ocular and systemic hypertension.

Keywords: raw quail egg, intraocular pressure, blood pressure, hypertension.

1. INTRODUCTION

Intraocular pressure (IOP) is the fluid pressure inside the eye, determined by the production and the drainage of aqueous humor mainly through the trabecular meshwork located in the anterior chamber angle [1]. It is measured with a tonometer and the measured values can be influenced

by corneal thickness and rigidity [2, 3]. Normal intraocular pressure is between 10-20 mmHg while its average value is 15.5 mmHg with fluctuations of about 2.75 mmHg. Ocular hypertension (OHT) is defined as intraocular pressure higher than normal, in the absence of optic nerve damage or visual field loss [1]. Normal IOP varies with the time of the day, heartbeat, respiration and blood pressure [4]. Previous researchers have reported that changes in blood pressure result in changes in intraocular pressure in humans and animals studies [5, 6, 7]. In the study of Leske *et al.,* [8], they concluded that raised systemic pressure preceded raised IOP in a given patient.

The term 'blood pressure' refers to arterial blood pressure which is the lateral pressure exerted by the contained column of blood on the wall of arteries. It is expressed in four different terms: systolic blood pressure, diastolic blood pressure, pulse pressure and mean arterial blood pressure. Normal systolic pressure is 120 mmHg; it ranges between 110 to 140mmHg, while normal diastolic pressure is 80 mmHg and varies between 60 and 80 mmHg [9]. Systemic hypertension (SHT) can be defined as a sustained rise in blood pressure, which can lead to other health complications like stroke and heart attack. A person is said to have systemic hypertension when the mean arterial pressure is greater than the upper range of the accepted normal measure of 110 mmHg or diastolic pressure greater than 90 mmHg and systolic pressure greater than 135mmHg [10].

Quail egg is beneficial in treatment of diseases and healthy living, it has been proven to cure a vast number of diseases including asthma, allergic rhinitis, tuberculosis, constipation, stomach ulcer, kidney, liver, or gallbladder stones [11, 12, 13]. Quail egg strengthens the immune system, promotes healthy memory, increases brain activity and stabilizes the nervous system, it contains bio-stimulator- a biologically active ingredients indispensable to human. The

eggs are rich source of vitamins, mineral salts, enzymes and amino acids such as methionine, lysine and phenolalanine [14]. Quail egg keeps the heart healthy, thereby preventing cardiovascular disorder such as heart attack, high serum cholesterol, high blood pressure and arteriosclerosis [15]. It is a rich source of antioxidants such as lutein and zeaxanthin which help to promote ocular health and also fight against age related macular degeneration. It is said to be useful in the treatment of dizziness, photophobia and red blood shot eyes [16]. It is also used in the treatment of diabetes, muscle weakness fatigue and anemia [17, 18]. Studies have shown that quail egg contains high contents of fatty acids (Omega 3 and Omega 6 fatty acids) and high density lipoprotein (good fat), it also contains sex hormone such as progesterone [13]. The nutritional value of quail egg shows that it contains 3-4 times more nutritional benefit than the chicken egg. Quail egg contains 6 times more vitamin B1, 15 times more vitamin B2, 5 times more phosphorus and 7.5 times more Iron than the chicken egg [16, 19]. The medicinal effects of quail egg can be attributed to its superior protein quality, high density lipid and high concentration of essential vitamins, amino acids and minerals compared to other eggs. The nutritional information (according to the USDA website) for one quail egg that weighs about 9 grams is as follows: Calories 14, Carbohydrate 0 g, Protein 1.17 g, which is 2.3% of daily value for protein, Fat 1g, which provides 1.5% of daily value for fat calories, Good Cholesterol, 76mg which is 25% of daily value for cholesterol, Omega-3 fatty acid 4.0mg, Omega-6 fatty acid 84.6mg, Vitamin A 48.9 IU, which is 1.6% of daily value of Vitamin A, Vitamin B2 0.1 mg, which is 5.8% of daily value of Vitamin B2, Folate 5.9 mcg, which is 1.5% of daily value of Folate, Vitamin B12 (Riboflavin) 0.1 mcg, which is 5.5% of daily value of Vitamin B12, calcium 5.8 mg, which is 1.0% of daily value of calcium, iron 0.3 mg, which is 2.0% of daily value of iron, magnesium 1.2 mg, which is 0.01% of daily value of magnesium, phosphorus 20.3 mg,

which is 2.0% of daily value of phosphorus, potassium 11.9 mg, which is 1.0% of daily value of potassium, sodium 12.7 mg, which is 1.0% of daily value of sodium, Selenium 2.9 mcg, which is 5.3% of daily value of Selenium, where: g = grams, mg = milligrams, mcg = micrograms, IU = International Units. [15, 16].

During the 17th century, the Chinese pharmacologist Li Shi Chen discovered, in addition to the nutritional value, the medicinal value of the quail egg, other Japanese and Russian scientists and doctors tasted and confirmed this discovery. Chinese medical practitioners have being using quail egg as a treatment for hundreds of years with brilliant results, Because of its medicinal properties, it is being used with more and more success in Europe and America as well as in the Far East. As a treatment regimen, the following number of eggs are needed for one course of therapy: Rejuvenation 240, improving the memory 240, Nervous disorders 240, Anemia 240, Migraine 240, heart attack 240, high serum cholesterol 240, diabetes 240, high blood pressure 240, arteriosclerosis 240, bronchial asthma 240, stomach ulcer 120, tuberculosis 240, and irregular digestion 240 [15]. Instruction for use of raw quail egg is as follows: Take the egg raw on an empty stomach, in the morning, half an hour before breakfast, in the following manner (Table 1); until completed therapy. Wait for two months before repeating therapy. Two courses of therapy are recommended the first year [15].

Table 1: Recommended dosage for oral administration of raw quail egg as sorted by age.

Age Group	Total No of Quail Eggs	Total No of Days	1st Day	2nd Day	3rd Day	From the 4th Day on
Adult	240	49	3	3	4	5
Adult	120	25	3	3	4	5
16-18 years	120	25	3	3	4	5
11-15 years	120	31	3	3	3	4
8-10 years	90	30	3	3	3	3
4-7 years	60	20	3	3	3	3
1-3 years	60	30	2	2	2	2
3 months - 1 year	30	30	1	1	1	1

(***Adapted from Quail Bird Eggs & their nutritional value by British Medical Researchers. 2013***)

It has been shown that quail egg has a lot of medicinal values, however there are no documented studies on the effect of quail egg on intraocular pressure, this study is therefore aimed at investigating the changes that occur in intraocular pressure when quail egg is administered orally to hypertensive and normal subjects.

2. MATERIALS AND METHODS

One hundred and fifty subjects, male and female were selected from a screening exercise conducted at the Department of Optometry, University of Benin, Benin City, Edo State. They were divided into three groups of fifty each. Group 'A' comprised of ocular hypertensives, aged 35 -52 (mean age 45 ± 3.64) years, Group 'B' comprised of systemic hypertensives, aged 45 -58

(mean age 50 ± 4.82) years, while Group 'C' comprised of normal healthy subjects used as the control group, aged 40 -55 (mean age 46 ± 4.20) years, Thorough case history was taken on all subjects, as well as ocular and general examinations. Subjects who met the inclusion criteria were co-opted into this study. Informed consent was signed by each subject after a detailed explanation was given to the subject. Ethical approval was also gotten from the department of Optometry ethics committee. All the subjects were those we newly diagnosed and were instructed to abstain from all medication during the period of the experiments. All experiment commenced at 9:00a.m daily. The subjects were instructed not to have breakfast before coming to the research clinic. Likewise they were instructed to abstain from water, juice and beverages in the morning before presenting for the study. Their weights were measured using the weighing scale and recorded. Thereafter, the baseline BP and IOP of the subjects were measured. Subjects were asked to seat comfortably for about 10 minutes before the blood pressure was measured in the left arm using the manual sphygmomanometer with the patient's appropriate cuff size, three readings were taken and the average recorded. Intraocular pressure was measured using the Keeler Pulsair non-contact hand-held tonometer while each subject sat comfortably and the mean of three readings were recorded. Subjects whose IOP showed normal diurnal variation when measured at 9am, 3pm and 6pm were the ones selected for the study. Their central corneal thickness (CCT) was measured with an SW-1000P ultrasound pachymeter, while each subject was comfortably seated with the head upright and eyes in the primary position of gaze. At least ten readings were continuously taken and the average was recorded as the CCT. Each Subject IOP was adjusted and corrected for CCT using the Ehler's formula. After taking baseline measurements, a dose of 0.6ml/kg body weight of raw quail egg was administered orally to each

subject according to their body weight, thereafter the effect on BP and IOP were measured at 30 minutes interval for 90 minutes and results recorded.

3. RESULTS

The results showed that 0.6ml/kg body weight of raw quail egg, have significant effect *($p<0.05$)* on intraocular pressure and blood pressure in systemic and ocular hypertensives as well as in normotensive control subjects. Data was analyzed using analysis of variance (ANOVA) and summarized in Tables.

Table 2a: effect of 0.6ml/kg body weight of raw quail egg on mean intraocular pressure (Right and Left Eyes) and mean arterial blood pressure in ocular hypertensive subjects.

TIME INTERVAL		N	Mean ±Standard Error
MEAN IOP RIGHT EYE	BASE LINE	50	28.61 ±0.29
	30 MINUTES	50	27.90 ±0.27
	60 MINUTES	50	27.34 ±0.28
	90 MINUTES	50	26.88 ±0.26
MEAN IOP LEFT EYE	BASE LINE	50	27.72 ±0.33
	30 MINUTES	50	26.92 ±0.31
	60 MINUTES	50	26.39 ±0.30
	90 MINUTES	50	25.91 ±0.31
MEAN ARTERIAL BLOOD PRESURE	BASE LINE	50	92.87 ±1.05
	30 MINUTES	50	88.06 ±1.01
	60 MINUTES	50	77.21 ±0.97
	90 MINUTES	50	82.60 ±0.92

Mean difference in baseline value (IOP Right Eye) and after 30 minutes is 0.71±0.02 mmHg
Mean difference in baseline value (IOP Right Eye) and after 60 minutes is 1.27±0.01 mmHg
Mean difference in baseline value (IOP Right Eye) and after 90 minutes is 1.73±0.13 mmHg

Mean difference in baseline value (IOP Left Eye) and after 30 minutes is 0.80±0.01 mmHg
Mean difference in baseline value (IOP Left Eye) and after 60 minutes is 1.33±0.01 mmHg
Mean difference in baseline value (IOP Left Eye) and after 90 minutes is 1.81±0.11 mmHg

Mean difference in baseline value (MABP) and after 30 minutes is 4.81±0.04 mmHg
Mean difference in baseline value (MABP) and after 60 minutes is 15.67±0.08 mmHg
Mean difference in baseline value (MABP) and after 90 minutes is 10.27±0.13 mmHg

Post Hoc showed that the peak effect on mean IOP occurred after 90 minutes of ingesting 0.6ml/kg body weight of raw quail egg in ocular hypertensive subjects. This was statistically significant (*p=0.000*), while the peak effect on mean arterial blood pressure occurred after 60 minutes of ingesting 0.6ml/kg body weight of raw quail egg. This was also statistically significant *(p=0.000)*. The peak effect on blood pressure occurred 30 minutes before the peak effect on intraocular pressure. This is seen in Tables 2a and 2b.

Table 2b: Post Hoc showing the significant effect of 0.6ml/kg body weight of raw quail egg on mean intraocular pressure (Right and Left Eyes) and mean arterial blood pressure in ocular hypertensive subjects

Dependent Variable	(I) BODY WEIGHT	(J) BODY WEIGHT	Mean Difference (I-J)	Std. Error	Sig.
MEAN IOP (RE)	BASE LINE	30 MINUTES	.70690	.38922	.072
		60 MINUTES	1.26897*	.38922	.001
		90 MINUTES	1.72759*	.38922	.000
MEAN IOP (LE)	BASE LINE	30 MINUTES	.80345	.43870	.070
		60 MINUTES	1.33103*	.43870	.003
		90 MINUTES	1.80690*	.43870	.000
MEAN ARTERIAL BLOOD PRESURE	BASE LINE	30 MINUTES	4.80345*	1.40000	.001
		60 MINUTES	15.66621*	1.40000	.000
		90 MINUTES	10.27552*	1.40000	.000

*The mean difference is significant at the 0.05 level.

In the systemic hypertensive subjects, Post Hoc showed that the peak effect on mean IOP occurred after 90 minutes of ingesting 0.6ml/kg body weight of raw quail egg. This was statistically significant (*p=0.001; p=0.002*) in right and left eye respectively, while the peak effect on mean arterial blood pressure occurred after 60 minutes of ingesting 0.6ml/kg body weight of raw quail egg. This was also statistically significant *(p=0.000)*. The peak effect on

blood pressure occurred 30 minutes before the peak effect on intraocular pressure. This is seen in Tables 3a and 3b.

Table 3a: effect of 0.6ml/kg body weight of raw quail egg on mean intraocular pressure (Right & Left Eyes) and mean arterial blood pressure in systemic hypertensive subjects.

	TIME INTERVAL	N	Mean ±Standard Error
MEAN IOP RIGHT EYE	BASE LINE	50	15.41 ±0.39
	30 MINUTES	50	14.82 ±0.38
	60 MINUTES	50	14.23 ±0.36
	90 MINUTES	50	13.59 ±0.33
MEAN IOP LEFT EYE	BASE LINE	50	16.62 ±0.43
	30 MINUTES	50	15.90 ±0.41
	60 MINUTES	50	15.38 ±0.40
	90 MINUTES	50	14.71 ±0.38
MEAN ARTERIAL BLOOD PRESURE	BASE LINE	50	107.92 ±1.37
	30 MINUTES	50	104.65 ±1.26
	60 MINUTES	50	95.57 ±1.21
	90 MINUTES	50	98.17 ±1.23

Mean difference in baseline value (IOP Right Eye) and after 30 minutes is 0.58±0.01 mmHg
Mean difference in baseline value (IOP Right Eye) and after 60 minutes is 1.18±0.03 mmHg
Mean difference in baseline value (IOP Right Eye) and after 90 minutes is 1.82±0.06 mmHg

Mean difference in baseline value (IOP Left Eye) and after 30 minutes is 0.72±0.02 mmHg
Mean difference in baseline value (IOP Left Eye) and after 60 minutes is 1.24±0.02 mmHg
Mean difference in baseline value (IOP Left Eye) and after 90 minutes is 1.90±0.0.05 mmHg

Mean difference in baseline value (MABP) and after 30 minutes is 3.27±0.11 mmHg
Mean difference in baseline value (MABP) and after 60 minutes is 12.35±0.16 mmHg
Mean difference in baseline value (MABP) and after 90 minutes is 9.75±0.14 mmHg

Table 3b: Post Hoc showing the significant effect of 0.6ml/kg body weight of raw quail egg on mean intraocular pressure (Right and Left Eyes) and mean arterial blood pressure in systemic hypertensive subjects

Dependent Variable	(I) BODY WEIGHT	(J) BODY WEIGHT	Mean Difference (I-J)	Std. Error	Sig.
MEAN IOP (RE)	BASE LINE	30 MINUTES	.58095	.52497	.272
		60 MINUTES	1.17619*	.52497	.028
		90 MINUTES	1.81429*	.52497	.001
MEAN IOP (LE)	BASE LINE	30 MINUTES	.71905	.60924	.241
		60 MINUTES	1.22381*	.60924	.048
		90 MINUTES	1.90476*	.60924	.002
MEAN ARTERIAL BLOOD PRESURE	BASE LINE	30 MINUTES	3.27105*	1.94804	.008
		60 MINUTES	12.35429*	1.94804	.000
		90 MINUTES	9.74524*	1.94804	.000

Likewise in the normotensive subjects, Post Hoc showed that the peak effect on mean IOP occurred after 90 minutes of ingesting 0.6ml/kg body weight of raw quail egg. This was statistically significant (*p=0.000*), while the peak effect on mean arterial blood pressure occurred after 60 minutes of ingesting 0.6ml/kg body weight of raw quail egg. This was also statistically significant *(p=0.000)*. The peak effect on blood pressure preceded the peak effect on intraocular pressure by 30 minutes. This is seen in Tables 4a and 4b.

Table 4a: effect of 0.6ml/kg body weight of raw quail egg on mean intraocular pressure (Right and Left Eyes) and mean arterial blood pressure in normotensive control subjects.

	TIME INTERVAL	N	Mean ±Standard Error
IOP RIGHT EYE	BASE LINE	50	13.68 ±0.26
	30 MINUTES	50	12.91 ±0.25
	60 MINUTES	50	12.39 ±0.24
	90 MINUTES	50	11.83 ±0.24
IOP LEFT EYE	BASE LINE	50	13.53 ±0.23
	30 MINUTES	50	12.87 ±0.22
	60 MINUTES	50	12.30 ±0.22
	90 MINUTES	50	11.77 ±0.20

MEAN ARTERIAL BLOOD PRESURE	BASE LINE	50	89.21 ±0.91
	30 MINUTES	50	84.21 ±0.87
	60 MINUTES	50	73.67 ±0.78
	90 MINUTES	50	79.16 ±0.83

Mean difference in baseline value (IOP Right Eye) and after 30 minutes is 0.77±0.01 mmHg
Mean difference in baseline value (IOP Right Eye) and after 60 minutes is 1.29±0.02 mmHg
Mean difference in baseline value (IOP Right Eye) and after 90 minutes is 1.85±0.13 mmHg

Mean difference in baseline value (IOP Left Eye) and after 30 minutes is 0.66±0.01 mmHg
Mean difference in baseline value (IOP Left Eye) and after 60 minutes is 1.23±0.01 mmHg
Mean difference in baseline value (IOP Left Eye) and after 90 minutes is 1.76±0.11 mmHg

Mean difference in baseline value (MABP) and after 30 minutes is 5.00±0.04 mmHg
Mean difference in baseline value (MABP) and after 60 minutes is15.54±0.05 mmHg
Mean difference in baseline value (MABP) and after 90 minutes is10.05±0.04 mmHg

Table 4b: Post Hoc showing the significant effect of 0.6ml/kg body weight of raw quail egg on mean intraocular pressure (Right and Left Eyes) and mean arterial blood pressure in normotensive control subjects

Dependent Variable	(I) BODY WEIGHT	(J) BODY WEIGHT	Mean Difference (I-J)	Std. Error	Sig.
MEAN IOP RE	BASE LINE	30 MINUTES	.56800	.35713	.063
		60 MINUTES	1.28600*	.35713	.000
		90 MINUTES	1.84800*	.35713	.000
MEAN IOP LE	BASE LINE	30 MINUTES	.65400	.31273	.068
		60 MINUTES	1.23000*	.31273	.000
		90 MINUTES	1.76400*	.31273	.000
MEAN ARTERIAL BLOOD PRESURE	BASE LINE	30 MINUTES	4.99900*	1.20404	.000
		60 MINUTES	10.05280*	1.20404	.000
		90 MINUTES	15.53940*	1.20404	.000

*The mean difference is significant at the 0.05 level.

IOP = intraocular pressure, MABP = mean arterial blood pressure
RE = right eye, LE = left eye

4. DISCUSSION

The fall in intraocular pressure and blood pressure observed in the three groups of subjects showed that quail egg has hypotensive property. The mechanisms responsible have not been identified, but numerous possibilities have been proposed. Many of the proposals have attempted

to relate dietary calcium to calcium metabolism in vascular smooth muscle and altered vascular tone [20]. Potassium supplements have modest blood pressure–lowering effect in persons with low dietary intake. The study of Frank *et al.,* [21] further showed the importance of potassium for blood pressure regulation in the general population. Therefore the high potassium content in the quail egg may have played a role in lowering blood pressure. Hoshi *et al*, [22] in their study concluded that Omega-3 fatty acids lower blood pressure by directly activating large-conductance calcium-dependent potassium channels. Hence, Omega-3 fatty acid present in quail egg may also be responsible for the significant decrease in blood pressure and consequently a fall in intraocular pressure.

Finally, as long as the aqueous humour drains into the episcleral venous system either by way of the intrascleral plexus or more directly along the aqueous veins, the intraocular pressure will vary directly with the venous pressure [23]. Increase in episcleral venous pressure results linearly in identical increase in intraocular pressure. This is because of a decreased gradient between the vascular and intraocular pressure for aqueous outflow, and the engorgement of the intraocular vascular bed, principally the choroidal vessels. Similarly, decrease in episcleral venous pressure will therefore result in an increased outflow of aqueous causing a fall in intraocular pressure. Since any agent causing a change in blood pressure will invariably cause a change in intraocular pressure, the fall in blood pressure caused by the high content of calcium, potassium and omega-3-fatty acid in quail egg caused a resultant fall in intraocular pressure.

5. CONCLUSION

Quail egg has hypotensive effect on intraocular pressure and blood pressure. The fall in intraocular pressure may have resulted from the fall in blood pressure which may have resulted

from the high content of calcium, potassium and omega-3 fatty acid in the quail egg. Further investigation may be required to determine the therapeutic dose of quail egg in the management of ocular and systemic hypertension. Quail egg is innocuous because toxicological studies including acute and repeated oral administration on rats as well as in vitro studies demonstrated good tolerability of the product without mutagenic or genotoxic effects [24].

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