

TRIO- MINERALS BASED BANANA MILK SHAKE- A NOVEL APPROACH TO EASE HYPERTENSION

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Abstract

Hypertension has been recognized as a “silent killer” that contributes to the utmost mortality rate of world population. Though pharmacotherapy is warranted to control blood pressure, yet life style modifications are also needed concomitantly. Dietary intake is an integral part in the management of high blood pressure. Especially the trio minerals like ‘Ca’, ‘Mg’ and ‘K’ modulate blood pressure significantly. However, a single dose of any food stuff containing an appropriate quantity of these elements would assuage blood pressure has been seldom documented. Hence, an attempt was made to explore the impact of Banana Milk Shake containing these minerals in suitable levels. A total number of 98 participants were screened for hypertension in a camp by purposive sampling method. Out of these, 25 were found to be under categories of “Prehypertensive” and “1st grade hypertension”. 200ml of Banana Milk Shake was administered and the BP was recorded after one hour and was compared with their baseline blood pressure levels. There was a significant difference ($p < 0.001$) between the baseline (Systolic initial -157.24±18.4 and Diastolic Initial- 87.92±11.03) and post treatment BP values (Systolic Final- 133.80± 12.4* and Diastolic Final - 80.44± 3.86*). Therefore, the study suggested that even a single dose of appropriate amount of calcium, potassium and magnesium can bring down blood pressure measured by Omron BP apparatus.

Key words: Blood Pressure, Banana Milk Shake, Calcium, Magnesium, Potassium

INTRODUCTION

High Blood Pressure also known as the “silent killer” affects one billion or one in three adults worldwide, and attributes to about 40% of cardiovascular related deaths; unfortunately more than 50% of hypertensive individuals are unaware of their condition ¹. American heart association defined Hypertension as a systolic blood pressure greater than 140 mmHg and or a diastolic blood pressure greater than 90 mmHg is one of the major risk factors for cardiovascular morbidities including coronary artery disease, myocardial infarction and kidney disease, as well as for mortality ²

Recent reports indicate that nearly 1 billion adults (more than a quarter of the world’s population) had hypertension in 2000, and this is predicted to increase to 1.56 billion by 2025³. Hypertension is reported to be the fourth contributor to premature death in developed countries and the seventh in developing countries ⁴. In India, hypertension is the leading non communicable disease risk and estimated to be attributable for nearly 10 per cent of all deaths⁵. From the studies

of Gupta, 2004 and Reddy, 2005 it is evident that adult hypertension prevalence has risen dramatically over the past three decades from 5 per cent to 20-40 per cent in urban areas and 12-17 per cent in rural area ^{5,6}. Also, Reddy (2005) reported that the number of hypertensive individuals is anticipated to nearly double from 118 million in 2000 to 213 million by 2025 ⁶.

From the study of Mohan et al, 2011, it is understood that 16 per cent of ischemic heart disease, 21 per cent of peripheral vascular disease, 24 per cent of acute myocardial infarctions and 29 per cent of strokes are attributable to hypertension, emphasizing the huge impact of effective hypertension prevention and control in order to reduce the accelerating encumbrance of cardiovascular disease (CVD) ⁷. There are number of factors that increase blood pressure such as obesity, insulin resistance, high alcohol intake, high salt intake (in salt-sensitive patients), aging and perhaps sedentary lifestyle, stress, low potassium intake, and low calcium intake ^{8,9}. Observational studies have shown that a diet rich in potassium, magnesium, and calcium, present mainly in fruits and vegetables, is associated with lower incidence and mortality from cardiovascular disease ¹⁰.

Clinical and population-based studies show that several components of the diet such as sodium, potassium, calcium, magnesium, fiber and fish oil influence blood pressure, and modification of these nutritional factors provide an important strategy to control blood pressure especially in the prehypertensive stage (SBP 120–139mmHg and/or DBP 80–89mmHg) or stage I hypertension (SBP 140–159mmHg and/or DBP 90–99mmHg) ¹¹. The role of these dietary factors, singly or in combination in blood pressure regulation and to what extent each contributes has been a subject of research for many decades.

Especially, the trio minerals are abundantly present in fruits and vegetables. Yet, the calcium content of fruits and vegetables are not comparable with animal foods, milk and its products and also grains. Nevertheless, potassium and magnesium are available in fruits, vegetables and nuts. Though dietary factors influence fluctuations of blood pressure, whether a single meal or a consumption of a particular food stuff containing hypotensive ingredients could reduce blood pressure has not been explored much. That too, a recipe rich in trio- minerals namely calcium, magnesium and potassium has not been tried to see its impact on post prandial blood pressure levels. Hence, a radical thought was conceptualized to design the present study in which “Banana Milk Shake” (BMS) incorporating appropriating ingredients (as given in the methodology of the study) that provide these minerals was chosen to look out for its impact on blood pressure levels. Specifically skimmed milk with Robasta banana, chikku, raisins and almonds were selected for the formulation, as the milk provides mainly calcium, banana and sapota provide magnesium. Along with this sugar was also just added in minimum level possible after standardizing to increase the palatability. However, only disadvantage of this recipe was, as it contains sugar, this may not be

suitable product for diabetics but otherwise it is a nutritious product and suits hypertension as it is particularly made out of skimmed milk.

However, traditionally any milk shake is made only with fat containing milk in addition; fresh cream would also be added to furnish a frothy, velvety, viscous milk shake. Indeed, this characteristic was missing in the trio minerals based milk shake but still the viscosity was maintained due to almond paste and banana.

Thus, based on this background the study was ventured to observe the effect of Banana Milk Shake on blood pressure.

METHODOLOGY

POPULATION

A total number of 98 adult non teaching staff of PSG college of Arts and science, Coimbatore was screened for hypertension and anthropometric indices. Purposive sampling technique was used in the present study.

METHODS

Anthropometric indices: Height and weight were recorded as per the standard protocol and the BMI was calculated.

Physiological indices: Body fat %, pulse rate, BMR readings were obtained by using hand held bio impedance based fat analyser.

Whereas systolic and diastolic pressures were recorded by using Omron digital BP apparatus

STATISTICAL ANALYSIS:

The data was analysed using SPSS version 16.0., descriptive statistics and paired “t” test were used to analyse the data.

INTERVENTION WITH ANTIHYPERTENSIVE TRIO MINERALS:

As trio minerals (Ca, Mg and K) tend to reduce blood pressure (Kannan et al., 2014), these minerals containing food stuff of banana milk shake was chosen. The composition of Banana milk shake was standardized by trials in order to almost meet out the RDA of these minerals. The final product had the following composition.

Skimmed Milk	5litres
Robusta Banana	3kgs
Sapota (Chikku)	2kgs
Raisins	200gms
Almonds	200gms
Sugar	1.5kgs

ADMINISTRATION OF BANANA AND MILK SHAKE

200ml of Banana Milk Shake was administered to each hypertensive and the final reading of BP was recorded after 1 hour of consumption of Banana Milk Shake. The mean initial and final systolic and diastolic blood pressures were subjected for comparative mean “t” test.

RESULTS AND DISCUSSION

TRIOMINERALS CONTENT OF THE INGREDIENTS INCORPORATED INTO BANANA MILK SHAKE

The below table number (1) portrays the quantity of ingredients and its corresponding content of calcium, magnesium and Potassium. Whereas, the table number (2) depicts the triominerals content per 100g of the respective ingredients. From these values, the amount of calcium, magnesium and potassium content has been calculated for 200ml of Banana Milk Shake, as 200ml was decided to be the targeted dose. Logically, any beverage is consumed as one glass or 200ml and that was the reason again why 200ml was chosen as test bolus dose.

Table No. 1 TRIOMINERAL CONTENT OF THE INGREDIENTS ADDED INTO BANANA MILK SHAKE

As per the table above it is understood that 200ml of BMS provides 369 mg each of Calcium and Potassium respectively and that of 146mg of magnesium. Except potassium the other two minerals

Ingredients	Quantity	Calcium(mg)	Potassium(mg)	Magnesium(mg)
Skimmed milk (2.5 kg of skimmed milk powder)	5000 ml	9227	9234	3653
Banana	3000g	510	264	1230
Sapota	2000g	560	5380	500
Almond	200g	460	1340	746
Raisins	200g	174	1452	14
Sugar	1500g	-	-	-
Total	11900	369	369	146

are almost forty to sixty percent of RDA which are good enough in a 200ml of Banana milk shake. The amount of calcium is 61% of RDA, Potassium is 11% of RDA and magnesium is 42% of RDA

Table No 2: TRIOMINERAL COMPOSITION OF INGREDIENTS OF BANANA MILK

Table 3: BASELINE CHARACTERISTIC OF THE SCREENED SUBJECTS

Out of 98 subjects, 25 participants were found to be having elevated Blood Pressure. The following table depicts the descriptive statistics of the 98 subjects.

Ingredients	Quantity	Calcium(mg)	Potassium(mg)	Magnesium(mg)
Skimmed milk (50g of Skimmed milk powder)	100 ml	301	319	46.5
Banana	100 g	17	88	41
Sapota	100 g	28	269	25
Almond	100 g	230	670	373
Raisins	100 g	87	726	7
Sugar	100 g	-	-	-
Total	600 g	663	2072	492.5

The mean age of the selected subjects (n= 98) was 33.73 ± 9.66 . With regard to anthropometric indices the mean height and weight of the selected subjects were 158.49 ± 6.18 and 58.46 ± 10.86 respectively. However, the mean BMI which was 24.74 ± 4.15 indicated that some of subjects fall under obese and overweight category. Similarly the body fat percentage for the selected subjects

parameters	Number of subjects	Minimum	Maximum	Mean± Standard deviation
Age	98	24.00	71.00	33.73 ± 9.66
Height	98	137.00	173.00	158.49 ± 6.18
Weight	98	45.00	100.00	58.46 ± 10.86
Body fat	98	18.75	43.00	30.09 ± 11.02
BMI	98	18.40	35.40	24.74 ± 4.15
Pulse	98	65.00	112.00	73.90 ± 9.2
Systolic pressure	98	102.00	197.00	126.35 ± 21.5
Diastolic pressure	98	60.00	127.00	77.54 ± 9.3

showed that they were having a abnormal value of 30.09 ± 11.02 . The overall mean baseline systolic and diastolic blood pressures were 126.35 ± 21.5 and 77.54 ± 9.3 which were found to be normal.

Table 4: COMPARISON OF SYSTOLIC AND DIASTOLIC PRESSURE AFTER INTERVENTION WITH BANANA MILK SHAKE

BP (n=25)	Systolic Pressure (mm/Hg)		Diastolic Pressure(mm/Hg)	
	initial	final	initial	Final
	157.24 ± 18.4	$133.80 \pm 12.4^*$	87.92 ± 11.03	$80.44 \pm 3.86^*$

The systolic blood pressure of the selected sub samples significantly got reduced after intervention with administration with Banana Milk Shake ($p < 0.001$). Similarly the diastolic blood pressures of the same subjects significantly dropped down ($p < 0.001$). Thus, from the above table it is imperative that the single dose of calcium, Potassium and magnesium in the form of banana milk shake attenuated the BP levels after one hour of administration.

Discussion:

Negative relationship between magnesium and blood pressure has been reported epidemiological and observational studies. In a follow up observational study involving 28, 349 middle aged women, Song et al reported that the highest quartile of magnesium intake (434 mg/ day) showed significantly lower hypertension risk than the lowest quartile (356mg/day) which indicated that magnesium intake had a significant negative correlation with hypertensive prevalence. Various studies have documented that magnesium intake ranging from 500 to 1000g/day may reduce blood pressure¹³⁻¹⁵. It has been proposed that magnesium lower blood pressure by function as a calcium channel blocker. With reference to mechanism of action, further magnesium competes with the sodium binding sites of smooth muscles, increase prostaglandin E, interacts with potassium induces vaso dilation reduces intra-cell calcium and sodium contents and thereby decreases blood pressure^{16, 17}.

Grundy et al, 2005 in his study based on the criteria of 130/85 mmHg or over, which is meant for the diagnosis of metabolic syndrome, the magnesium intake showed a significant negative relationship with high blood pressure risk. In addition, finding from the studies indicated that just as in previous studies, magnesium intake through daily meals plays an paramount role in the prevention of high blood pressure¹⁸.

Hypoglycaemia, either due to dietary deficiency or altered calcium metabolism, have been associated with high blood pressure, or, hypertension, by many researchers^{19, 20}. According to NHANES there is a threshold of 400 to 600 mg/day of dietary calcium that may attenuate the risk of high blood pressure and thereby can modestly render cardiovascular benefits¹⁹. However various factors influence calcium absorption. As per Honolulu Heart Study, it is understood that the threshold may be shifted to 800 to 1000 mg/day for alcoholics due to impaired intestinal calcium absorption in this group. Similarly the threshold would also be increased in the pregnant women who require a higher calcium intake in order to cater the fetus.

Studies using genetically hypertensive rats have documented that calcium supplementation during development of hypertension have significantly lowered blood pressure in comparison with those not receiving supplements²¹

The mechanism of regulation of hypertension by calcium intake may be attributed to alteration in intracellular calcium which in turn affects vascular smooth muscle interaction²², effect on calcium metabolism on regulatory hormones²³⁻²⁵. Modulation of the function of sympathetic nervous system and finally increased natriuresis²⁶⁻²⁸. Different intake level for calcium are recommended by FAO/WHO experts for infants, children and adults²⁹ to assure optimal whole body calcium retention and consequently adequate development and maintenance of bone mass and mineral density. Based on the existing data, the Indian council of medical research recommended calcium intake of 600mg/ day as adequate intake for all adults³⁰.

From the studies of McCarron 1999 it is clearly understood that individual receiving more than 800 mg/ day of calcium compared with 400mg/ day accomplished a 23% reduction in risk of developing hypertension³¹. Though there are different recommendation of calcium for different age groups yet seldom there are constructive studies that have demonstrated that single dose of calcium supplementation have brought down blood pressure.

The relationship between potassium and blood pressure has been described in many studies. The mechanism by which potassium takes and regulates antihypertensive effect can be explained by natriuresis by inhibiting sodium reabsorption in the proximal renal tube³², Suppressing renin secretion³³ increase urinary volume excretion³⁴, smooth muscle relaxation by increasing nitric oxide production^{35- 37}, stimulation of the rectifier potassium channel³⁸ and suppression of free

radical formation³⁹. Based on the above mechanisms, potassium as a potential antihypertensive has been demonstrated in various studies. Potassium intake was found to be inversely related to both diastolic blood pressure and systolic blood pressure in a population based study including 685 men and women who were principally Caucasian in southern California, USA⁴⁰. Similar result was illustrated in Rotter Dam study^{41, 42}; a big population based study in which 3239 participants were included.

Several interventional studies have shown the positive effects of potassium supplementation on blood pressure reduction. Cappuccio and MacGregor reviewed 19 clinical trials in which oral potassium supplements significantly lowered SBP (mean of -5.9mmHg, at 95% confidence interval (CI), -6.6 to -5.2mmHg) and DBP (mean of -3.4mmHg, at 95% CI, -4.0 to 2.8mmHg)⁴³. A meta-analysis consisting of 27 potassium trials in adults with a minimum of 2 weeks duration also demonstrated a reduction in blood pressure with increased potassium intake: a mean of -2.42mmHg (95% CI, -3.75 to -1.08mmHg) in SBP and -1.57mmHg (95% CI, -2.65 to -0.50mmHg) in DBP pressure⁴⁴

In line with these documentations, our single dose administration of potassium along with other two elements as previously mentioned in our study, dropped down both systolic blood pressure and diastolic blood pressure significantly.

Hence, as corollary of our experimentation it is suggestive that even an acute bolus supplementation of a beverage containing these trio minerals would dip down the blood pressure levels. In the present study 369mg of calcium along with 146mg of magnesium and 369mg of potassium have significantly brought down blood pressure levels of the group administered with Banana Milk Shake containing these elements.

Though, study has many confounding factors too, the results may not be drawn to be conclusive. The first drawback of this study was low sample size. Followed by, the participants were not advised to follow the same diet on the day of experimentation. However, the study was conducted during post breakfast period. Similarly, the unique feature of the study was, unbelievably for the first time when participant were recorded for their blood pressure, 25 of them were falling under prehypertensive (121- 139mm/Hg) and first grade hypertension (systolic pressure 140-159 and diastolic pressure 90- 99) but the same population when they were administered with single dose of banana milk shake within an hour, the systolic blood pressure and diastolic blood pressure significantly dropped down.

CONCLUSION

It is concluded that even single dose or bolus administration of banana milk shake containing substantial amount of calcium, magnesium, potassium could mitigate both systolic blood pressure and diastolic blood pressure of prehypertensives and persons with first grade hypertension.

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